Cuba's Energy Challenge: Fueling the Engine of Future Economic Growth

Jorge R. Piñón

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CUBA’S ENERGY CHALLENGE:
Fueling the Engine of Future Economic Growth

By Jorge R. Piñón
Introduction

Cuba’s economy and infrastructure, in shambles following the economic crisis caused by the end of Soviet aid in 1991, improved growing after the government enacted a series of “market reforms” in 1993. The inevitable continuation of these policies, particularly in a post central planning system, would create substantial benefits and investment opportunities for national and foreign companies alike. For the past ten years, these market reforms, oriented toward attracting foreign investment, have certainly paid off in the energy sector.

As Cuba’s economy evolves, through a comprehensive construction boom, necessary in order to rebuild the country’s service infrastructure and basic industries, and creating thousands of labor-intensive jobs in the process, the country could become a considerable target market for energy related products and services. Of paramount importance in the island’s economic recovery is the development of a long-term comprehensive national energy plan, which promotes and balances three key factors; economic growth, energy conservation, and the protection of the environment.

This paper, by providing some historical background, and an overview of the current market, could be used as a road map for both the private and public sectors through Cuba’s development process and should also raise some issues and alternatives that warrant further debate, in the following areas;

- Hydrocarbon exploration and production
- Oil refining and natural gas processing
- Environmental remediation
- Oil products logistics and distribution
- Gasoline marketing and convenience retailing
- Oil products commercialization
- Electric power generation and transmission
- Renewable energy sources
- Sugar cane ethanol

Exploration and Production

Prior to the 1940s, oil and gas exploration and production in Cuba were confined primarily to shallow drilling and recovery, associated with numerous oil seeps in western and central Cuba. Since the mid nineteenth century, some of these oil seeps, such as the
heavy tars (asphalt) of Cárdenas Bay, and the light condensates (naphtha) of Motembo, among others, have been exploited for commercial purposes. Shallow exploratory activity by U.S. and Cuban companies in the 1940s and 1950s eventually resulted in the discovery of several small commercial oil fields in La Habana, Matanzas, and Las Villas provinces. Eventually commercial fields were developed, the most important of which were Jatibonico and Jarahueca. With the exception of the Cristales Field, most of the oil discovered during this period was high sulphur heavy crude oil with over 5 percent sulphur and an average gravity of 18 degrees API.

U.S. companies and private investor syndicates, in association with Cuban partners, were the main participants in the oil and gas upstream sector during the 1950s. Among them were Consolidated Cuban Petroleum Corporation, which had production in Motembo and Bacuranao; and Corporación General de Petroleo de Cuba S.A., owned by various associates of the government of Fulgencio Batista, with production in Motembo and Jarahueca Fields, and operating concessions from Kerr-McGee Oil in Jatibonico and from Gulf Oil Company in Placetas, among others. (1)

Other major U.S. oil companies, such as Standard Oil of New Jersey (ESSO) and Standard Oil of Indiana (Amoco), conducted various geological and geophysical studies, and exploratory drilling work in central and eastern Cuba without any success in the 1950s. Cuban oil production in 1958 was less than 50,000 tons annually, approximately the equivalent of 1,000 barrels per day (b/d). Most U.S. companies ceased exploratory operations in 1959, and all physical production assets of both U.S. and Cuban companies were expropriated by the government by early 1960.

Cuba has two oil-bearing provinces, the northern province, which is part of the Florida-Bahamian Plate, and the southern province which is part of the Caribbean Plate. Most discoveries in the northern province have been low gravity (heavy), high sulphur quality crude oil, along with associated natural gas in pre-Upper Cretaceous Campanian plays along a 150 km stretch of the coastal and onshore region between Guanabo and Corralillo. The southern province has seen some exploratory work in the past in the Golfo de Guacanayabo, Golfo de Ana María and Jardines de la Reina, with no promising results.

During the 1960s, exploration results were also poor; with only several small oil discoveries made. Results changed during the 1970s, with Soviet assistance and the discovery of the Varadero Oil Field in 1971. After the fall of the former Soviet Union in 1991, Cuba opened in 1993-94 its oil and gas exploration and production sector to foreign oil companies, with a total of 33 onshore and coastal blocks offered during its first international bidding.

In order to attract foreign oil companies to explore and produce Cuba’s hydrocarbon resources, the Cuban government through Unión Cubapetroleo (Cupet), the state oil company under the Ministry of Basic Industry (Minbas), adopted a Production Sharing Agreement (PSA). A PSA is a contractual format used by many countries and generally accepted by major international oil companies.
Most PSAs are contracts in which the international oil company assumes all risks and expenses, and works as a contractor to the national oil company. In the event of a commercial discovery, the foreign oil company is allowed to recover its expenses and share in profits from the field’s production. The term or duration of the contract, along with costs and production share, are negotiable, and vary according to the complexity and level of risk of the work. The foreign oil company generally pays a 30 percent corporate tax on its profits to the host government. The foreign company is also allowed to dispose of its share of production by exporting it or selling it to the national oil company at world price levels. Due to the quality of Cuba’s current production of crude oil and the final end-use of the same, the price basis for the island’s production is a discounted price off U.S. Gulf Coast No. 6 fuel oil. Under PSAs, the title/ownership of the hydrocarbons belongs to the state, along with the production’s associated assets and other infrastructure. Cuba’s PSAs allows for international arbitration in case of a dispute.

Among the early entrants were Sweden’s Taurus, Canada’s Northwest Energy and Talisman, Brazil’s Braspetro, and France’s Total. Drilling by Total in 1994 resulted in two dry holes, the second well being abandoned prior to reaching the objective horizon, that is, the originally planned depth of the well. Talisman eventually sold its interest to Northwest Energy’s parent, the Sherritt Corporation which has become Cuba’s preferred and most successful, upstream partner.

Cuba has seen over US$1 billion spent since 1991 in its upstream oil and gas sector with good results. Crude oil production reached a level of 50,000 barrels per day in 2001 from 18,000 barrels per day in 1992. The majority of the production from the Varadero, Puerto Escondido and Boca de Jaruco fields is between 9 to 12 degrees API gravity heavy crude oil. With ultimate primary recovery around 9-10% of the oil in place, and estimated recoverable reserves at 1 billion barrels, and assuming a reserves to production rate of forty years, the production from these fields could reach about 25 million barrels per year.
or about 70,000 b/d. Most of these recently discovered heavy oil production, are the results of the Production Sharing Agreement between Cupet and Canada’s Sherritt, using horizontal drilling technology and enhanced recovery and production methods.

Year end 2003 financial statements published by Sherritt International in March 2004, show gross working interest oil production in Cuba was 41,226 b/d from 38,256 b/d in 2002, demonstrating the success of the various exploration PSAs and production enhancement contracts between the Canadian company and Cupet. Net working interest, or net sales volumes, which represent Sherritt’s share of gross working interest production in 2003, amounted to 21,203 b/d from 21,682 in 2002, a two percent decrease due to lower capital spending and “below expectation” production from the Puerto Escondido and Canasi fields. Sherritt has ceased any new exploration activity in Cuba until certain income tax calculation methodology differences are settled between the company and Cuban tax authorities; ongoing exploration and production activities remain unaffected. Cuban investments represent approximately a third of both total revenues and capital assets for this Canadian oil independent.

The future of Cuba’s oil and gas exploration and production sector could very well be in the deep offshore Gulf of Mexico waters, along the western approaches to the Florida Straits and the eastern extension of Mexico’s Yucatán Peninsula. In industry circles this area has been christened as the “Donut Hole”. Cuba’s Exclusive Economic Zone (EEZ) in the Gulf of Mexico is an 112,000 square kilometers area that has been divided in 59 exploration blocks of approximately 2,000 sq km each at an average depth of 2,000 meters, with some blocks as deep as 4,000 meters. The EEZ lies within demarcation boundaries, between Mexico, Cuba, and the United States, agreed upon during the administration of U.S. President Jimmy Carter. In June 2000, Mexico and the United States signed an agreement that demarcates each country’s rights to the Western Gulf of Mexico. The agreement gives Mexico control of over 60 percent of the “Donut Hole”. The agreement provides for a ten-year moratorium during which neither country may exploit the region’s resources.

Industry experts categorized this area as high risk from the technical geosciences standpoint; but some reports indicate some hydrocarbon potential exists, with Cupet officials, quoted in Cuba’s official government newspaper Granma, estimating a potential of more than 2 to 4 billion barrels of recoverable reserves. Given the possible presence of a sufficiently large structure, technical risks might be reduced to acceptable levels. Another advantage would be that these undiscovered reserves are likely to be of light crude oil, and not the heavy high sulfur quality that Cuba’s onshore and coastal wells currently produce.

Cupet is currently in conversations with various large oil companies, such as Brazil’s Petrobras and others and in 2001 signed an agreement with Spain’s Repsol-YPF to explore Cuba’s new hydrocarbon “frontiers.” Repsol’s agreement is broad and encompasses exploration and production, fuels marketing, electricity, and refining activities. In oil exploration, Repsol has partnered with Cupet to conduct seismic studies and explore six EEZ blocks; N25, N26, N27, N28, N29, and N36. The Spanish oil company will provide the initial capital, and has committed to two exploratory wells.
Recent press reports indicate that Repsol has contracted the world’s largest offshore drilling platform, the Erik Raude, at an estimated cost of $195,000 per day. The platform, currently working in Canadian waters, will be drilling in Cuban waters by early in the second quarter of 2004. As discussed above, this type of deep water exploration is expensive and has a high degree of geological and technical risk, risks that companies like Repsol-YPF and Petrobras certainly have the necessary deep water expertise to handle; however, the anticipated payoff would have to exist for most international oil companies even to consider it. If successful, the 1,650 meters deep project would take from three to five years to bring into full development at an estimated total cost of between US$1 to 3 billion.

(Reprinted with permission from the Oil & Gas Journal)

During the September 2003 visit to Cuba of Brazil’s President Luiz Inácio Lula da Silva, Petrobras announced a new oil technology agreement with Cupet. This marks Petrobras’s return since its major exploration setback in 2001. In 1998 Petrobras, in association (60/40) with Canada’s Sherritt International, announced their first Cuban offshore wildcat project (block 50), 32 km north of Cuba’s Ciego de Avila province at Cayo Felipe, a coral formation off Cayo Coco/Cayo Guillermo. At the time Petrobras’s geological
surveys estimated the potential of oil reserves at 500 million barrels. After three years of work, US$15 million dollars, and reaching the 4,000 meters depth, they declared the well a dry hole. Petrobras’s experience in Cuba is nothing new in the high risk/high reward environment of oil and gas exploration; it is simply the nature of the business.

Over the last decade Cuba’s upstream program has been successful; having reached a milestone production threshold of 71,000 barrels of crude oil per day in 2003. Future studies and exploratory results in the Gulf of Mexico’s EEZ waters will determine the industry’s future and investment potential; an investment potential possibly worth tens of billions of dollars.

**Natural Gas**

Cuba’s natural gas production is all associated gas (natural gas-methane, found within the crude oil reservoirs). The island’s geology to date has not proved to be a major source of reservoirs rich in dry, non associated natural gas, which could have made Cuba a net exporter of piped gas to Florida or a liquefied natural gas (LNG) exporter such as Trinidad and Tobago.

<table>
<thead>
<tr>
<th>Cuba-Trinidad and Tobago Hydrocarbon Comparison 2002</th>
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<tbody>
<tr>
<td>Reserves</td>
</tr>
<tr>
<td>Crude Oil (mmbls)</td>
</tr>
<tr>
<td>Cuba:</td>
</tr>
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<td>T &amp; T:</td>
</tr>
</tbody>
</table>

Source: OGJ

Cuba’s associated gas production from the Varadero fields has been flared for many years, creating a considerable air and visual pollution in the tourist sensitive area, not to mention the hydrogen sulfide (H2S) smell of “rotten eggs” along the Via Blanca highway as it approaches Varadero. Pressure from tourist groups and economic incentives influenced Cupet to seek a business solution to the problem, and once again a new business venture was developed with Canada’s Sherritt.

Locally produced associated natural gas from the Varadero, Jaruco and Puerto Escondido fields is now being used as fuel for onsite power generating plants of 173 megawatts (MW) and 33 MW respectively. The power plants and related sour gas processing units are being built by Energas, a joint venture in which Sherritt has a one-third indirect interest, along with Cupet, which supplies gas at no cost to the joint venture, and Unión Eléctrica, which buys all the power from the plants. Each has a one-third interest in Energas. The $250 million dollar project is being financed by Sherritt International. Depending on the natural gas reserves of the recently discovered Puerto Escondido field, additional generating capacity could be built.
Cupet is also in the process of building a system of pipelines that will move natural gas and crude oil production from Puerto Escondido, Santa Cruz del Norte to Boca de Jaruco and then on to La Habana, and crude oil to the oil super port in Matanzas. Associated natural gas processing (sour gas) plants are also in line and more are projected. There are today approximately 240,000 households in metropolitan La Habana that are connected and use natural gas as a cooking and water heating fuel. This fuel is mostly associated natural gas from the Puerto Escondido/Boca de Jaruco fields, but it also includes some naphtha manufactured gas. Manufactured gas, “gas de la calle”, plants are located in the La Habana neighborhoods of Marianao, Cerro, and Plaza de la Revolución.

The inevitable rationalization of the oil refining industry in Cuba (discussed in more detailed below), and its environmentally sensitive tourist industry, will force Cuba to consider, and probably develop an energy policy that should rely heavily on clean burning natural gas as its fuel of choice. Cuba’s future natural gas needs could be sourced as LNG from Trinidad and Tobago, as Puerto Rico and the Dominican Republic are currently doing, or by piped natural gas from Mexico or the United States, through undersea natural gas pipelines that could be built from the Yúcatan or Florida. These pipeline options are technologically feasible today, just as the various 95 miles, $650 million dollar natural gas underwater pipeline projects between the Bahamas and Florida have demonstrated.

**Oil Refining**

It was in Regla, a suburb located on the east side of La Habana harbor, where oil refining was started in Cuba during the 1890s by John D. Rockefeller’s partner, John Archibold. The Belot refinery, as it was known at the time, was eventually owned and operated by Standard Oil of New Jersey (Esso), and it was expanded from 8,000 b/d to 35,000 b/d in 1958. In 1957, Shell Oil, which had operated in Cuba as a fuels marketer since 1922, built its own 28,500 b/d refinery, also in Regla. Cuba’s third oil refinery, with a capacity of 20,000 b/d, was built in 1957 by Texaco in the eastern city of Santiago de Cuba. All international oil companies’ refining and marketing assets were nationalized without compensation in 1960. There were also a number of small distillation units (topping plants) located together with some of Cuba’s shallow light crude oil production fields such as; Refinería Cabaiguán, Refinería Jarahueca and Refinería Santa María, among others.

The Esso and Shell refineries in Regla have been interconnected and are currently operating as a single site refinery, now called Ñico López refinery. The Hermanos Díaz (Texaco) refinery in Santiago de Cuba peaked production at 71,000 b/d in 1989, was idle for over a decade, and is currently reported to be back in production. The Hermanos Díaz refinery also has a lubricants facility, and a liquefied petroleum gas (LPG) bottling operation, both operated as joint ventures with Castrol and Elf, respectively. (See the section below entitled Fuels Marketing). Actual refinery production data is difficult to assess due to the lack of reliability of the units, product contamination, off-specification of product, and intermediate feedstock qualities. U.S. Department of Energy/Energy Information Administration (DOE/EIA) data shows that Cuba’s refinery system
processed 56,000 b/d in 2000, less than 20 percent of the system’s total capacity. (See Supply/Demand Balance section below.)

Over the years, Cuba’s refineries have undergone some processing upgrades, such as; middle distillates and reformer feed hydrotreating, sulphur recovery, and naphtha stabilization, in order to meet new environmental standards in transportation fuels quality. According to Cupet, Cuba’s refinery system has a capacity of approximately 3 million tons; actual refinery production data is not readably available. The Ñico Lopez La Habana refinery processes medium to light foreign crude oil grades blended with heavier Cuban quality crude. Even though most Cuban crude oil production is directly earmarked as electric power plant fuel, about twenty percent has gone into refinery processing.

From 1985 through 1991, with financial and technical assistance from the former Soviet Union, Cuba built a 76,000 b/d refinery in its southern port city of Cienfuegos, which has never become commercially operational. This refinery, technologically obsolete today, has a similar configuration to the Schwedt (Veba-BP) refinery located near the Polish border of the former East Germany. The Cienfuegos refinery still requires a catalytic cracker, vacuum distillation unit and other extensive modifications, at an estimated cost of at least US$200 million dollars. Over the years many national oil companies such as; Pemex (Mexico), PDVSA (Venezuela), Ecopetrol (Colombia) and Petrobras (Brazil), have evaluated the economic and strategic potential of upgrading and activating the Cienfuegos refinery. All have reached the same conclusion: no economic or strategic justification currently exists for such a major investment. Cienfuegos, could function solely as a third-party merchant refinery for refined products exports, as it has been suggested, to take advantage of price arbitrage between the United States, Europe and the Caribbean, but this does not make sense. Caribbean Basin merchant refinery capacity stands today at 1.255 million b/d, not counting on Venezuela’s 1.282 million b/d, ample processing capacity to meet the region’s demand. However, within an overall national energy strategy, the Cienfuegos Refinery could become the cornerstone of Cuba’s future oil processing industry at some point in the future.

Cuba’s Ñico López (La Habana) and Hermanos Díaz (Santiago de Cuba) refineries are technologically obsolete, energy inefficient, and huge environmental threats; they should be shut down. The 5.2 sq km La Habana harbor is one of the world’s ten most polluted harbors of the world. According to the Center for International Policy’s: Cuba Project report; “The worst sources of pollution of the waters in the bay are the López Refinery, sewage, cargo boats and cruise ships docked at the harbor, and the untreated waters of three rivers that flow into the bay.” The Hermanos Díaz refinery is also one of the main culprits in the contamination of the 11.9 sq km Santiago de Cuba harbor. (2)

Even though the former refinery owners might seek some sort of financial compensation for Cuba’s expropriation of their assets, in private they express very little hope of re-investing in these obsolete plants, which now are of very little value, not to mention the additional burden of assuming their environmental liabilities. These old sites should be remediated and turned into distribution facilities for refined products supplied via pipeline from the Matanzas superport, thereby avoiding tanker traffic in tourist-sensitive
Havana harbor. Santiago de Cuba could be supplied via coastal tankers once the Cienfuegos refinery becomes operational.

Cuba should also consider enacting legislation so that only doubled hauled tankers can use its territorial waters, in order to safeguard its US$1 billion per year tourist trade. This would increase the cost of fuels; but the cost and impact to the tourist industry as the result of a major oil spill, as in the Exxon Valdez or Spain’s Prestige, would be disastrous and should be avoided at all costs. A major catastrophe was avoided in March of 1998 when two oil tankers, the Panamanian-registered Shavadar and the St.Vincent/Grenadines-registered El Bravo collided in Matanzas Bay, spilling crude oil in the near by coastal areas; fortunately for Cuban tourism, no oil reached Varadero.

<table>
<thead>
<tr>
<th>Havana harbor. Santiago de Cuba could be supplied via coastal tankers once the Cienfuegos refinery becomes operational.</th>
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<tr>
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</tr>
</tbody>
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### Cuba’s Refinery Capacity 2002 (mb/d)*

<table>
<thead>
<tr>
<th></th>
<th>Distillation</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Crude</td>
<td>Vacuum</td>
<td>Cracking</td>
<td>Reforming</td>
<td>Cat-Hydro</td>
</tr>
<tr>
<td>Hermanos Díaz (Santiago)</td>
<td>101.5</td>
<td>37.5</td>
<td>0</td>
<td>7.5</td>
<td>29.7(1)</td>
</tr>
<tr>
<td>Ñico López (La Habana)</td>
<td>121.8</td>
<td>38.2</td>
<td>14.7</td>
<td>5.0</td>
<td>28.5(1)</td>
</tr>
<tr>
<td>Cienfuegos</td>
<td>76.0</td>
<td>0</td>
<td>0</td>
<td>7.5</td>
<td>7.7</td>
</tr>
<tr>
<td>Sergio Soto (Cabaiguan)</td>
<td>2.1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>301.4</td>
<td>75.7</td>
<td>14.7</td>
<td>20.0</td>
<td>65.9</td>
</tr>
</tbody>
</table>

Source O&GJ Note: *The volumes above are name-plate capacity. Actual capacity depends on the quality of the feed, and the levels of operational efficiency and maintenance of the units. (1) Refiner feed and straight run distillates.

The repositioning of Cuba’s refinery assets; dismantling of Ñico López and Hermanos Díaz refineries, the retrofitting of the sites into refined products import and distribution facilities, and the completion of the Cienfuegos refinery, would require investments of over $350 million dollars.

The environmental remediation and clean up of the refinery sites’ top and sub soil, below- ground water table, and surrounding marine waters and wetlands could well amount to over $100 million dollars.
Logistics and Distribution

The main foreign crude oil unloading facility in Cuba is found in the north coast port city of Matanzas, east of La Habana. The facility includes a 187 km – 21 inches crude oil pipeline with a capacity of 134,000 b/d, connecting the port with the Cienfuegos refinery located on the south central coast of the island. Other pipelines connect the port facility with the Ñico López refinery in La Habana, the thermal electric power plants in Santa Cruz del Norte and Matanzas, and the crude oil fields of Varadero and Jaruco/Puerto Escondido.

The Matanzas facility consists of a 45,000 deadweight ton (dwt) fuel oil dock in the Bayona area of Matanzas harbor and three deep water docks, also used for lightering, equipped to handle 150,000, 70,000, and 35,000 dwt tankers respectively. Data on the crude oil, refined products, and LPG storage capacity of the facility are not available. This facility also addresses the inherent environmental risk associated with marine transportation of oil and oil products by localizing the risk in one site rather than multiple sites, such as La Habana and Cienfuegos.

The refineries in La Habana and Santiago de Cuba can handle ships of up to 30,000 dwt on a limited basis, and the Cienfuegos refinery can handle up to 52,000 dwt vessels. Other ports such as Mariel, Nuevitas and Manzanillo also have limited liquids handling and storage facilities.

It has been suggested that Cuba could also become a third party crude oil transshipment and lightering point for ultra large crude carriers (ULCCs) and very large crude carriers (VLCCs) carrying oil from the Middle East to Atlantic coast refineries. This idea lacks economic and strategic merit, because ample throughput space is available in the Caribbean, and the Louisiana Offshore Oil Super Port (LOOP), providing lightering and shipping services from the U.S. Gulf Coast to refineries in the Midwest. Even with today’s high shipping standards and double hauled tankers, lightering and transshipment of crude oil is an enterprise that would jeopardize Cuba’s environmentally sensitive coasts and harbors and should be minimized and avoided.

In a future free market environment, Cuba’s ports are going to be a focus of substantial investment opportunities worth hundreds of millions of dollars, as facilities are upgraded and modernized to accommodate anticipated increase in general dry cargo, liquids, and passenger traffic. The main ports for oil products and transportation fuels distribution would be; Mariel, Matanzas, Nuevitas, Santiago de Cuba, Manzanillo, Cienfuegos and Nueva Gerona.
Fuels Marketing

Major oil brands began marketing operations in Cuba after 1925, when import duties were removed, which up to then had given Standard Oil of New Jersey (Esso) a virtual monopoly over the market by having the only refinery on the island. Companies such as Shell, Atlantic Richfield (Sinclair), Texaco, Quaker State, California Oil Company (Chevron) and others, participated in the Cuban market until 1960 with a wide range of products such as; transportation fuels, lubricants and greases, chemicals, asphalt and LPG.

Prior to the current central planning economic system, Cuba was one of the most advanced countries of the world in the per capita ownership of automobiles, second only to Venezuela in Latin America and far ahead of Southern Europe and Asia. Today Cuba’s vehicular fleet is limited to automobiles and trucks owned and operated by state enterprises, foreign entities, and state-owned car rental companies servicing the tourist trade. Private vehicles are few and the motor pool is made up mostly of 1950’s vintage U.S. automobiles along with some Russian Ladas, 1970s Argentine built Fords and 1980s Italian Alfa Romeos.

There are over 200 gasoline service stations in Cuba today, and most of them are out of service due to the lack of product or spare parts for its equipment. About 140 of them are operated by CIMEX, a company controlled by the Ministry of Interior (MINIT), which services the tourist and dollar trade. A smaller number of service stations operated by Cupet and Corporación Cubalse, under the brand Oro Negro, also serve the dollar market.

In an effort to replace kerosene and electricity as cooking fuel, in 2002, Cupet formed two LPG bottling and marketing joint ventures in La Habana and Santiago de Cuba. Cubana de Gas S.A., a joint venture with the London office of Dutch-owned oil trading company Trafigura Beheer meets the growing demand of this product in La Habana, while a similar joint venture with French-based Total, Elf-Gas Cuba S.A., operates in Santiago de Cuba. In order to meet the demand for automotive oils and industrial lubricants and greases similar blending, packaging, and marketing joint ventures operate in La Habana and Santiago de Cuba by Total-Elf and Castrol Cuba, S.A., a Dutch subsidiary of BP’s Castrol.

The country’s road and rail infrastructures are geographically sound due to the island’s topography, and reaches all of its major metropolitan centers. The island’s 60,000 km road network, of which half is paved and includes 638 km of expressways and approximately 5,000 km of standard gauge railroad lines, would support a quick growth for the transportation fuels sector. There are definitely considerable investment opportunities for an expanded rail and road mass transit system.

As the island’s transportation infrastructure is upgraded, and the general Cuban population begins the process of creating economic wealth and disposable income, substantial investment opportunities will also develop for transportation fuels marketing and its associated convenience services such as food stores, fast food, and automotive parts and repairs.
Electric Power

Cuba’s light and power industry began during the second half of the nineteenth century. At first it was closely associated with the railway and public urban electric tramway systems. Not only La Habana, but many other Cuban cities had electric power before the turn of the century such as, Cienfuegos and Sagua La Grande (1892); Pinar del Rio (1893); Santa Clara, Regla, and Caibarien (1895); and Santiago de Cuba (1897). During the Cuban War of Independence from Spain, General José Miro Argenter wrote in his diary how the “brilliance of La Habana’s electric lights could be seen on the horizon and mesmerized the mambises” (Cuban rebels) as they marched south of the capital during Antonio Maceo’s invasion of the western provinces in 1896. (3)

During and following the U.S. occupation of Cuba, numerous foreign-owned power companies were formed throughout the island. Canadian, German, British and American investors built, owned and operated power plants; in 1902 in La Habana, Compañía de Electricidad de Cuba was formed by British investors, Canadian invested in the Havana Electric Railway Company in 1899 and in 1908 formed the Camaguey Electric Company; and in 1908 the Compañía Anónima Eléctrica Alemana Cubana was formed in Cárdenas by German investors. During the second half of the 1920s a consolidation of Cuba’s electric and power industry resulted in the near monopoly of the Compañía Cubana de Electricidad in 1928, whose major shareholder was the American and Foreign Power Company, part of the JP Morgan Trust. The public electric system was nationalized in 1960 and it is currently operated by Unión Eléctrica, part of the Ministry of Basic Industries. (1)

Installed generating capacity in Cuba today is 4,490 MW; with 14.38 billion kwh of production covering 13.37 billion kwh of demand in 2001. Cuba’s oil fired system is made up of obsolete and aging equipment from the United States, the former Soviet Union and Eastern Europe. The average age of the units is over twenty years, with some units with over 60 years of service. The newest units are located in Matanzas, Felton and Cienfuegos; these were built with Japanese, French and Slovak technology. The distribution and transmission network has been deteriorating due to lack of maintenance, and consists of 6,816 km of 220 and 110 kv transmission lines, 9,224 km of sub-transmission lines to 33 kv; and 33,400 km of primary distribution lines and 26,923 km of secondary distribution lines. Cuba’s power plants boiler systems have been retrofitted over the years in order to process, as discussed earlier, its north coast’s heavy crude oil production as plant fuel. Some small hydroelectric capacity exists (43 MW) in Manicaragua, along with approximately 800 MW of biomass (bagasse) sourced electricity generated by the sugar industry.
### Cuba’s Thermoelectric Power Plants

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>Units</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eliseo Caamaño</td>
<td>Pinar del Rio</td>
<td>1</td>
<td>6.9</td>
</tr>
<tr>
<td>Maximo Gómez</td>
<td>Mariel</td>
<td>8</td>
<td>600.0</td>
</tr>
<tr>
<td>Este Habana</td>
<td>Santa Cruz del Norte</td>
<td>3</td>
<td>300.0</td>
</tr>
<tr>
<td>Antonio Maceo</td>
<td>Regla</td>
<td>2</td>
<td>104.0</td>
</tr>
<tr>
<td>Frank País</td>
<td>Regla</td>
<td>2</td>
<td>40.0</td>
</tr>
<tr>
<td>Antonio Guiteras</td>
<td>Matanzas</td>
<td>1</td>
<td>330.0</td>
</tr>
<tr>
<td>Carlos Manuel de Céspedes</td>
<td>Cienfuegos</td>
<td>6</td>
<td>351.0</td>
</tr>
<tr>
<td>10 de Octubre</td>
<td>Nuevitas</td>
<td>2</td>
<td>500.0</td>
</tr>
<tr>
<td>Raul Martínez</td>
<td>Ciego de Avila</td>
<td>3</td>
<td>26.5</td>
</tr>
<tr>
<td>Lidio Ramón Pérez (Felton)</td>
<td>Mayari</td>
<td>1</td>
<td>500.0</td>
</tr>
<tr>
<td>Antonio Maceo (Renté)</td>
<td>Santiago de Cuba</td>
<td>6</td>
<td>500.0</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td>27.0</td>
</tr>
<tr>
<td>Total Unión Eléctrica</td>
<td></td>
<td></td>
<td>3,285.0 MW</td>
</tr>
<tr>
<td>Co-Gen Producers*</td>
<td></td>
<td></td>
<td>1,205.0</td>
</tr>
<tr>
<td>Total Capacity</td>
<td></td>
<td></td>
<td>4,490.0 MW</td>
</tr>
</tbody>
</table>

Source: EIA/DOE  *Energas, Hydro, and Sugar Industry among others.

While the Cuban electrical system has serious problems, additional generating capacity and recent major repairs and maintenance programs have led to a decline in the number of blackouts and other technical problems. Cuba’s electric power system has seen substantial growth in the last ten years; nearly 12 percent growth in generating capacity from 3.988 million kilowatts (kw) in 1992 to 4.486 million kw in 2001. Thermal electric generation grew by 38 percent, from 9.8 billion kilowatt hours (kwh) in 1992 to 13.5 billion kwh in 2001; and consumption grew by 33 percent, from 10.1 billion kwh in 1992 to 13.5 billion kwh in 2001. Over ninety percent of the island has electricity.

As early as 1956, the government of Fulgencio Batista was discussing the possible construction of a nuclear power plant with Compañía Cubana de Electricidad. But it was not until 1983 that construction of Cuba’s first nuclear power plant began at Juragua, near the south central coastal city of Cienfuegos, the result of a formal agreement signed between the Soviet Union and Cuba in 1976. The project would save Cuba hundreds of millions of dollars a year in imported oil. But in September of 1992 after the collapse of the Soviet Union, the Cuban government stopped construction of the facility, and the incomplete buildings for the reactors were mothballed. The Juragua 1 buildings were about 90 percent completed but only nearly 40 percent of the reactor equipment was in place. Juragua 2 building facilities were about 25 percent completed. Various attempts have been made to revive the project but they have all failed. It is estimated that it would take over US$1 billion to complete the two 440 MW reactors project, which is reported to have major construction defects, and deteriorated equipment due to improper mothballing.
In recent years the Cuban government has explored various BOOT (built, own, operate, transfer) business ventures with foreign companies in order to expand and upgrade its power generation capacity. Future upgrade and modernization improvements to the electric power industry, undertaken to support a developing economic and industrial system, could very well require hundreds of millions of dollars of investments. We should again underscore the importance of evaluating, within a national energy policy, the economic and strategic validity of a fuel switching program from an oil fired to a natural gas/LNG fired boiler system for electric power plants and other major industrial projects.

**Supply – Demand Balance**

An analysis of Cuba’s past petroleum supply/demand patterns during the twenty-year period (1970-1991) of Soviet economic influence would be quite complicated. According to economist Jorge Pérez-López, an economic central planning system along with; sugar for energy barters, subsidized sugar prices, and the re-exports of Soviet oil and refined products, “contributed to questionable investment decisions in energy intensive industries and to wasteful consumption practices.” (4)

Therefore, it is more productive to look toward future energy consumption trends based on an anticipated free market system, and on the island’s economic growth engines of; tourism, agriculture, oil and mining, and a highly educated labor pool willing to work at competitive rates. This labor advantage, along with possible advantageous tariff regulations, and the close proximity to U.S. markets, would create large number of jobs in the maquiladora, pharmaceuticals, engineering design, and financial and computer customer service industries.

Rice University’s economists Amy Myers Jaffe and Ronald Soligo, project that as the result of these market changes generating an annual per capita gross domestic product (GDP) growth rate of 4 percent, along with an annual population growth rate of 0.5 percent, Cuba’s oil energy consumption would nearly double from 179,000 b/d (boe) in 1998 to 349,000 b/d (boe) by the year 2015. (5)
### Cuba’s 2000 Petroleum Supply- Demand Balance (mb/d)

<table>
<thead>
<tr>
<th></th>
<th>Crude Production</th>
<th>Crude/Prod. Imports</th>
<th>Refinery Production</th>
<th>Product Exports</th>
<th>Apparent Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude Oil</td>
<td>41</td>
<td>15</td>
<td>56</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NGL/LPG</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Gasoline</td>
<td>-</td>
<td>1</td>
<td>14</td>
<td>(3)</td>
<td>11</td>
</tr>
<tr>
<td>Jet Fuel</td>
<td>-</td>
<td>8</td>
<td>0</td>
<td>(3)</td>
<td>4</td>
</tr>
<tr>
<td>Kerosene</td>
<td>-</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Distillate</td>
<td>-</td>
<td>28</td>
<td>8</td>
<td>0</td>
<td>35</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>-</td>
<td>79</td>
<td>15</td>
<td>0</td>
<td>93</td>
</tr>
<tr>
<td>Asphalt</td>
<td>-</td>
<td>0</td>
<td>n/a</td>
<td>0</td>
<td>n/a</td>
</tr>
<tr>
<td>Gain/Loss</td>
<td>-</td>
<td>-</td>
<td>(5)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Other</td>
<td>-</td>
<td>1</td>
<td>7</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>133</td>
<td>52</td>
<td>(7)</td>
<td>161</td>
</tr>
</tbody>
</table>

Source: EIA/DOE

Note: Some totals might not balance due to; product in transit, inventory balances, gain and losses, and refinery feedstocks accounting.

As of 2002 Cuba had a deficit of approximately 100,000 b/d of oil/products in order to meet internal demands. Almost all of Cuba’s heavy oil production is used directly as boiler fuel in the electric power, cement, and nickel industries. Less than 10 percent goes into refinery (Nico López) processing. Under an advantageous financial agreement, Cuba receives 53,000 b/d of crude oil and/or refined products from Venezuela. This agreement made in May 2002 calls for the oil to be repaid over a fifteen-year period with an annual interest rate of 2 percent and an initial two-year repayment grace period. The shortfall balance of approximately 50,000 b/d of crude oil or oil products is purchased by Cuba on the international market.

Based on oil reserves of 1 billion barrels, it is estimated that Cuba could sustain production rates of about 70,000 b/d of crude oil for the next 40 years. With future demand expected to reach the 350,000 b/d level within the next fifteen years Cuba will continue to be a net importer of oil, not considering EEZ potential.

Cuba is advantageously located within the oil producing and processing Caribbean/Gulf of Mexico Basin region which today has nearly 50 percent of the Western Hemisphere’s oil producing and refining capacity. This will allow Cuba, in a future free market environment, to exploit the economic benefits of oil products as a commodity, as well as to take advantage of its arbitrage and fungible characteristics; along with its associated short-haul transportation costs.
Ethanol

Sugar cane based Ethanol deserves high consideration and focus within Cuba’s national energy policy. It would create considerable economic benefits in new investments and employment creation. It would also support the sugar cane industry, preserving a large number of agricultural jobs, that otherwise would have been lost. Also, it would support the national balance of payments by reducing the demand for imported oil and creating a new export revenue source.

Ethanol (ethyl/grain alcohol) is made by the fermentation of sugars (sugar cane), or starches from potatoes, corn, or wheat. Ethanol is used today as an additive to gasoline in many countries, particularly in the United States and Brazil. In the United States, approximately 2 billion gallons of ethanol are added to gasoline each year to increase octane and improve emissions quality. In most areas ethanol, or other “oxygenates”, are blended to a 10 percent ratio with gasoline; even thought it can be use in higher concentrations or in its pure form. The demand for ethanol in the United States will increase in the future due to environmental and underground water contamination concerns of other oxygenates currently used such as methyl tertiary-butyl ether (MTBE).

Cuba’s production of ethanol would reduce its dependence on imported oil and would supplement refinery capacity saving hundreds of millions of dollars per year, plus it would become a new source of export revenue. Cuba has the production capacity (in sugar cane) to compete with Brazil as a major exporter, and its proximity to the U.S. gives it a price advantage over Brazil. Ethanol is low in reactivity and high in oxygen content, making it an effective tool in reducing ozone pollution and it’s a safe replacement for petroleum-based toxic octane enhancers, such as benzene, toluene, and xylene.

It was no surprise that during President Luiz Inácio Lula da Silva’s visit to Cuba in September, 2003, a $20 million fuel ethanol production agreement was signed between Brazil and Cuba. This aid will finance the planting of approximately 400,000 tons of sugar cane and the construction of a 100,000 liters per day processing plant. The production of 100,000 liters per day of ethanol, assuming a 10 percent ratio and a domestic demand of 1.7 million liters of gasoline per day, represents about a 6 percent reduction of import needs valued at about US$8 million per year.

Renewable Energy

As part of its energy conservation policies after the 1991 economic crisis, Cuba began an aggressive program of developing renewable energy projects. Conventional sources such as biomass, hydro, solar, wind, and even exploiting the peat reserves located in the Cienega de Zapata have been considered and pursued.

For many years Cuba’s sugar mills have burned waste cane solids (bagasse) as fuel to power their boilers, but the process is inefficient due to the age and condition of the turbines. With a more advanced and efficient technology the system could become an important contributor of co-generation to the national grid generating up to 100 kWh per
ton of sugar cane from the current average of 20 kwh/ton. Due to poor sugar cane production levels, low sugar world prices, and the deteriorating conditions of its older than fifty years processing technology, Cuba announced in June 2002 the closing of 71 of its 156 sugar mills. Today only 22 of Cuba’s sugar mills co-generation plants were connected, and able to contribute to the national grid. (6)

The only major hydro project in Cuba is the hydroelectric plant Robustiano León, a 3 units, 43 MW plant located in the central town of Manicaragua using the waters of the Hanabanilla River. Throughout Cuba there are more than 175 (138 <50 kw, 32 <500 kw, 5 <5000 kw) small rural hydro-generators of which 26 are connected to the national grid. Just like the small hydro projects, solar (photovoltaics), and wind power projects are important contributors of electricity for schools, health clinics, irrigation, and small rural communities, particularly in Eastern Cuba.

**Summary**

In conclusion, Cuba’s energy challenge begins with its future economic growth and rising standard of living within a free market environment. This anticipated growth will depend largely on the development of a competitively priced, readily available, environmentally sound long termed energy plan. There will be no sector, industry or infrastructure group that will not be directly impacted and or influenced by such a comprehensive energy policy. A new energy policy should embrace energy conservation, modernization of the energy infrastructure, and a balance sourcing of oil/gas supplies in a way that protects the island’s environment. This future reconstruction period, along with the search and development of new energy sources, will also provide national and foreign firms alike many investment opportunities worth billions of dollars.
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About the author

Jorge R. Piñón is an international energy consultant in Miami and Research Associate at the Institute for Cuban and Cuban-American Studies, University of Miami.

Mr. Piñón has over twenty five years of international downstream oil and gas experience with companies such as Shell, Transworld Oil, and Amoco-British Petroleum BP. Among his most recent assignments were President of Amoco Oil de México, México City and General Manager of Supply and Logistics for BP’s Western Mediterranean operations based in Madrid, Spain. Jorge Piñón holds a degree in International Economics and Latin American Studies from the University of Florida.