

## *Prospects for Sustainable Energy*

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“Energy services are essential for sustainable development. The way in which these services are produced, distributed and used affects the social, economic and environmental dimensions of any development achieved. Although energy itself is not a basic human need, it is critical for the fulfillment of all needs. Lack of access to diverse and affordable energy services means that the basic needs of many people are not being met.” — A Framework for Action on Energy, World Summit on Sustainable Development, Johannesburg 2002

In the summer of 2005, Hurricane Dennis had a devastating impact on the Cuba’s energy infrastructure. A vast majority of the damage occurred in the eastern part of the island, a region that had been generally spared extensive damage from the spate of hurricane activity in the Caribbean over the course of the past few years. But this is ironic because by the end of 2005, Cuba had suffered 16 direct hits from hurricanes in a 15 year period. Dennis, like some of its predecessors, had essentially cut the national electrical grid in half. There are two main network links traversing the island east-to-west. The lines nearest the south-central coast bore the brunt of the hurricane’s force and areas in the vicinity of Cienfuegos went nearly two weeks without electricity after the storm. All provisions and potable water had to be trucked in almost daily to offset the already arduous tasks of cleaning up the mess. For some observers this compounded an already difficult situation related to energy production on the island. (Curbelo Alonso, 2005)

After remarkable gains in first stabilizing and then increasing energy production after the Special Period, the recent past had been disappointing.

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1. The author wishes to thank the Cuban Ministry of Basic Industry, CUPET - Cuba Petroleo S.A., Union Electrica de Cuba, Sherritt Inc., Alamar Associates, The World Security Institute and in particular the following individuals for granting me access and valuable information for conducting this research: Kirby Jones, Vice Minister Raul Perez de Prado, Eloy Leon Gomez, Bruce Blair and Glen Baker.

While Cuba has been able to relieve its external dependency on oil imports by increasing its domestic production capacity, this has not allowed Cuba to address a more pressing issue of an ageing energy production infrastructure. 1996 was the last year that any major renovations were undertaken and almost all other production facilities date back to the 1970s and early 1980s, and are of varying design and varying states of maintenance (or the lack of it) and disrepair.

The energy efficiencies gained in the Energas/Sherritt Oil joint venture of re-capturing gas and using it for energy generation was limited to three sites of limited generation capacity only. Moreover, the poor quality of Cuban oil (heavy and sulfurous), while representative of a larger share of energy production (over 95 percent in 2004 and 2005) has taken a toll on existing thermo-electric generation facilities that were already plagued by questionable maintenance regimes and a lack of spare parts and prone to being chronically offline.<sup>2</sup>

By 2004, an increasing demand for electricity on the island required energy officials to run the island's energy production at levels above the 90 percent of capacity. It was simply a matter of time until the precarious balance of poor quality oil, old and failing thermo-electric generation facilities, and transmission and delivery system was upset. By early 2005, the results were dramatic. After having reversed the trend of *apagones* (blackouts) so prevalent during the early stages of the "Special Period," they appeared once again and this time the lack of oil was not to blame.<sup>3</sup> Plant breakdowns caused the productive capacity of electricity to be reduced to less than 80 percent prompting energy officials to reluctantly ration electricity in the Havana metropolitan area. It was reported that this prompted much in-fighting within the Cuban government resulting in the dismissal of Marcos Portal as the Minister of Basic Industry. (Erickson, 2005; Reuters News Service, 2004)

Yet, that itself did little to stem the growing public dissatisfaction over energy matters. In Marianao and Habana Vieja spontaneous demonstrations broke out in May and June 2005 over chronic blackout conditions.<sup>4</sup> After promises of increased productive capacity online by July 2005, the impact of Hurricane Dennis essentially rendered them empty. Another factor mitigating the integrity of the electrical grid is the associated losses in the transmission

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2. Although Cuban energy officials admit that the Antonio Guiteras 330MW thermo-electric generation facility in Matanzas has been taken offline there has been little in the way of explanation other than to state it was plagued with significant breakdown and repair issues.

3. To emphasize the gravity of this situation FOCAL, the Candian Foundation on the Americas dedicated an entire section of its *2005 Cuba/Energy Chronology* to the "Electricity Crisis" citing no less than 26 events that were reported in the international media. ([www.cubasource.org/index.asp](http://www.cubasource.org/index.asp))

4. Loss of water is one of the major service disruptions caused during blackout periods owing to the fact that water pumping stations are usually run off the electrical system.

and delivery system. The most recent figures place these losses at 15 to 20 percent, and over 30 percent across the entire system. (de la O, 2006) The end result of these recent developments has been powerful as Cuba has been forced to contend with the following factors:

The rapid decline of energy productive capacity that must be addressed post-haste;

The nagging decrepitness of the national transmission and delivery system also demanding immediate attention;

*Apagones*, if they are an inevitable by-product of the energy problem, will increase public dissatisfaction with the regime.

From this we can only surmise that the government's reaction to these outpourings will be less than benevolent; and, developments under the growth of international cooperation in energy (renovating refineries, increased investment in oil and gas exploration) will do little to address these critical short term problems.

Added to this domestic element of the energy problem is the growing presence of new actors on the Cuban scene. Over the course of the past three years, both Venezuela and China have made significant inroads in Cuba's energy sector. Venezuela by virtue of the massive imports from that oil rich country (75,000 to 85,000 barrels of oil per day) and China by its investment in the energy sector, both of which will generate new and much needed capital inflows that will increase economic capacity and improve infrastructure in the energy sector. But assuming that there are no changes in the Cuban government or any significant changes in the U.S. policy towards Cuba, these new players on the Cuban stage present a threat to the U.S. interests. This is ironic, inasmuch as the U.S. has no formal economic or diplomatic relations with Cuba, and yet considers it a strategic interest while simultaneously seeking to isolate and cut-off Cuba from the rest of the world.

Because of the less than favorable relations between the governments of the United States of America and the Republic of Cuba over the past 45 years the free flow of accurate information has become and continues to be a somewhat rare commodity. This owes in large part to inaccurate reporting, less than reliable sources and politically motivated disinformation emanating from both sides of the Straits of Florida. In some areas of inquiry, this has been the case for much more than just ideological reasons, especially so in areas critical to the material well-being and the survival en lo actual of the Cuban state.

Without a doubt, energy has been one of those areas. This paper seeks to fill that gap by presenting an analysis that definitively and comprehensively speaks to the issue of energy development and the challenges facing the Cuban state in both the short and long term. More importantly, this requires

us to frame this inquiry within an additional context that addresses more than just the existing and possible base of resources and constraints facing Cuban energy policy makers, that context being sustainability.

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### *A Criterion for Energy Policy Sustainability*

While being aware of, and sensitive to the nature of the various narratives that animate efforts to design and implement sustainable energy policy, states (for better or worse) are served by standing organizations (governmental agencies and bureaucracies) that, while not diametrically opposed to, are often ignorant of such principles in decision-making. Moreover, the in-state capacity (or lack of capacity) requires these states to seek external assistance to carry out the development of energy policy. Detailed below is one such effort. The *Organizacion Latino Americano de Energia* or OLADE, has devised a general criteria for what they term “sustainable energy development.” As such, it serves as an arena for the reflection upon and formulation of energy policies that can legitimately be termed “sustainable.”<sup>5</sup> While by no means are these principles comprehensive, they do provide a template or heuristic orientation to the design, implementation and evaluation of a sustainable energy development policy that is consistent with the notion of generating and supporting a social adaptive capacity within a particular setting. Detailed below are the OLADE principles.

#### **Energy Security**

States under development must constantly guard against disruptions in the source of energy supply, production and distribution. This is a paramount concern owing to the often tenuous nature of developing economies and the generally high level of dependency upon imports of oil and petroleum related products. In essence, these states cannot account for, neither to sufficiently inure themselves from the vagaries in world market prices for oil, nor are they situated to deflect the externalities of disruptions in trade due to war, natural disasters, and the like. Energy security is contingent on the state’s ability to develop a sound energy infrastructure that can account for temporary losses of energy supply. The key objective is to diversify and augment the domestic sources of energy in general, thereby diminishing dependence on any one source of supply and perhaps reducing the dependence on imported energy sources. While it is beyond the capacity of most developing states, some possess storage and refinement capacity that when coupled with

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5. Energy use can also be evaluated using indicators for sustainable energy development (ISED) developed by the International Atomic Energy Agency (IAEA). An example of the application of ISED can be found in David Perez, I Lopez, and I Berdellans, “Evaluating Energy Policy in Cuba using ISED,” *Natural Resources Forum* 29 (2005) 298-307.

domestic production provides the state with a modicum of additional security. Beyond the scope of a sole reliance on oil, some states have sought to increase energy production by developing hydro and nuclear power capabilities. Few if any developing states have the requisite financial and technical resources for such an undertaking and often encounter additional challenges in the pursuit. (Benjamin-Alvarado, 2000)

### **Improving Energy Efficiency**

States under development often face resource constraints that limit the full and integral application of advanced technologies. Sustainable development requires the development of domestic technical capabilities that contribute to the effective management of these types of systems. Major infrastructural development requires an on-going regime of preventative maintenance and replacement of hardware to ensure the efficient operation of such systems. The failure to maintain the regime often results in poor performance, reduced productivity and a significant loss of return on investment. Moreover, if states are plagued by losses from theft and diversion this further erodes the return on investment, raises the costs of transmission and delivery of electricity.

The state must also work to improve energy conservation and limit waste in the commercial, industrial and residential sectors of the economy. This often requires aggressive public information campaigns, the replacement of high energy use appliances and machinery, and the inculcation of values and norms consistent with energy saving and conservation.

The failure to address any of these concerns will almost certainly result in the erosion and limits the ability of state's to effectively design and implement a meaningful program of energy efficiency, either in the short term or the long term.

### **Greater Use of Renewable Energy**

The diversification of energy supply is a must for developing economies. The reliance and dependence upon imported oil and petroleum over-exposes developing states to the vagaries of world market prices and supply. Most developing states do not have sufficient storage and refining capabilities in the case of extended loss of, or major disruptions in supply of oil exports. Those states possessing a relative comparative advantage in natural resources in terms of solar-, wind- and hydro – power should assiduously pursue their long-term development. Considering the high costs of initial development, these renewable energy sources provide developing states with an additional buffer in energy and economic security over the long term.

### **Making Markets Function**

The principle driving forces behind this reform movement in the development community, include the following: (a) the poor performance of the state-run electricity sector in terms of high costs, inadequate expansion of access to electricity service for the general population, and/or unreliable supply; (b) the inability of the state sector to finance the needed expenditures on new investment and/or maintenance; (c) the need to remove subsidies to the sector in order to release resources to other pressing public expenditure needs; and (d) the desire to raise immediate revenue for the government through the sale of assets from the sector. Sector problems in energy are most likely to be felt in terms of non-delivery of the product. Power blackouts and brownouts (*apagones*) are the most dramatic instance of this, with their very high costs of alternative supply for those who have come to count on the public supply of electricity. Quality of service, which takes many forms, also can deteriorate and impact users adversely. The failure of supply may be partly associated with very low operating efficiency caused by lack of maintenance, theft, etc., and partly associated with lack of investment caused by financial restrictions. The inability of a state enterprise (and eventually government) to finance new and needed investment is often compounded by poor public sector price or tariff setting, which does not allow the state to recoup all of its costs, as well as by inefficiency in collecting all revenue due it. Hence, a strong hypotheses is that policy reform is more likely where there are obvious problems of shortage of supply, such as blackouts, and less likely where there is excess capacity, making financing investment less likely.<sup>6</sup>

### **The Proper Role of Technology and Research**

There is a large and growing technological gulf between the major industrial and developing states. Any state energy development program should have as one of its primary objectives the development of individuals possessing core scientific competencies. This enables states to access new and advanced technologies capable of providing the developing state the ability to effectively and efficiently exploit them as a part the overall development project. The investment in human capital then ensures the ability of the state to evaluate the best means for achieving sustainable development. Unfortunately, for most states this is not a task that can be taken in isolation. The international community must understand the implications of this “technological divide.” Not only is the technological potential for development squandered, the failure to more widely disseminate technological innovations and methodologies

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6. This is especially important in when state electricity firms engage in energy development through turn-key projects. States lacking the personnel trained in all aspects of operational safety, management, repair and maintenance quickly realize lost value and efficiency in their investment.

has profound implications for planning, evaluation research and public administration when such large infrastructural projects are put into place.

### **Increasing Access to Energy**

At the beginning to the 21st century, the access to electricity in the Americas varies greatly from 35 percent coverage in Haiti to 98 percent coverage in Barbados. Resources for the transmission and delivery of electricity (and the lack of them) and geography also play large role in development of national electrical grids. Moreover, in the face of such constraints, policy-makers may favor interests whose linkages to, and demands upon, state power are meaningful. In some settings this contributes to what can be termed the “Bel-India” syndrome. That is, the wildly uneven development resulting in pockets of development, on one hand, that rival the posh urban settings in a developed state like Belgium, and on the other hand, the squalor and misery associated with the most egregious forms of abject poverty and penury like that found in parts of India. In reference to the opening quotation of this chapter, energy, while not a basic need, is indeed critical to the fulfillment of those needs. The access to energy is at the core of our understanding of equity, justice and the quest for material well-being in the modern world.

### **Sustainable Transportation**

The major urban centers of the world are increasingly mired in gridlocked traffic and choking in dangerous levels of air pollution. The principle of sustainable transportation calls upon all states to begin addressing these challenges by looking to increased the capacity of infrastructure to deal more effectively with the movement of populations in and out of major urban centers. This also implies: (a) the more efficient consumption of petroleum products for public, private and state transportation; (b) the promotion of for efficient fuel consumption standards; and (c) the promotion and development of efficient mass transit systems.<sup>7</sup>

### **Environmental, Health and Safety Concerns**

This criterion is the most obvious and perhaps the most easily evaluated because it relies on formal responses by states to address these concerns. The extent to which states: (a) provide adequate regulation and legislation for public and environmental concerns; (b) creates responsive bureaucracies (both administrative and technical) that place into force these regulations; (c) provides a legal framework for the adjudication of violations, and (d) provides sufficient resources to the responsible government agencies, determines

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7. This is especially important in when state electricity firms engage in energy development through turn-key projects. States lacking the personnel trained in all aspects of operational safety, management, repair and maintenance quickly realize lost value and efficiency in their investment.

the effectiveness of state responses to this critical component of sustainability.

TABLE 2-1. Criteria for Sustainable Energy Development

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<b>Criteria</b>
Energy security
Improving energy efficiency
Greater use of renewable energy
Making markets function
The proper role of technology and research
Sustainable transportation
Environmental health and safety concerns

Source: OLADE, 2004

All told, these principles are not efforts easily undertaken or financed by developing states. But they do reflect the guiding heuristic that states must assume if they are to successfully address the need for and implementation of sustainable energy policy. Obviously, this is not done in isolation as it reflects a posture that must be assumed if such endeavors are to be even remotely successful. It is not to cast aspersions or doubts at developing states or emerging markets, rather it is a reflection of the need for the redoubling of efforts by both the developing states and the international development community to guard against the failures of the past. Rather than being viewed as a repudiation of the prevailing neo-liberal models of economic development, sustainable energy development is the product of the integration of a wider set of imperatives that seek to expand development beyond the purely instrumental indicators of capital cost and return on investment toward a heterogeneous model that serves multiple interests in a sustaining fashion.

These ideas are critically important for three reasons: First, the extent to which energy policy initiatives can be deemed sustainable will be highly determinate of the ability of policy measures to meet both the existing and future energy demands on the island under any scenario; Second, the sustainability of Cuban energy initiatives must necessarily take into consideration the external political and economic environment including U.S.–Cuban relations and global energy markets; and third, the sustainability must include the extent to which energy policy is adaptable to the evolving natural resource environment, inasmuch as all states' must take into consideration the impact of diminishing global stocks of fossil fuels, changing weather systems, etc. (Kunstler, 2006)<sup>8</sup>

It suffices to say that in the post-Cold War era that energy has been and remains the Achilles heel of the Cuban economy although to a much lesser extent than it was in 1992. The loss of Soviet subsidies and the resulting energy catastrophe of the early 1990s, the effort to develop a nuclear energy capability, and the recurring crisis due to an ageing energy complex highlight the tenuous nature of Cuban energy. The recent discovery of oil reserves off the north coast of the island provides yet another arena of inquiry that perhaps offers Cuban energy policy-makers with a buffer against the vagaries of world oil markets, but of that there is no guarantee. Cuba is confronted with a mounting bill for the modernization of the energy complex and a legitimate question that arises is, who will ultimately bear that cost, as it may total into the hundreds of billions of dollars?

This analysis is based on field work conducted in Havana over the course of the past three years and a series of primary interviews and discussions of these matters with Cuban senior government officials, and representatives of national and foreign firms presently engaged in any number of energy related activities on the island. Especially critical to the analysis is the presentation of information recently collected at the U.S.–Cuba Energy Summit in February, 2006, in Mexico City that included discussions with American oil industry representatives, and extended interviews with Cuban President Fidel Castro and high level Cuban energy policy makers in February and March 2006.<sup>9</sup> This includes discussions related to the following issue areas: oil exploration and production in Cuba; the status of Cuba’s energy infrastructure; international cooperation in Cuba’s energy sector; the development of alternative energy projects; and the plausibility of various future energy scenarios in Cuba. As such this discussion will serve as the basis of the evaluation of the sustainability Cuban energy policy objectives.

The analysis concludes with an argument that Cuba’s energy future will largely be determined by the extent to which American resources are open and accessible to Cuba in its effort to renovate and restore the integrity of the island’s energy infrastructure. It will also offer a series of policy recommendations for both Cuban energy officials and American policy makers and businesses that could possibly serve as a template for ensuring that the results of bilateral, regional and international cooperation produces a lasting and sustainable future for energy development for Cuba. This includes recom-

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8. Kuntsler argues that as we have already begun to experience a “long emergency” in terms of a changing energy reality, states’ should radically change consumption patterns rather than proceed with a “business-as-usual” mentality toward the manner in which we organize of collective lives in terms of energy consumption patterns.

9. The author was part of an American delegation that visited Cuba from March 2-5, 2006 to discuss collective energy security issues. Included in that visit were meetings, site visits and interviews with officials from: Cupet, the Cuban state oil enterprise; Union Electrica, the Cuban state electrical utility enterprise; the Cuban Ministry of Basic Industry; and members of the Cuban Council of State including President Fidel Castro.

mentations for substantive political, economic and environmental considerations as they pertain to energy development prospects.

The analysis frames the discussion of the abovementioned issues area within the context of pathways to renewal of Cuba's energy sector, long-term energy development, and reintegration of Cuban energy prospects within the context of regional energy security interests.

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### *The Context for Renewal and Revolution in Cuba's Energy Sector*

A brief history of the Cuban energy sector in period since the collapse of the Soviet bloc and the loss of economic subsidies to the Cuban state can be marked by the devastation, recovery, renewal and revolution within the energy sector. One can hardly imagine the toll that losing more than half of the nation's oil imports would have on the American economy but this is indeed what transpired in Cuba in the period between 1991 and 1993. The well-documented collapse of the Cuban economy compelled the Castro regime to put into place strict measures aimed at easing the collapse of the Cuban society. In part this is the success of the "Special Period in A Time of Peace." Because Cuba had lost its preferential trade relations the Soviet Union, whereas Cuba would receive 13 million tons of oil annually at below world oil prices and the Soviet Bloc nations would agree to purchase Cuban sugar at above world market prices. Cuban annual demand was between 11 and 11.5 millions tons of oil, and it was free to sell the excess on the open market in order to earn much needed hard currency. (Benjamin-Alvarado and Belkin, 1994)

The impact of the loss of Soviet oil was crushing. As a result, Cuba's economy collapsed by over 35 percent in a two year period, and its industrial capacity reduced by over half. All aspects of Cuban life were impacted by the devastation to the energy sector from the almost complete disappearance of gasoline for public and private use, significant periods of blackouts and brownouts. These were literally the "dark days" of the Special Period where economic and social lives were brought to a standstill and the prospects of recovery were indeed grim. At the same time, Cuba was trying to keep its nuclear energy development program alive. Beginning in 1982, Cuba and the Soviet Union had been working together to construct two 440 mw VVER model, light-water reactors at Juragua in Cienfuegos province. Completing the project would have certainly solved the energy dilemma and the idea was originally hatched in the 1970s as a means of addressing Cuba's dependency on oil imports. Over the course of the next decade, the Chernobyl accident, the Soviet Union's lack of experience in building a plant in the tropics, con-

struction delays and project re-designs, and the collapsing capacity of the Soviet Union had brought the entire venture to a halt by 1992 when it was only partially constructed and in need of perhaps US\$1 billion dollars to complete. Cuba would spend the next few years attempting to secure the funding to complete the reactors. This issue was compounded by growing concerns over the safety of the reactors should they become operational. By the end of the decade, Cuba would officially abandon the project, but quietly it had looked in another direction to address its long-term energy concerns. (Benjamin-Alvarado, 1998)

### **Recovery through Domestic Means – Increasing Oil Production**

Cuba had long been aware of the existence of oil reserves in the Matanzas-Varadero region on the north coast of the island. Indeed most of Cuba's oil industry was concentrated in the region. But they were also aware that the quality of the oil was heavy and contained high levels of sulfur. The quality of the oil was such that it had little potential for being refined into gasoline or any other high quality petroleum by-product. But the Cubans found that it could be used in the nation's network of thermoelectric power generation plants to produce electricity. Over the course of the next 10 years Cuba increased the production of its crudo nacional and dedicated almost all of it to the production of electricity by burning it in the national network of thermo-electric generation facilities. Cuba now produces in excess of 95 percent of all of its electricity using Cuban oil. This has allowed Cuba concentrate its search for external sources to be focused on refined petroleum products for industrial, commercial and domestic uses. Under that scenario Cuba still must import nearly 50 percent the oil that it consumes on an annual basis and this would necessitate that Cuba dedicate nearly half of its export earnings annually to meet that demand for oil imports. But since 2000 Cuba has had the benefit of receiving significant oil imports from Venezuela (nearly 85,000 barrels per day) in an exchange reminiscent to the preferential arrangements that it enjoyed during the Cold War with the former Soviet Union. Cuba has exported (as it were) nearly 30,000 medical personnel to the Chavez regime in Venezuela to provide basic preventive medical care to the poor of that oil rich country in exchange for oil imports. This may explain why the Cuban economic indicators have remained relatively robust in a time of downturns in tourism since the 9/11 disaster (4.2 percent increase in GDP in 2005 with a projected growth of 4.3 percent in 2006) (Morris, 2005) and why it has been able to expand the social welfare safety net on the island, by increasing salaries and distributing household appliances across the entire island as a part of its energy conservation program. These efforts have prompted significant "chatter" on the Cuban street that Cuba will soon be an oil rich country due to

the oil discoveries and the rising number of joint venture projects with a growing number of international oil exploration and production firms.

TABLE 2-2. Energy and Electricity Use

	1970	1975	1980	1985	1990	1995	2000	2002
Final energy use, Mtoe	10.30	9.96	11.51	11.78	13.89	7.51	8.25	8.16
Share of sectors, %								
Industry	76	66.8	66.6	67.2	70.9	73.3	66.7	64.1
Transport	6.6	9.1	10.3	11.3	9	8.8	8.4	9.3
Services	10.2	14.7	13.4	10.5	11.2	7.4	13.7	14
Household	7.2	9.4	9.7	11	8.9	10.6	11.2	12.6
Electricity use, GWh	3.983	5.517	8.574	9.924	11.950	9.133	9.794	10.482
Generation matrix, %								
Fossil	80.13	87.57	89.48	90.28	89.75	93.87	92.52	93.34
Renewable	19.87	12.43	10.52	9.72	10.25	6.13	7.48	6.66

Sources: CEE (1986, 1990); ONE (1998-2003)

Table 2 reveals that while Cuba increased its total GW/h of electricity production by over 14 percent in the period from 1995 until 2002, the amount of electricity generated using fossil fuels remained constant at around 93 percent annually. (Perez, et al, 2005) Hidden in those figures is the amount of Cuban oil that is used for the production of electricity. This amount has increased steadily from 10 percent in 1990 to the 95 percent figure consistently presented by Cuban energy officials.<sup>10</sup> Cuba presently produces around 75,000 barrels per day of a total daily demand of 170,000 barrels. (Piñon Cervera, 2006)

### **Cuba's Joint Venture Success – Energas, Sherritt and the Environment**

In 1997, Cuba launched an ambitious Energas joint venture project with the Canadian energy and mining firm Sherritt Ltd. to convert flared gas from its Matanzas-Varadero oil fields into fuel through a combined cycle process. (Benjamin-Alvarado, 2000: 97-98) The project would allow Cuba to make use of the gas for low yield generation facilities in Boca de Jaruco and Varadero on 15MW and 30MW respectively. The project was financed by an initial public offering (IPO) in Canada by Sherritt and construction was

10. This is information presented by Cuban energy officials at professional conferences and private meetings in February and March 2006 in Mexico City and Havana.

completed in 2004. The process entailed the removal of the sulfur from the heavy crude from the region, and utilizing the gas to fuel turbines. Environmentally, this process is much cleaner and allowed the Cubans to capture emissions and particulates that were previously being discharged into the environment. This is especially critical as the Matanzas-Varadero oil fields are contiguous to Cuba's major tourist destination, the beaches of Varadero, located some 90 miles east of La Habana. Ironically, there are no tell-tale signs of the existence of the oil production in this region to the tourist crowds owing to two factors. First, most of the offshore fields are accessed by slant and horizontal drilling techniques behind and out of sight of the Varadero peninsula, and the thermo-electric generation stations are relatively distant from the tourist zone.

FIGURE 2-1. Oil Facilities in Cuba



Source: CUPET, 2006

The Energas facilities are small-scale showcase of the Cuban energy sector exemplifying the application of ecologically-friendly processes for the production of electricity to the national grid in a partnership with a foreign firm that has been successful in creatively utilizing the existing oil reserves in a manner that promotes efficiency and was by all indications, provided a sound return on investment for the joint venture.

But why has Sherritt succeeded when the perception on the part of many American observers has been that Cubans are difficult and mercurial part-

ners? Sherritt Oil is a medium sized firm with medium sized aspirations that simultaneously seeks to produce a reasonable return on investment for its ventures in Cuba while operating a humanistic commercial enterprise that is working within a country in dire need of reliable energy sources that operates under the strictures of a command economy. (Hatt, 2005)

This perhaps explains why Sherritt has been successful where others failed. The terms of “doing business” in Cuba are often too severe for conventional profit-seeking firms, but in this case, Sherritt appears to have altered its basis for success to coordinate its objectives with those available under the prevailing Cuban joint venture model. The Spanish oil firm, Repsol spent \$53 million in oil and gas exploration in 2004 and came up with nothing and yet has contracted to continue exploration of 8 offshore tracts on the northwest coast of Cuba.<sup>11</sup>

It is also interesting that all, of the firms operating in Cuba at the present time are operating with dated technology and must be able to service all of its own exploration operations. This owes in part to the fact that American oil engineering represents the leading edge of oil exploration technology and explicit in all of its foreign sales are export control stipulations that none of that technology can be sold or transferred to a short but well known list of countries: Iraq; North Korea; until recently Libya; and of course, Cuba. This prescription adds up to 30 percent to the operating costs that what is still for Sherritt, and other joint venture partners, a profit making venture. Sherritt must also account for being largely responsible for providing all engineering support services as Cuba provides few of these services owing to the technology denial on the part of the U.S.

On this point, the U.S. embargo has been successful in relegating Cuba’s energy development schemes to a less than world class status. Moreover, it appears to have had a residual effect – as not to appear to be suffering from a technology gap, Cuba pursues upstream investment, such as the purchase of three drilling rigs from the Chinese for symbolic as well as practical reasons.<sup>12</sup> Legitimately, given the existing resources on the island and interest from oil and gas exploration firms from Europe, Latin America and Canada,

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11. One could argue that like many oil exploration firms, Repsol subjected itself to “gambler’s ruin” by placing all of its chips on a single bet -making the enormous oil find in Cuba. From all estimates, there is oil in Cuba but not readily present and of the scope necessary for firms like Repsol, Petrobras, Total SA or ExxonMobil for that matter to justify in the already risky business of oil and gas exploration. For an excellent review of the joint venture project, see Eloise Linger, “Joint Ventures: New Developments in Cuban Mining and Oil Exploration,” paper presented at the National Summit on Cuba, June 10, 2005, Mobile, Alabama.

12. Cuba Petroleo (CUPET) signed a \$40 million dollar contract for drilling rigs with China’s SINOPEC Group – a state-run oil firm to conduct drilling operations in Santa Cruz de Norte, some 33 miles east of Havana. EFE, Prensa Latina, 1/31/05 and Reuters, 6/4/05).

and especially because of Cuba's cozy relationship with oil-rich Venezuela it is perhaps a questionable investment. American oil industry experts suggest that a small country like Cuba could derive a greater benefit from investment in oil infrastructure such as pipelines, terminals, batteries, etc. These are the types of services essential to oil production and serve as revenue generating sources long after the reverie of an oil find. In an inherently risk driven industry it makes better sense for a small, relatively resource-constrained state to pursue this course of energy investment.

FIGURE 2-2. North Cuban Heavy Oil Belt



Source: CUPET, 2006

Another example of the Cuban effort to address *la problemática energética* is the creation of remote diesel fueled generation sub-stations in Pinar del Rio province. (Perez de Prado, 2006; de la O, 2006) In the past 16 years, Cuba has suffered direct hits from hurricanes in the Caribbean. While there has been almost no loss of human lives from these natural disasters, the impact on the national electrical grid of the country has been devastating. This owes to the fact that the electrical grid extends the length of the island, traversing it east to west. Almost all of the hurricanes pass over the island in a south-north direction essentially slicing the island in half, destroying everything in its path, and in this case, the towers support the high-tension electrical wires of the national grid.

After the storms' passing, these towers often resemble the set of monster movie where the path of the beast has rendered a swath of flattened and twisted metal in its wake. This was most critically evident in 2004 in the path of Hurricane Charley. The path of Charley cut across the island over Pinar del Rio province on August 12th (Fidel Castro's birthday) with winds in excess of 145 mph, cutting the national electrical grid in half and leaving the entire province of nearly a quarter of a million inhabitants without electricity for the next 14 days. The Cuban electrical utility, Union Electrica and the Cuban Ministry of Basic Industry subsequently designed and implemented a project that would address the nature of energy supply disruptions to the grid from natural disasters and allow for additional electricity to be generated during peak demand periods.

Most importantly, this would enable the officials of Union Electrica to deal with an increase in the number of, and the strength of hurricanes and tropical storms in the region.

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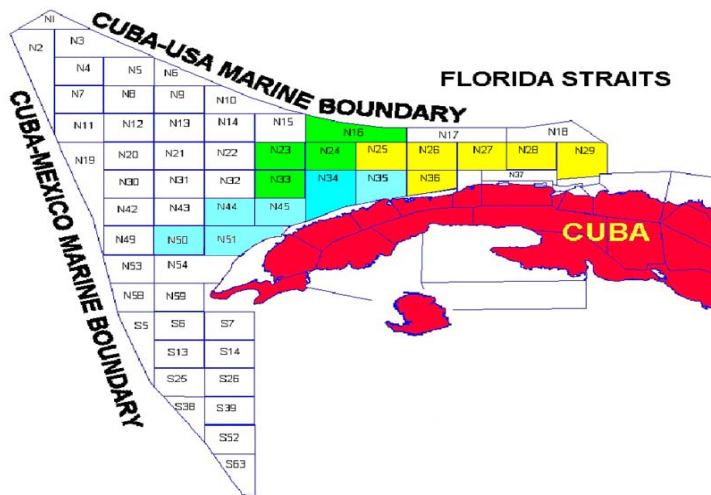
### *Buscando Oro Negro: The Reality of a Cuban Oil Bonanza*

In December 2004, the Cuban regime of Fidel Castro announced that it had discovered a significant oil reserve off the northwest coast of the island. More importantly, the potential of the oil finds could dramatically decrease the island's dependence on imported oil and could serve as boon to the Cuban economy. There has been much conjecture of the size and scope of oil reserves in the 59 offshore tracts in Cuban exclusive economic zone (EEZ). The working estimates are that there is the potential for 120 thousand barrels of oil per day, perhaps more, but the sea floor is over a mile deep and the oil reserves perhaps an additional 3,000 feet beneath the sea floor. This lies within the capacity of the existing oil drilling technology, but as previously explained, the task of extracting the oil will have to be undertaken using second- or third-generation technology because of U.S. export control regulations against trading with Cuba. The challenge for Cuban oil development policy makers is to simultaneously pursue frontier exploration in the Gulf of Mexico, while continuing to produce from the existing mature oil reserves with higher levels of efficiency and environmental integrity. Add to this challenge the additional question of securing the appropriate technology for the task.

The shaded blocks in Figure 3 indicate the 16 blocks under contract with various oil companies. Six blocks are under contract to Repsol-YSP from Spain,<sup>13</sup> four blocks with Sherritt from Canada, six blocks are presently under negotiation, and the remaining 43 are presently open. According to Cuban

energy officials, the objectives for 2006 are to increase the drilling of wells by over 50 percent, to carry out a seismic campaign to collect more data for the available tracts, to increase the domestic production of oil and gas (presently 85,000 barrels/day, and to put more drilling rigs into operation.

FIGURE 2-3. Cuba's Exclusive Economic Zone for Oil Exploration



Source: CUPET, 2006

Since the announcement of the discovery of oil reserves off the northwest coast, discussions with American oil industry representatives strongly suggest that there is credibility to the claims being made.

### *The Long-term Energy Development Prospects and the New “Cuban Energy Revolution”*

Cuba's present electricity market has 3.18 million customers. Its annual generation is 11.30 million giga-watt/hours (GW/h) with an average peak hourly demand of 2,199 megawatts. The structure of electricity consumption is 45 percent residential, and 55 percent non-residential (commercial, service and

13. Spanish oil-prospecting company Repsol YPF resumed subsurface sounding in Cuban waters, following a failed attempt last year. With a new joint-venture deal that entitles it to 40 percent of all revenues and puts it at the helm of the drilling rig, the company is planning to pick up where it left off. Other shareholders in the joint-venture will be Chinese state-owned CNOOC, with a 30 percent stake, and Norwegian Norsk Hydro, with the remaining 30 percent. (*Notimex*, 3/6/05)

state enterprises). Rather than concentrating the focus on energy development on increasing oil production and hence the production of electricity, Cuban energy officials have decided to take a revolutionary course towards addressing its energy demands—that is to eliminate waste in the production, transmission and delivery of electricity, while simultaneously improving conservation and reducing waste on the consumption end. Unlike open societies where consumers are free to consume to their hearts content and producers are free to pass the costs of waste onto consumers, the Cuban energy revolution seeks to minimize and hopefully eliminate these losses and concentrate on the energy savings as a source of the production of what have been termed “nega-watts.” Nega-watts are the idea that energy savings can be viewed as the production of new sources of energy through conservation measures, including the introduction of high energy efficiency household appliances, the application of a graduated fee/fine structure in the domestic sector, the rehabilitation of the national transmission and delivery system, and a concerted effort to minimize losses at the production inputs of energy generation.

The essential aim of the “Cuban Energy Revolution” is to create a new energy saving culture in the Cuban society.<sup>14</sup> This effort is coordinated through the Programa de Ahorros de Energia Cubana (PAEC), a program first implemented in 1997 to promote the following measures:

The promotion of energy efficiency in the commercial, industrial and residential sectors through an aggressive program of public information through all instruments of the state media, schools and community organizations;

The distribution of efficient household appliances, this has commenced in Pinar del Rio province and will extend across the entire island;

Increase efficiency in the production, transmission and delivery of electricity, including the process of rehabilitation of networks has begun in order to reduce loss in distribution and low voltage levels the production of distribution transformers will be triplicated, and new brigades of linesmen are being formed in the whole country. (de la O, 2006)

In addition, in recent years Cuba has developed an increasing capacity to extract significant quantities of gas that are generated with the petroleum production. The associated gas equivalence used has been about one MM tons/year. Cuban energy officials are seeking to continue this practice and potentially increase the usage of associated gas in energy generation. They plan on installing two new gas turbines and with a second combined cycle facility developed by ENER GAS, an additional 90 MW will be available in the near future. The thermo-electrical plant in Boca de Jaruco (east of Havana) is

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14. This policy objective was formally unveiled during Fidel Castro’s speech commemorating the Moncada Barracks attack on July 26, 2005. It has been an important part of most policy speeches related to energy in the time since, and it now referred to as the “Energy Revolution.”

ready for simultaneous burning of associated gas and crude oil. Cuba energy officials will augment the national electrical generation capacity with the installation of batteries for energy generation plants, synchronized to the National Electric System (SEN), for generation in rural sub-stations, and the installation of independent energy generation plants in key places of economy and services. (Leon Gomez, 2006; de la O, 2006)

FIGURE 2-4. Cuba's Proven Oil Reserves



Source: CUPET, 2006

The development of new and renovated thermo-electric generation capacity is being conducted in alternative energy resources domestically and in conjunction with projects with foreign universities, governments and inter-governmental organizations such as the United Nations Development Programme (UNDP) which is presently coordinating a project on the Isla de la Juventud with Cuba's *Centro de la Gerencia de Proyectos Priorizados* of the Ministry of Science, Technology and the Environment (CITMA) to develop a pilot project employing wind, solar and biomass produced energy in isolated island settings. Cuba's role is significant in the design and implementation and may provide for small-scale alternative energy production in similarly isolated locations across the island. (Curbelo Alonso, 2005)

One should also bear in mind that Cuba still possesses a large and well-articulated capacity in nuclear technology owing to its 15-year effort to develop a nuclear energy capability at the end of the Soviet era. There are large number of nuclear scientists and technicians who were dedicated to the effort and it allowed Cuba to design and develop and significant educational capacity from pre-university through post-graduate programs of study in nuclear engineering, physics and medicine. In the coming decades and as petroleum stocks diminish, Cuba may re-visit the nuclear option for energy production and could utilize this option as a means of addressing energy

demands. Cuba continues to cooperate with international and regional entities on matters related to the peaceful uses of nuclear energy and perhaps could emerge as a Latin American leader in global nonproliferation efforts.

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### *Reintegration of the Cuban Energy Sector and Development Prospects*

#### **The Sheraton Mexico City Debacle**

The convening of the U.S.–Cuba Energy Summit in Mexico City in February, 2006 marked a watershed of sorts for the Cuban energy sector. Dating back to the early 1990s and echoing back to before the Cuban revolution, the most logical choice for Cuban energy production partners has been American firms. Consistently, through the Special Period, in discussions related to rescuing the nuclear option and now in the wake of the oil finds off the northwest coast, Cuban officials have stated that because la tecnología de pico (cutting edge technology) can be found in the United States, and because of proximity and cost efficiencies, it makes the most sense for Cubans to seek American partnerships in meeting its energy development objectives. So for observers of the campo energético the extent to which American oil company representatives would find Cuba's presentation of its oil and gas development plans credible would go along way to achieving that particular objective. The fact that a number of major American firms were represented and came away stating that there is significant interest in discussing options for investment created a sense of excitement of what might transpire in the near term. The decision of the Sheraton Maria Isabel to expel the Cuban delegation from the hotel, notwithstanding, did not dampen the enthusiasm for what to most appeared to be a logical and mutually beneficial relationship for the two nations. What the Mexico City meeting revealed is that the Cuban and American oil and gas interests are aligned to pursue a path where technology transfer, investment and production projects and cooperation can become a reality. The fact that no less than 20 firms from eight countries are already an indication that the Cuban energy sector is already "reintegrated" into the global market, and that the United States is not already a partner perhaps spells an exclusion from the process of revitalization that merely slows the progress already being made in this critical sector.

#### **The American solution**

Regardless of the American foreign policy vis-à-vis the Castro regime, the United States will play an important role in the sustainability of Cuban energy policy imperatives well into the 21st century for three critical reasons. First, the United States, and its business community will bear most of the cost

for investment and development in Cuba after transition. Because the U.S. presently holds the outstanding claims against the Cuban government for expropriated properties, the resolution of these claims assume a priority in the process of normalization of diplomatic and economic relations between the two countries. It should also be noted that because of the influential role and owing to the contributions the U.S. makes to multilateral lending institutions the brunt of the financing for the renovation of Cuba's aged energy infrastructure will fall these agencies, U.S. government agencies through grants and assistance, and through direct foreign investment by U.S. firms. That fact alone requires that it is incumbent upon the U.S. at this time to calculate a "best-guess" estimate of what the bill for this project will cost. One can easily surmise that the cost of this effort will total in the billions of dollars, but it is important to note that the more that the work is put-off or delayed, insinuates a higher cost of renovation down the road. Second, because of proximity and affinity, the Cubans have always expressed a preference for utilizing leading-edge American technology and working with Americans. Virtually all of Cuba's engineering and scientific community speaks, reads and write English owing to the fact that all technical and scientific journals and textbooks are almost exclusively in English. Moreover, in the few instances where Cubans and Americans have had the opportunity to interact and discuss the possibility of cooperation and collaboration, Americans have left impressed and given serious thought to what types of projects and joint ventures might develop if the diplomatic relations between the two countries were normal. It is taken as an article of faith by most Cuba observers, that every major corporation in the United States has in its files a "Cuba" folder waiting for the day when they will be allowed to conduct business on the island. Finally, there have been interesting proposals that see Cuba as a potential entrepot for American petroleum interests. (Myers Jaffe and Soligo, 2006) This includes the development of oil storage and refining facilities to offset the concentration of this type of facility in the Gulf Coast of the Southern United States, as a hedge against what appears to be a long-term shift in Caribbean weather patterns, promising a spike in the number of tropical storms and hurricanes for the near future. Ironically, in the wake of Hurricanes Rita and Katrina there is a call to increase the number and to diversify the location of American oil refineries away from the Gulf Coast region insofar that 25 percent of the refining capacity for the United States is still offline nearly a year later at the beginning of the new hurricane season. This could alter the strategic view of Cuba for American policy makers, but under the present set of circumstances and with the prevailing policy prerogatives of the Bush Administration, Cuba for all of the well-documented reasons will remain isolated and beyond the reach of U.S. business interests.

## The Cuban solution

*“We are not going to spend our nights dreaming about offshore oil”* — Fidel Castro, March 4, 2006

All indications from the series of interviews and site visits in Cuba indicate that Cuba fully intends to seek the means of developing oil and gas resources wherever they exist on the island and with whoever chooses to partner with the Cuban government. That much is very clear. But the statement by President Castro also insinuates that the present and existing energy resources and issues will guide Cuba’s responses to energy development issues. Those responses include a vigorous program of energy conservation from the power plant to the kitchen seeking to extract energy savings and economies of scale that credibly meet policy objectives, while simultaneously boosting domestic oil production and increasing efficiency in the production, transmission and delivery of electricity across the island.

Moreover, the efforts on the island to enhance energy efficiency along the entire chain of production to consumption compliments the possible gains derived from increasing Cuba’s domestic production capacity through oil exploration in the deep water tracks off the northwest coast of the island. That Cuba can still import its shortfall in domestic production of refined petroleum products through its favorable trade arrangements with Venezuela gives Cuba the type of energy security cushion it enjoyed during the latter Soviet period. And similar to that period Cuba has chosen to aggressively pursue energy independence by virtue of its recent offshore discoveries and by promoting a revolution in the end uses of energy in all sectors of the Cuban economy.

Events in the past few months within the Cuban energy policy arena indicate that the possibility of increasing the island’s energy productive capacity is well within reach of the Castro regime. What is perhaps most evident is the growing presence of international partners that will be instrumental in assisting Cuba to push the effort forward. Canada, China and Venezuela are all playing critical roles in the drive to increase domestic productive capacity as well as assisting the Cuban effort to put into place remarkably creative and important technological developments to meet the many challenges facing Cuban policy makers. Moreover, it is also abundantly evident that the “Cuban energy revolution” as a policy development, while not entirely new, places Cuba at the forefront of implementing a concerted energy conservation program that is unique among developing states and responds to the challenges that all states are now facing in the wake of rising oil prices.

But an equally significant energy challenge is going unmet at this particular time in Cuba, that of an effort to address a complete modernization of the

energy infrastructure on the island, an infrastructure that ranges in age from 30 to 80 years and is in dire need of repair, maintenance and replacement. Cuba has announced that it is investing in the rehabilitation of transmission and delivery systems in an attempt to curb the significant losses of electricity generated and one can be relatively certain that the effort corresponds to a task to which Cuban policy makers are determined to complete. But it suffices to say that the cost of such an all-encompassing task perhaps lies beyond the financial capacity of the Cuban government, and the negative influence of the American economic sanctions against the island chills the investment environment in the country's energy sector. It is not that progress isn't being made. And by almost any measure, the Cuban joint venture approach to energy development has been successful but not at the level that meets the totality of the challenge. We can only estimate that the cost of modernizing the energy sector on the island totals into the billions of dollars, and the millions now being dedicated to the task only partially addresses the myriad projects that could be undertaken. For now the piecemeal approach will address the most critical needs facing the Cuban energy sector but all said it only scratches the surface. Perhaps, if and when the offshore production promise becomes a reality, Cuban policy makers may once and for all be able to address this grand undertaking inasmuch as it will be the grandest and most important infrastructural project of the century.

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### *Conclusion*

In closing, the overview of the Cuban energy developments clearly and unambiguously reveals that the Castro regime has every intention of continuing to promote, design and implement energy development policies that will benefit Cuba for generations to come. Cuba is sparing no effort by instituting bottom-up and top-down policy initiatives to meet this challenge. It has significantly increased its international cooperation in the energy sector and continues to enhance its efforts to ensure energy security in these most uncertain of times. But it stands to reason that no matter how successful these efforts are, they will come up short. Two factors may alter this present situation. First, Cuba may indeed realize a bonanza from the offshore tracts that will allow it to possibly address its many energy challenges, from increasing oil production and refining capacity, to improving the nation's energy infrastructure, ensuring a stable energy future. Second, and no less significant, is the possibility of normalization of trade relations with the United States. This is important not only because it will allow direct foreign investment, technology transfer and information sharing between these neighboring states but it possibly enhances the energy security of both states, and hence, the region, realized through a division of labor and dispersion of resources that serve as a

hedge against natural disaster and market disruptions. Moreover, all states could derive benefit from the public information campaigns to promote energy efficiency and conservation presently being promoted in Cuba in the face of diminishing energy stocks and uncertain global markets. Ultimately, and only after normalization, the task still falls to the Cuban government, but the cost will necessarily be spread through a number of sources that are predominately American because of strategic interests, proximity and affinity. It suffices to say that the requisite investment and assistance will have a distinct American tinge to it, inasmuch as American corporations, U.S. government agencies, and international financial institutions, to which the U.S. is a major contributor, will play important roles in the funding of the effort to revitalize the Cuban energy sector. Cuban officials are not averse and perhaps would prefer that the U.S. be its major partner in this effort owing to the fact that most if not all of the cutting-edge technology in energy, oil and gas comes from the United States. It is remarkable that the Cuban energy sector is as vibrant as it presently is, absent the type of infrastructural investment that is available to most developing states, in large part because of the American economic embargo.

Finally, the cost is significant and it stands to reason that the longer one waits to address the challenge at hand the higher the cost of modernizing the energy sector. For this reason alone, the American role in assisting Cuba in this effort will be significant and every day that the task is put off, it increases the cost of the effort. This should serve as an obvious point of entry into cooperation with the Cuban government and perhaps can serve as a catalyst for promoting confidence, trust and cooperation in this critical issues area across the region.

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