



What's next for Cuba's electricity sector? [☆]

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ABSTRACT

Cuba's electric sector is approaching an inflection point. Although the country has historically relied upon non-commercial barter agreements for imported oil to meet its electric demand, a combination of factors including reducing imports, increasing demand, and ambitious climate change goals suggest new pathways forward may be warranted. The way Cuba responds to near- and long-term challenges will help set the stage for its energy future. This article describes Cuba's electric sector and provides a set of key recommendations to consider going forward.

1. Background on Cuba's electricity sector

From the early years of Cuba's revolutionary government until the early 1990s, Cuba's relationship with the Soviet Union was the dominant force in the state's energy sector. Cuba imported nearly 90% of its fuel needs from the Soviet Union over this time period.¹ Cuba utilized this heavily subsidized oil to expand electricity access to its citizens. In 1959, only about 50% of households in the island nation had access to electricity. By 1989, the electric grid provided service to 95% of households.² The Cuban economy contracted rapidly after the Soviet Union's collapse. Cuba's GDP fell 35% between 1989 and 1993 and oil,

gas, and food shortages regularly affected the country.³ The Cuban government responded with a 1993 National Assembly-approved national energy policy. This policy set forth three overarching goals: invest in energy efficiency and renewable energy, increase domestic oil production, and invest in the sugar industry to more efficiently utilize bagasse (sugarcane biomass) electricity generation.⁴

These post-Soviet Union policy pivots in the 1990s proved insufficient in reducing stress upon the electric grid. The country's 11 thermoelectric plants only functioned roughly half the time due to aging infrastructure, complications from using high-sulfur heavy crude in power plants, and natural disasters. Hurricane-related blackouts in

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¹ Jorge R. Piñón and Jonathan Benjamin-Alvarado, "Extracting Cuba's Oil and Gas: Challenges and Opportunities." In *Cuba's Energy Future: Strategic Approaches to Cooperation*, edited by Jonathan Benjamin-Alvarado, The Brookings Institution: Washington, DC, 2010, p. 37.

² Ibid at 7.

³ Käkönen, *supra* note 6 at 9.

⁴ Ibid at 10.

2004 left 1 million people without power for 10 days.⁵ The energy sector during this period thus faced internal reliability threats from under-performing power plants and external resiliency threats from extreme weather. The Cuban government responded to these energy resiliency and reliability issues with renewed efforts, through a policy known as the “Energy Revolution.” The policy included several overarching goals,⁶ and two – increased energy efficiency and greater use of sustainable resources – are emblematic of the variability of success experienced.⁷

Increasing energy efficiency quickly proved successful. In a matter of months, the policy replaced millions of appliances with more efficient, upgraded alternatives in Cuban homes. Cuba’s energy efficiency program is notable both for its speed and its breadth. Over roughly six months the country quickly switched to compact fluorescent lightbulbs, reducing electricity consumption 3–4% annually. Cuban officials likewise replaced 2 million refrigerators and 1 million fans, installing more efficient, upgraded appliances. They distributed 3.3 million new electric stoves, 3.5 million rice cookers, and 3.2 million pressure cookers, replacing kerosene and liquid petroleum gas stoves.⁸ Nearly all of the appliances were purchased from China, as part of a larger credit deal that also sent vehicles and distributed power generation systems to Cuba.⁹

In addition to appliance upgrades, Cuban officials implemented a new electricity tariff to reduce demand. The tariff introduced progressive rates based on consumption levels, i.e., a tiered rate structure.¹⁰ Consumer electricity cost remained extremely inexpensive, however, through heavy subsidies – and remains so to this day. Even with the new tariff, the average consumer pays less than \$0.02/kWh,¹¹ far lower than the average tariff across several Caribbean countries (\$0.33).¹² Due to significantly lower average wages in Cuba, however, electricity prices as a percent of income are actually higher in Cuba than in neighboring island countries. Cuba’s electricity tariff structure, particularly in the context of average household income, is discussed in more detail below in Section 2.4 below.

The Energy Revolution proved unable to increase the deployment of sustainable and renewable resources projected. Renewable electricity generation did not increase substantially until years later and remains an under-deployed and underdeveloped resource.¹³ Instead, fuel oil remains the dominant source of electricity generation.

Cuba’s relationship with Venezuela is central to Cuba’s current energy sector. The two countries entered into a barter agreement in 2000, which increased in the mid-2000s, and was similar to the previous barter agreement between Cuba and the Soviet Union. Imports under this agreement currently account for about half of Cuban energy needs¹⁴ and fulfill more than 60% of its crude oil supply needs. Between 2003 and 2009, Cuba imported \$14 billion worth of oil. The agreement continues to provide Cuba with inexpensive oil, but recent economic and political strife in Venezuela may endanger the agreement’s future. As of June 30, 2016, Venezuela was still sending about 90,000 b/d to Cuba. More recently, Cuba has begun importing crude oil from Russia for the first time since the collapse of the Soviet Union.¹⁵

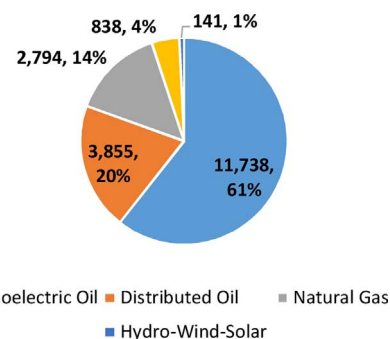


Fig. 1. Electric generation by fuel source in 2014 (GWh).¹⁷

Source: Jorge R. Piñón

2. Current cuban electricity sector

2.1. Fuel sources

Cuba relies heavily upon liquid fuels for electricity generation, with the fifth-highest percentage of total energy derived from liquid fuels in the world.¹⁶ Fuel sources are represented in Fig. 1.

Cuba has increased domestic oil production in the last two decades. The country now produces around 50,000 b/d, or roughly 30–40% of its consumption needs. This represents a dramatic increase from around 9000 b/d in 1991.¹⁸ Most of this oil consists of low-quality, high-sulfur oil that is extracted from shallow waters just off the coast.¹⁹ Burning this high-sulfur oil leads to failures in power stations and harmful local air pollution. Natural gas production makes up a small but significant proportion of Cuba’s fuel sources. Domestic production averages 43 billion cubic feet (21,000 b/d equivalent) per year and all current production is associated natural gas, recovered alongside oil. Cupet estimates the recovery rate of this natural gas to be 94%.²⁰ Cuba’s renewable energy profile remains a small percentage of total generation; however, the country is laying the groundwork for increases in the near future. Cuba currently generates around 4% of its electricity from renewable sources, with bagasse being the major resource.²¹

2.2. Centralized generation

Cuba had 6169 MW total installed generating capacity in 2014.²² This represents a 19% growth from 2006. Cuba’s generating capacity is significantly greater than other large Caribbean island nations, including the Dominican Republic (3702 MW in 2013), Jamaica (918 MW in 2012), and Trinidad and Tobago (2104 MW in 2012).²³ Cuba’s population is greater than each of these nations, however. In this context, Cuba has a generating capacity of about 547 MW per million residents, while the Dominican Republic has roughly 356 MW/million residents and Trinidad and Tobago has 1570 MW/million residents. Cuba’s centralized generation is primarily concentrated in oil-fired power plants. The country additionally has three major natural gas plants, which account for 506 MW of electric generating capacity, or about 8% of total generation capacity in 2014.²⁴ The Russian company Inter RAO is building expanded generation capacity by adding generators at two

⁵ Ibid at 13.

⁶ Other goals included increasing the availability and reliability of the national grid, the generalization of distributed generation with smaller electric power plants, increasing the exploration and production of local oil and gas, and international co-operation.

⁷ Ibid at 13.

⁸ Ibid at 14–15.

⁹ Dieter Seifried. “Cuban Energy Revolution – A Model for Climate Protection?” *Quadrat*, p. 23, http://www.oe2.de/fileadmin/user_upload/download/Enginiererevolution_Cuba_eng.pdf.

¹⁰ Käkönen, supra note 6 at 15.

¹¹ Cereijo, supra note 13 at vii.

¹² IDB, “Pre-Feasibility Study of the Potential Market for Natural Gas as a Fuel for Power Generation in the Caribbean,” *Inter-American Development Bank*, 2013, p. 77.

¹³ Käkönen, supra note 6 at 16.

¹⁴ Rodríguez, supra note 8.

¹⁵ Zainab Calcuttawala, “Cuba Imports First Russian Crude Since Collapse Of Soviet Union,” *Oilprice.com*, <http://oilprice.com/Latest-Energy-News/World-News/Cuba-Imports-First-Russian-Crude-Since-Collapse-Of-Soviet-Union.html>

¹⁶ Belt, supra note 10 at 59.

¹⁷ Jorge R. Piñón. “Cuba Energy Review 2014 Growth and Opportunities.” *The University of Texas at Austin*, January 2015.

¹⁸ Piñón, supra note 16 at 25.

¹⁹ Käkönen, supra note 6 at 11.

²⁰ Ibid at 28.

²¹ Käkönen, supra note 6 at 7.

²² ONE, supra note 9 at section 10.17.

²³ CIA, “The World Factbook: Electricity – Installed Generating Capacity,” <https://www.cia.gov/library/publications/the-world-factbook/rankorder/2236rank.html>.

²⁴ Sherritt, supra note 49 at 13.

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