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ENERGY IN CUBA

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Introduction

Cuba is considered a promising growth energy market in the Americas. Not only might domestic supply increase in the coming years, but rising local demand and trading opportunities could also be attractive to energy companies. However, while the country is strategically located close to US markets, the United States economic sanctions against Cuba limit for now the country's potential as both an energy supplier and growth user market.

Although there are elements of a mixed economy in Cuba, the economy remains primarily a command, planned economy where the government owns and runs the means of production. About 75% of the work force is employed by the state. The Cuban economy is still suffering from the aftermath of the collapse of the Soviet Union, which provided generous economic subsidies including cheap energy supplies. To alleviate the economic downturn that began in the early 1990s, Cuba has introduced some market-oriented reforms including opening the economy to tourism**,** decentralizing agriculture and authorizing self-employment in 150 occupations. These reforms are likely to pave the way for both increased energy use and a shift in distribution of energy use by sector. Significantly, by the mid-1990s, tourism surpassed sugar as the primary source of foreign exchange. Roughly 1.6 million tourists visited Cuba in 2000 providing over $2 billion in gross revenues.

Cuba has invited foreign private investment in a variety of industries including its energy sector. Several firms have explored for oil and gas off Cuba's coastline but with only limited success. Cuba's refining sector is also in need of investment and upgrading. Despite US sanctions, several European, Canadian and South American energy firms have investigated the possibility of making investments in Cuba's energy sector, anticipating an expanding market even without exports to nearby US markets. Were US economic sanctions to be eased, the growth potential of the Cuban energy sector would be even greater.

This paper investigates the state of Cuba's energy sector and its future trends. Attention is given to the impact that an easing of US sanctions against Cuba could have on its energy sector.

Cuba's waters could also provide a rich source of natural gas, either to fuel Cuban industry or potentially for export to Florida by pipeline. While it is hard to predict how much natural gas might be discovered in the coming years were U.S. sanctions against Cuba to be lifted, demand for the relatively clean fuel in Florida is expected to grow substantially over the next decade. Cuban natural gas supplies could save Florida at least $15 million to $30 million a year in energy costs, and possibly significantly more, as market competition fostered by the incremental Cuban supplies shaves several cents off Florida prices. The projected costs for Cuban natural gas compares favorably with more distant supplies of Liquefied Natural Gas (LNG) from the Middle East and could be equally competitive to deepwater supplies from the US Gulf of Mexico. Thus, an easing of US sanctions for the Cuban energy sector could help enhance US energy security, create a diversified energy supply for Florida and help ease an expected shortage in US local refining capacity. However, these advantages must be weighed against other US goals and domestic political considerations.

Energy Demand Trends in Cuba

Total primary Cuban energy supply (TPES), that is total energy used including process losses, rose from 10,934 thousand tons of oil equivalent in 1971 to a peak of 16,877 thousand toe in 1989 before beginning a general descent following the cut-off of Soviet aid (see Table 1). After hitting a 20 year low in 1993, total primary Cuban energy supply recovered to 12,464 thousand toe in 1999. Throughout the period in question, oil commanded the lion's share of TPES, averaging roughly 80% in 1999. Of the 9,620 thousand tonnes of oil equivalent (KTOE) of hydrocarbon resources consumed in 1999, 96.2% was in the form of petroleum and petroleum products. Natural gas accounted for 3.9%. Coal use was miniscule.

In addition to hydrocarbons, renewables and waste such as sugar cane biomass, windmills, solar and small hydro-powered generators have accounted for a substantial, although declining share of energy supply. Their share of TPES declined from 32.9% in 1971 to 22.8% in 1999.

Some 60% of total primary energy supply is imported. Production of oil has steadily increased but in 1999, 80% of petroleum and petroleum products were imported. According to the US DOE, Cuba generated 13.3 quadrillion BTUs of electricity in 1998, of which 94% came from thermal powered generators. Hydroelectric power is miniscule, accounting for less than 1%.

It should be noted that Table 1 shows *net* energy imports rather than total imports. For most years there is little difference. However, during the 1980s Cuba re-exported Soviet oil. In 1985, these exports amounted to roughly 3,500 KTOE. Exports declined to 2,700 KTOE in 1989 and then ceased in 1990.

At the end of the 1970s, Cuba began to pursue an ambitious program of building nuclear generating capacity. Construction began in 1983 on the first of two planned nuclear reactors at Juraguá in Cienfuegos province. In 1992, work was suspended with the cessation of financing from Russia. The two 440 megawatt nuclear reactors are reportedly 75% and 30% completed, respectively. The USSR had paid for most of the US$ 1.1 billion invested in the project. A further US$ 750 million is believed to be required to complete the first reactor. Subsequent to 1992, Cuba and Russia have talked about restarting construction but in 2000 they agreed to abandon the project. Each reactor when fully running would have saved Cuba around 600,000 tons of oil annually[1].

Almost all Cuban households (95%) have electricity, accounting for 36% of total electricity consumption in 1999. Approximately 100 thousand cubic meters of natural gas were also consumed by households (in Havana) in 1997[2].

The collapse of the Soviet Union and the end of Soviet aid to Cuba have had a dramatic impact on Cuba's economy in general and on its energy sector in particular. Cuban GDP fell sharply during the "special period" of transition in the early 1990s. Energy demand was curtailed to the largest extent in the sectors involving private usage such as the transportation

[1] Wetlau, p 208
[2] Werlau p 208

sector and to a lesser extent, the residential electricity sector. Transportation was the sector that could be squeezed the most with the least disruption to the rest of the economy. Energy had to be provided to the manufacturing sector where it is a critical input and to the residential and commercial sectors for every day lighting and cooking purposes. Still, electricity blackouts were common during the transition period.

Table 1: Cuban Energy Production and Imports

(KTOE)

	Domestic Production	Net Imports	TPES	Production Renewables	Renewables Share	Net Imports Share
1971	3739	7436	10934	3593	32.9%	68.0%
1972	3351	7360	10651	3207	30.1%	69.1%
1973	3563	8804	11918	3391	28.5%	73.9%
1974	3694	9307	12839	3481	27.1%	72.5%
1975	3809	9390	13119	3535	26.9%	71.6%
1976	3811	9959	13781	3524	25.6%	72.3%
1977	3931	9655	13708	3622	26.4%	70.4%
1978	4554	10349	14765	4214	28.5%	70.1%
1979	4683	10393	15126	4335	28.7%	68.7%
1980	4227	10438	14910	3896	26.1%	70.0%
1981	4534	11020	15464	4230	27.4%	71.3%
1982	4881	11395	15992	4261	26.6%	71.3%
1983	5038	11018	16115	4192	26.0%	68.4%
1984	5075	9651	14708	4309	29.3%	65.6%
1985	4890	10159	14525	4018	27.7%	69.9%
1986	5168	9804	14654	4227	28.8%	66.9%
1987	5187	10397	15377	4276	27.8%	67.6%
1988	5349	10946	15954	4613	28.9%	68.6%
1989	5893	10955	16877	5144	30.5%	64.9%
1990	6271	10198	16524	5576	33.7%	61.7%
1991	5459	8184	13530	4908	36.3%	60.5%
1992	5792	6932	12456	4901	39.3%	55.7%
1993	4636	6323	10839	3521	32.5%	58.3%
1994	4741	6591	11264	3443	30.6%	58.5%
1995	4285	7030	11149	2819	25.3%	63.1%
1996	4799	7687	12222	3324	27.2%	62.9%
1997	4613	7901	12186	3134	25.7%	64.8%
1998	4448	7669	11816	2689	22.8%	64.9%
1999	5242	7428	12464	2837	22.8%	59.6%

Note: Domestic production plus net imports do not add up to TPES because of stock changes. TPES is net of energy exports.

Source: IEA Energy Balances

Table 1 shows this effect of the collapse of the Soviet Union and end of Soviet aid on energy imports and supply. Net imports fell sharply from 13,626 KTOE in 1989 to 8,184 KTOE in 1991 – almost 40%. TPES fell only 20%, reflecting the importance of renewables and waste products in Cuban energy supply. Imports dropped a further 23% from 1991-93 while TPES decreased another 20%. TPES regained some of that loss by 1996. However, TPES in 1999 was essentially the same as it was in 1996.

Table 2 shows per capita income levels and changes in per capita income and in total final energy consumption (TFC) –that is energy use minus losses-- from 1989 to 1999[3]. An interesting aspect of the data is that there is not always a close relationship between changes in GDP and TFC. The two series generally move together but changes in TFC tend to be more abrupt as in 1991 and 1998, probably reflecting a concerted government action to curb energy use. And although GDP fell by double-digit amounts in each of the three years 1991, 1992 and 1993, TFC was initially reduced dramatically in 1991, saw only a small reduction in 1992 and then experienced another large decrease in 1993, probably indicating the effects of government interventions.

The effect of the end of Soviet aid on energy use can also be seen in Figures 1-3 which show energy consumption per thousand persons (in TOE) for three end-use sectors: residential/consumer, transport and industrial/other, plotted against per capita income measured in terms of 1995 PPP$. The data are displayed in two segments: the period of Soviet aid, 1980-1989 and the post-Soviet period 1990-1999. As the figures show, the most dramatic decline in energy use occurred in the transport sector where use declined from 313 TOE per thousand persons in 1989 to only 73 TOE in 1994. Consumption in the residential/commercial sector declined from 142 TOE to 87 TOE. Finally, consumption in the Industry/Other sector fell from 769 TOE per thousand persons in 1989 to 612 TOE in 1995.

[3] IEA per capita data are significantly higher than estimates by the CIA. For example, the CIA estimates per capita income for 2000, in year 2000 PPP dollars, at only $1700.

TABLE 2: Changes in Per Capita GDP and TFC

Year	Per Capita Income in 1995 PPP Dollars	Change in Per Capita Income	Change in Per Capita TFC
1989	$3,723	-0.4%	9.8%
1990	$3,578	-3.9%	-0.5%
1991	$3,163	-11.6%	-19.8%
1992	$2,774	-12.3%	-4.3%
1993	$2,351	-15.2%	-14.7%
1994	$2,358	0.3%	2.5%
1995	$2,405	2.0%	-2.8%
1996	$2,581	7.3%	10.5%
1997	$2,636	2.1%	-0.3%
1998	$2,653	0.7%	-6.3%
1999	$2,804	5.7%	6.7%

Source: IEA Energy Balances for Non-OECD Countries

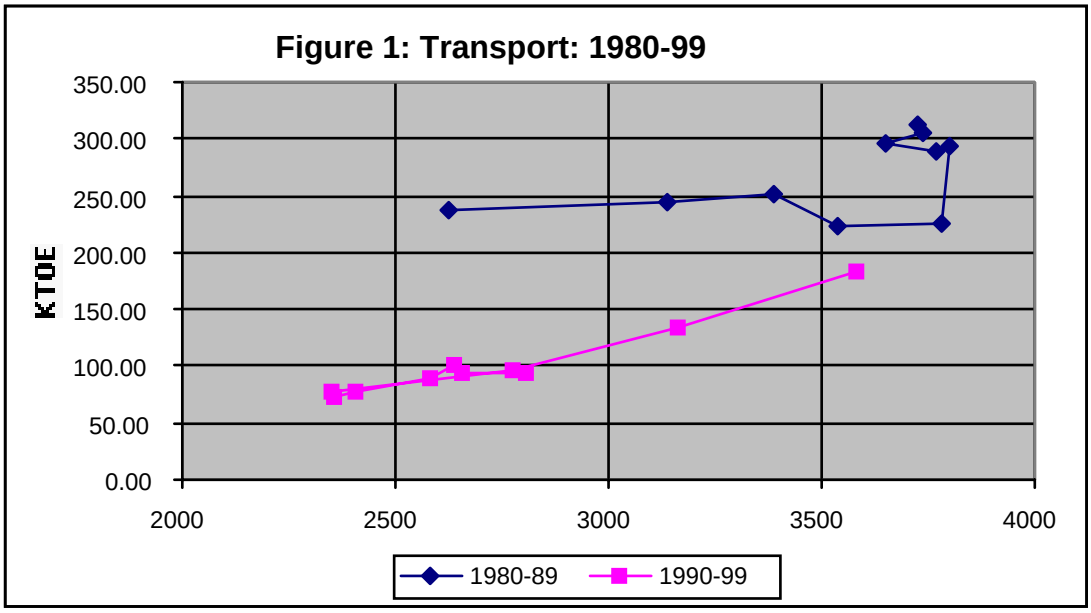


Figure 1: Transport: 1980-99
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
KTOE
2000
2500
3000
3500
4000
1980-89
1990-99

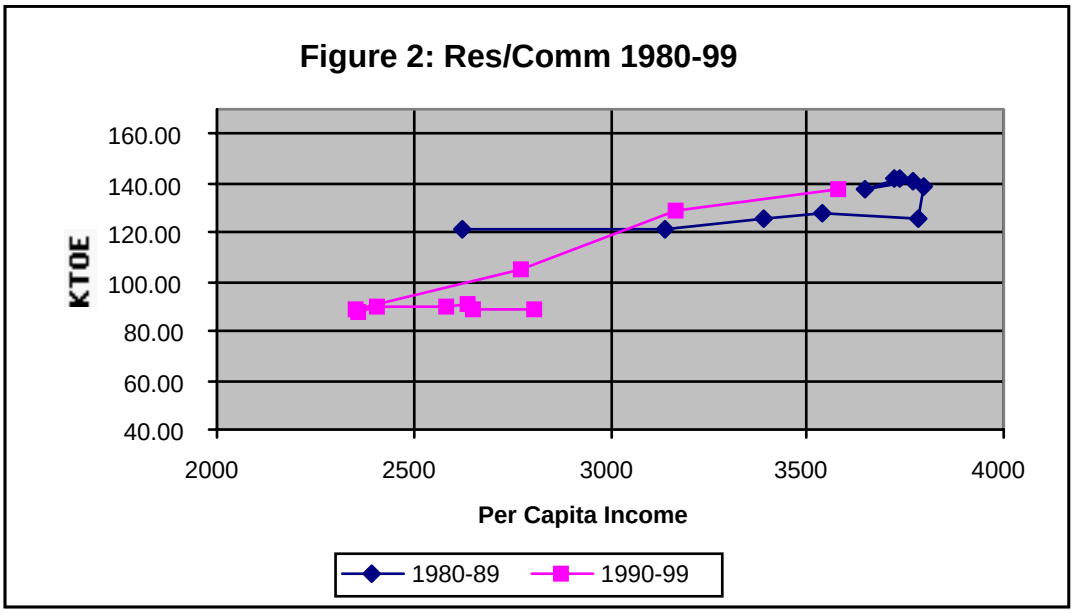
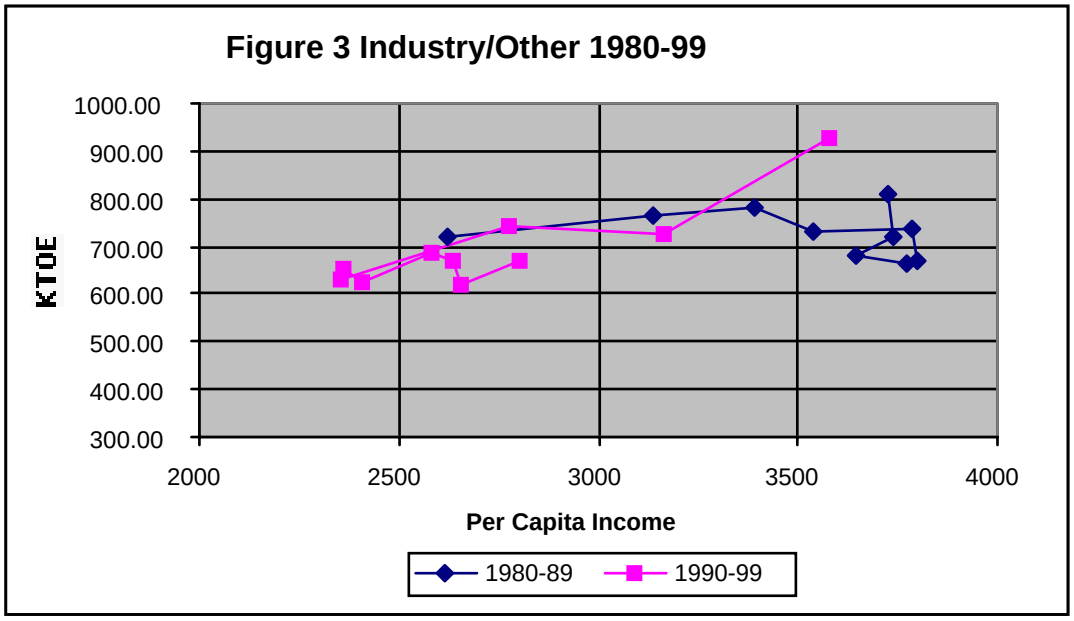


Figure 2: Res/Comm 1980-99
160.00
140.00
120.00
100.00
80.00
60.00
40.00
KTOE
2000
2500
3000
3500
4000
Per Capita Income
1980-89
1990-99



Much of the energy used in the residential sector is in the form of electricity. Consumption fell from 13 billion kilowatts (kw) in 1990 to 9 billion kw in 1993. But by 1999, electricity consumption has increased back to 12 billion kw.

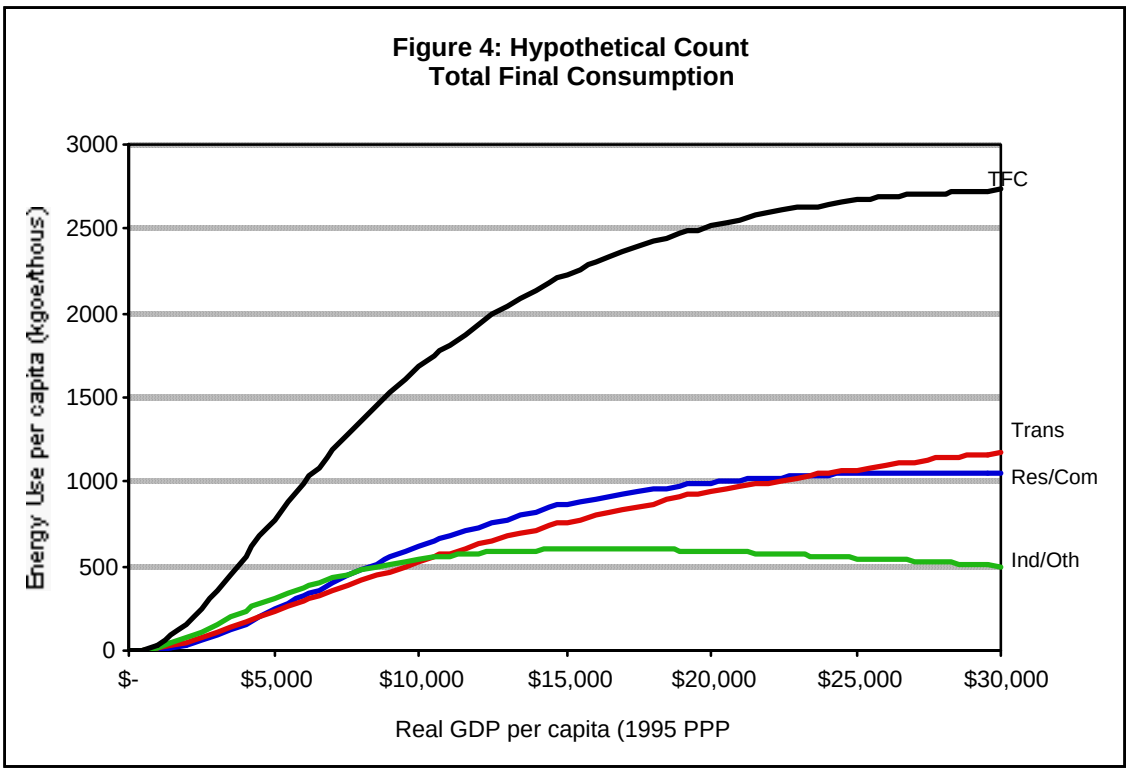
Patterns of End-Use Energy Demand

Medlock and Soligo (2001) have examined the patterns of end-use sector energy demand as a function of the level of economic development as measured by per capita GDP. Allowing for country-specific heterogeneity, the Medlock-Soligo model permits the forecasting of per capita end-use energy demand using the assumption that countries tend to follow similar patterns of economic development. Although the resulting forecast assumes the energy intensity of various countries will follow similar patterns, it ignores future technological changes that may improve energy efficiency. Hence, forecasts of future energy may tend to be biased upward.[4].

Figure 4 shows the typical pattern of end use energy demand estimated by Medlock/Soligo using data from Latin American countries plus Canada and the US. (Although

[4] Because income is highly correlated with time (in most countries), use of a time trend to account for technological change produced statistically insignificant coefficients for either the time trend or income variable.

the data are from different countries, the pattern is similar to that for a data set of non-Latin American countries). Per capita energy use (KTOE per thousand persons) is plotted against per capita income measured in 1995 PPP dollars. In the early stages of development, energy use by the industrial sector rises rapidly as countries begin to industrialize. At some stage of development, this process slows down and energy use in the industrial sector levels off. However, per capita energy use in the transport and commercial/residential sectors continues to increase, eventually overtaking consumption in the industrial sector.



In the long run, the demand for energy is inelastic with respect to changes in per capita GDP. That is, the demand for energy, per capita, rises at a slower rate than output. However, at low levels of per capita income, this elasticity is greater that unity. Countries at specific levels of per capita income will deviate from the predicted level of energy use to the extent that there are differences in climate, population density, energy taxes and other policies that affect energy prices and investments in transportation infrastructure.

Projecting Per Capita Petroleum Use: The Cuban Case

The Medlock/Soligo model has been estimated using data from market economies. Placing Cuba into this framework requires some adjustment and comparative analysis because Cuba has been and generally remains a "command" economy. As such, the level and composition of energy use has not followed the pattern of development experienced by more market-oriented economies. In particular, private motor vehicle ownership is substantially lower in Cuba than in other countries with comparable per capita incomes, reflecting the different priorities of the planning authorities and possibly, the more equal distribution of income.

As shown in Table 3, the pattern of energy use in Cuba is quite different from other countries with small economies in the Caribbean area. While these comparison countries, Costa Rica, Dominican Republic and Jamaica, have different per capita incomes they share many other characteristics, including their Latin history/culture, geographical size and dependence on tourism. The Dominican Republic has a population comparable to Cuba's and an important tourist industry. Jamaica, while smaller than Cuba, represents a country with a highly developed tourist industry that could typify a future Cuba. Costa Rica is also small but represents a country that, albeit on a smaller scale, shares Cuba's focus on human development with high literacy rates and universal health provision. Its tourist industry is smaller that that of Jamaica and features eco-tourism where per diem expenditures of tourists are lower than the resort oriented tourism of Jamaica. Eco-tourism is also less energy intensive than resort tourism. Two Central American countries, Honduras and Nicaragua, are added to the comparison. Although they share some of the same characteristics (size and culture) as the other three, they differ in that they have a lower per capita income (in PPP terms) and are less dependent on tourism.

Per capita income for Cuba in 1999 (measured in 1995 PPP dollars) is substantially below that of Costa Rica and the Dominican Republic, about 14% below that of Jamaica but roughly 25% higher than that of Honduras and Nicaragua. Despite having a much lower per capita income than Costa Rica and the Dominican Republic, per capita final energy consumption (TFC) for Cuba and Jamaica is over a third larger.

Table 3: End-Use Sector Energy Consumption for 1999
(TOE per thousand persons)

	GDP per capita	TFC	Ind/Ag/Other	Transport	Res, Com and Public
Cuba	2,904	852.66	654.05	95.01	88.48
Costa Rica	7,731	638.62	165.51	325.44	134.02
Dominican Rep.	5,354	617.56	125.54	249.88	242.15
Honduras	2,342	472.78	93.70	105.41	273.66
Jamaica	3,495	845.27	315.63	352.58	172.83
Nicaragua	2,452	438.30	79.49	99.41	252.29

Source: IEA Non-OECD Energy Balances
Note: Per Capita GDP in 1995 PPP dollars

Table 4 shows the energy intensity of our sample countries using two measures of GDP: in 1995 PPP dollars and 1995 dollars using exchange rates. Under the former definition, Cuba has the second highest energy intensity after Jamaica. The picture is changed somewhat when per capita income is converted to dollars using exchange rates.

Jamaica continues to have the highest intensity. However, Honduras and Nicaragua place second and third, reflecting the very low per capita income under this definition. Cuba, on the other hand, has an energy intensity that places it in the middle of the group. Clearly, there is no one concept of GDP that is "correct"[5]. But taking per capita TFC into account, one can conclude that Cuba does tend to have an energy intensity that places it at the upper end of this group of countries. In other words, Cuba uses more energy to produce a unit of GDP than most of the other comparable countries.

[5] The difference in the two measures of GDP are correlated with per capita income. The two measures show the greatest difference for the poorer countries.

Table 4: Energy Intensity 1999					
Country	1999 Population millions	Per Capita GDP in 1995 PPP$ (IEA)	Per Capita GDP 1999 (IEA)	TPES/GDP (toe/thousand 1995 US$ PPP)	TPES/GDP (toe/thousand 1995 US$)
Cuba	11.18	2,803	2,311	0.398	0.482
Dominican Rep.	8.40	5,357	1,918	0.166	0.463
Costa Rica	3.59	7,731	3,994	0.11	0.213
Honduras	6.32	2,342	689	0.221	0.750
Jamaica	2.60	3,492	1,689	0.456	0.942
Nicaragua	4.20	2,452	553	0.221	1.148

The breakdown of final energy consumption by end-use sector also shows unusual patterns for the composition of energy use in Cuba. The per capita TFC for Cuba in the "Industry, Agriculture and Other" end-use category is extremely high compared with other countries. There is always the possibility that the data have not been accurately reported. The IEA data is not always consistent for cross-country comparisons and different countries may define end-use sectors differently. The classification of "other, not elsewhere classified" could cover many misclassifications. Nonetheless, even if "other" is excluded, Cuba still shows up as having a much higher energy use in industry/agriculture than the other countries. These data appear to be inconsistent with data on electricity use. That data shows that the industry sector uses only about a third of the total electricity consumed while residential, commercial and the public sector consumes about 60%.

Cuba's high per capita energy use in the industrial/agricultural sector is consistent with the experience in other Centrally Planned economies. These economies had a bias towards autarkic development. An additional characteristic of centrally planned economies is very high-energy intensity, explained mainly by the fact that government-owned plants and monopolies have less incentive to lower costs by saving energy than private firms in a competitive marketplace. Without additional data, it is difficult to determine more definitively the source of the high per capita energy use in the Cuban industry sector, but it is possible that inefficient and aged equipment and non-competitive business practices have discouraged conservation.

Per capita consumption among the sample countries' transport sectors is not closely correlated with per capita income. Costa Rica, the richest country in the sample, does have the highest per capita consumption but Jamaica has a substantially higher consumption level than the Dominican Republic despite having a lower per capita income. This may reflect the importance of the tourism sector where foreign visitors have high transportation vehicle utilization. In Jamaica, for example, tourism earnings on a per capita basis, are higher relative to those in the Dominican Republic (see Table 5 below). For Cuba per capita energy consumption in transport use is especially low (below that of Honduras and Nicaragua with lower levels of per capita income), reflecting the lack of widespread private ownership of motor vehicles and the curtailment of public transport.

Data for consumption in the residential and commercial sector shows that the Dominican Republic, Honduras and Guatemala have the highest per capita consumption followed by Jamaica. Costa Rica, with the highest per capita income is second-to-last with Cuba having the lowest per capita consumption in this sector. These data may reflect the fact that both the Dominican Republic and Jamaica specialize in "resort tourism" with the large air conditioned hotels, cafes and clubs while Costa Rica focuses on 'nature tourism" where tourists are disproportionately backpackers, rafters and hikers. Despite its own large and rapidly growing tourist sector, Cuba has a fairly low level of per capita consumption in the residential/commercial sector. While Cuba also focuses on "resort tourism", the commercial sector is relatively undeveloped. Cuba is distinctive from the group because it has yet to develop a proliferation of retail shopping establishments that characterize other economies. Within the residential component of this sector, low consumption levels in Cuba also reflect lower levels of ownership in energy using consumer durables.

Forecasts of Energy Demand

Given the energy use characteristics of the Cuba economy, how do we estimate future Cuban energy consumption? Will Cuba be able to hold energy intensity relatively constant as GDP continues to grow? In our opinion, this latter possibility is unlikely. Energy consumption

has been severely repressed during the past decade. As per capita income grows, the public will demand better public, if not increasing access to private, transportation and more consumer durables. Also, as tourism, the primary engine of growth, continues to increase, demand for transportation fuels and electricity will similarly grow. Tourists will demand access to air conditioned hotels and restaurants (especially important given Cuba's climate) and rental cars or transportation by taxi.

Tourism to Cuba has been growing rapidly as appropriate infrastructure has been built. The number of hotel rooms increased from 10,000 in 1988 to over 32,000 in 1999[6]. In nominal terms, revenues from tourism have grown fromUS$243 million in 1990 to US$2 billion in 2000, an increase of over 700%.

During 1999-2000, gross income from tourism to Cuba grew by 8.1%[7] despite the restriction on travel by US citizens. In 1998, US tourists accounted for 60%[8] of all tourists to other Caribbean islands. Without the embargo, ordinary Americans would be free to travel to Cuba possibly adding an addition $1 billion to Cuban tourist earnings within a few years[9].

Table 5 compares total revenue and per capita revenue from tourism for several countries in 1998. Per capita tourist income in Cuba is fourth, behind Jamaica, Dominican Republic and Costa Rica. Given its proximity to the US and the combination of both historic and natural beauty, Cuba has great potential for future growth in this sector. So far, Cuba has focused on the type of resort tourism that has significantly large energy demands. Its natural endowment favors this emphasis (in contrast with Costa Rica). Thus, it is reasonable to expect an increase in demand for energy to fuel the hotel/resort complexes as well as transport fuel as tourists use rental cars to tour other parts of the island.

[6] Crespo and Suddaby, p353.
[7] Economic Survey of Latin America and the Caribbean, 1999-2000, ECLAC
[8] Ernest H. Preeg, Testimony Before the Subcommittee on trade, House Committee on Ways and Means, May 7,1998
[9] Preeg, op. Cit.

TABLE 5: Tourist Income (1998)		
Country	Tourism Income $ million	Per Capita Tourist Income
Cuba	1816	163.31
Dominican Rep.	2141	260.86
Costa Rica	902	255.38
Guatemala	314	27.29
Honduras	164	26.60
Jamaica	1197	453.41
Nicaragua	100	20.81

Source: Association of Caribbean States, web site: http://www.acs-aec.org/

In generating some estimates of future energy demand in Cuba, we use the Medlock/Soligo model, mindful that this model has been estimated using data from market-economies. In forecasting future energy demand for Cuba a critical assumption concerns whether or not Cuba will move towards a more market oriented economy where investment and output decisions reflect consumer preferences to a greater degree than in the past. At this point, significant reforms towards a more open, market-oriented economy do not appear to be imminent. On the other hand, it does seem reasonable to assume that the Cuban economic model will eventually evolve towards at least a market economy, be it socialist or capitalist, where consumer preferences will have a larger effect on resource allocation.

In applying the Medlock/Soligo modeling approach to Cuba, it is necessary to make some assumptions about future growth rates in per capita income. As Table 2 showed, Cuban GDP growth has recently averaged about 4 per cent per annum. If *per capita* income were to continue to grow at this rate, per capita income will increase from 1999 levels by 54% by 2010 and 87% by 2015. By 2010, Cuban per capita income in 1995 PPP dollars would be slightly below the 1999 level for the Dominican Republic. By 2015, it would be $4700, still substantially below the 1999 Costa Rican level of $7731.

Clearly, the future growth rate for Cuba will depend on a number of factors including future US policy towards the island. Removal of sanctions will increase the rate of growth, more

so if the Cuban government encourages trade and investment with the US. Growth prospects are higher if sanctions are removed and foreign relations are normalized within the context of the current political regime so that property claims and other contentious issues can be dealt with in a stable and orderly manner. A chaotic transition accompanied by civil strife and a struggle to assert old property claims could seriously set back growth and development. We have used 3.5% as the upper bound on future per capita income growth rates. This is a fairly high rate compared with experience in other Latin American cases. It is equivalent to the 4% growth rate that Cuba has experienced in the latter half of the 1990s (with population growth at .5%) but that growth rate might reflect the fact that Cuba was rebounding from the repressed levels of GDP experienced in the early 1990s. A more realistic per capita growth rate is 2%, especially over a longer period of time. As a lower bound, we assume a growth rate of 0.5%.

Table 6 shows projections for total energy consumption by end-use sector, total primary energy demand and, finally, total primary energy less biomass as projected by the Medlock/Soligo model. This final number represents the energy that for Cuba must be supplied by hydrocarbon sources, mainly oil and to a lesser extent, natural gas.

Table 6: Energy Consumption Forecasts for Cuba (in KTOE)

	Historical	Projected			Projected			Projected		
	1999		2005			2010			2015	
Per Capita GDP growth Rate		0.005	0.02	0.035	0.005	0.02	0.035	0.005	0.02	0.035
Consuming Sector										
Residential and Commercial	989	1337	1626	1956	1450	2053	2822	1570	2569	3954
Transportation	1062	2150	2487	2858	2297	2983	3808	2454	3561	4996
Industrial and Other	7480	7718	8894	10153	8240	10584	13214	8793	12479	16718
Total Final Consumption	9531	11206	13006	14967	11987	15621	19843	12816	18608	25668
Total Primary Consumption (a)	12697	14926	17325	19936	15967	20807	26431	17071	24786	34190
Thousands barrels/day equivalent	254	299	346	399	319	416	529	341	496	684
Less Biomass (d)	58	54	62	72	48	62	79	41	59	82
	196	245	284	327	271	354	449	300	436	602
Increase over 1999 thousands b/d		49	88	131	75	158	253	104	240	406
Real GDP per capita	2804	2889	3157	3446	2962	3699	4093	3037	3849	4862

Notes:

(a) Transformation losses in 1999 were 29.3%. Thus, to obtain Primary, we assume this value.

(b) Population is assumed to grow at a rate of 0.5% per annum.

(c) Conversion used for tons to barrels is 7.30 barrels/ton.

(d) Share of Biomass assumed to be 18% in 2005; 15% in 2010 and 12% in 2020.

For all of the scenarios studied, it is assumed that the Cuban population will increase by a total of 8% between 1998 and 2015, roughly the same rate of growth (about 0.5% per annum) as experienced in the 1990s.

Projections yield estimates for 2015 of between 300 and 602 thousand barrels a day of oil equivalent, an increase in consumption over 1999 levels of 104 to 406 thousand of b/d of oil equivalent. This is the energy requirement that would have to be supplied by non-biomass sources, principally oil and natural gas.

The Medlock/Soligo model predicts a growth in energy demand that is much greater than assuming that demand would grow at the same rate as GDP. For example, if per capita income were to grow at 3.5% per annum, energy demand would be only 440 thousand b/d in 2015 (an increase of 196 thousand b/d) in contrast with the 602 thousand b/d forecast by the model. This is not surprising since the model predicts that at low levels of per capita income, the elasticity of energy demand with respect to GDP will be greater than unity.

An important factor in these projections is that we have assumed that Cuban population growth will continue at the very modest growth rates of the past, roughly 0.5% per annum. This low rate reflects, to some extent, the higher education standards and better access to health care in Cuba. To the extent that current birth rates reflect other factors such as limited and crowded living space or pessimism about the future, population growth rates may increase. The estimates of future energy use would be markedly affected if higher population growth rates were to occur.

Forecasts of future energy consumption also indicate a significant change in the composition of demand by end-sector. In particular, demand from the transport sector will grow much more rapidly than in other sectors. Table 7 shows, the share of total final consumption coming from various end-use sectors in 1999 and 2015 as well as the absolute increase. Assuming an annual per capita growth of 2%, the industry/other sector shows the largest increase in consumption but its share of total final consumption

declines from 78.5% to 67.1%. The transportation sector shows the second largest absolute increase in demand but experiences an increase in its share of TFC from 11.1% to 19.1%. The residential/commercial sector shows the smallest increase in demand but its share also increases. It should be emphasized that these are conservative estimates in the sense that they do not assume a rapid adjustment of the structure of the Cuban economy that might accompany a change in the economic model. Rather, the projection take the existing structure of demand and assumes that demand will *change* over time, in response to increases in per capita income, following the pattern of other developing economies.

Table 7: Composition of Sector Energy in Total Primary Consumption

Consuming Sector	1999	2015	Increase (KTOE) 1999-2015
Residential and Commercial	10.4%	13.8%	1580
Transportation	11.1%	19.1%	2499
Industrial and Other	78.5%	67.1%	4999

Assuming annual Per Capita GDP growth of 2%

To summarize, we project that Cuban energy needs will increase by 104,000 b/d-406,000 b/d by 2015. With a per capita income growth rate of 2%, the additional requirements would be 240,000 b/d. This increase will have to be met by additional imports or increases in domestic production of crude or natural gas. In absolute terms, the Industrial and other sector will show the largest increase in consumption. But in relative terms, it is the transport sector that will show the greatest increase in demand.

Cuba's Energy Industry: Present Conditions

To meet Cuba's rising energy needs, its current industry will need to be significantly expanded. Otherwise, the country's import bill will increase substantially.

Cuba has proven crude oil reserves of about 283.5 million barrels, while its proven natural gas reserves total 636 billion cubic feet. Due to its limited natural resources, Cuba is dependent upon oil imports to meet about two-thirds of its 190,000 b/d domestic needs. In 2000, Cuba produced about 46,500 barrels a day (b/d) of crude oil, mostly from the north central coast in the state of Matanzas, and 600 million cubic meters of natural gas. State oil firm Cubapetroleo (Cupet) has also recently suggested that it plans to boost output from output from 52,000 b/d in 2001 to 120,000 b/d in 2005, though those figures appear speculative in light of recent exploration disappointments.

Approximately half of Cuba's crude output is produced from wells operated by Canadian mining firm Sherritt International Corp., with most of the remaining production accounted for by Cupet. Toronto-based Sherritt holds an indirect interest in seven exploration/production-sharing contracts with the Cuban government that encompass most of the island's existing crude fields, totaling 3.55 million acres. Increases in oil output over the past two years have come primarily from new wells in the Puerto Escondido and Varadero West blocks east of Havana, as well as exploratory wells in the Ymuri, Canasi and Seboruco fields along the island's north coast. Because approximately 90% of the crude that Cuba produces comes from the northern coast and is heavy oil with high sulfur content – 8 to14 degrees API gravity with about 8% sulfur -- it is only suitable for use in specialized plants that produce cement, electricity and nickel.

Most recently, Cuba has relied upon crude imports from Venezuela although these shipments were temporarily disrupted in the aftermath of the attempted coup d' etat in Caracas. Prior to 1999, Cuba received almost all the oil it needed from a long-term sugar-for-oil barter arrangement with Moscow. That agreement collapsed in 1999 though Cuba continued to receive a very small volume of Russian oil in exchange for use of a monitoring station on the island. Venezuelan President Hugo Chavez, who came into office in 1999, has moved to fill the void left by Moscow's departure as a financial supporter and main crude supplier to the island state. Based on a new agreement inked in October 2000, Caracas was providing about 53,000 b/d of Venezuelan crude or refined products to Havana, while financing up to a fourth of the cost. The deal allowed for

additional Venezuelan oil supplies in exchange for Cuban medical services and advice on athletics and agriculture. But Cuban and Venezuelan newspapers report that the deal was interrupted following Venezuela's political turmoil, and it remains to be seen if it will be reinstated next month as proposed by President Chavez. In the meantime, Russian energy Minister Igor Yusufov announced in May that Russian state oil concerns would be making new oil deliveries to Cuba.

Chavez has been willing to stand up to the U.S. extraterritorial legislation, the 1996 Helms-Burton Act or Libertad Act, that has sought to penalize new investment in Cuba but which has never been strongly enforced by Washington. The U.S. government currently has sanctions in place under Helms-Burton against Sherritt and the B.M. Group, a Panama-based company controlled by Israeli investors, for their activities in Cuba, banning executives and large shareholders of those firms entry into the U.S. U.S. President George W. Bush in July 2001 continued the policy of his predecessor to waive a provision in the act that would penalize foreigners for investing in properties once owned by Americans that was expropriated by the Cuban government.

Although Cuba may not have the energy potential of some of its Caribbean or Latin American neighbors, there is continued interest from foreign oil firms in exploring for crude and natural gas in the island state. Between 1991 and 1999, foreign investment in oil exploration and production in Cuba increased by about $600 million. Roughly half a dozen foreign companies are currently active in Cuban waters, either exploring for or producing oil, despite the threat posed by the Helms-Burton Act. In early 2000, Cuba offered up 59 deepwater offshore blocks in its 112,000 sq km exclusive economic zone in the Gulf of Mexico to a handful of international firms. About 20 of the 59 blocks that were tendered have subsequently been awarded to companies from the U.K., Canada, France, Spain and Sweden.

Spain's Repsol YPF was awarded six exploration blocks totaling 10,200 sq km that are located along the island's coast northwest of Havana. The Spanish firm is to provide start-up capital for at least two wells, and if drilling proves successful, will share

the profits with Cuba. The exploration efforts in Cuba's sector of the Gulf of Mexico are targeted on the "northern band," an area that extends from Guanabo in Havana province to Corralillo, 150 km to the east. But, foreign investors are also eyeing the new offshore opportunities cautiously, following the decision by Brazilian state oil firm Petrobras and its junior partner Sherritt in June 2001 to withdraw from an agreement they had signed with Cupet in 1998 to explore Block 50,a 3,000-sq km area off the north central coast, after the consortium drilled a $15 million dry well in April 2001. The structure had previously been believed to hold as much as 500 million barrels of crude.

Although Cuba opened its petroleum industry to outside investment in 1991, it has gained its biggest momentum with the recent tendering of the deepwater blocks in the Gulf of Mexico, an area that is estimated to contain 3-4 billion barrels of recoverable crude reserves. The difficulty lies in the location of these blocks, with depths that range between 2,000 to 4,000 meters – requiring technology that is relatively new and possessed only by the large international oil companies.

The northernmost of the blocks that Cuba put up for tender lies south of three areas that the U.S. has also made available for exploration and development. Foreign firms that have been exploring in Cuba in recent years include several small Canadian companies – Beau Canada Exploration, Perbercan, Cubacan and Alturas Resources -- U.K. firm Premier Oil, France's Maurel & Prom and Sweden's Taurus. Although French-Belgian giant TotalFinaElf stopped exploration in 1994 after drilling two dry wells, the company is believed to be in discussions with the Cuban government on natural gas and liquefied petroleum gas opportunities.

Since 1998, Cuba's crude production has slowly increased, from 38,500 b/d to 46,500 b/d in 2000. Roughly half of the crude production comes from Sherritt's operations in the north central Varadero fields. The firm currently leads other foreign investors in production-sharing agreements, supplying capital, technology and know-how in exchange for 50% of output, which is subsequently sold to Cupet. Sherritt is also

involved in a $150 million joint venture to process natural gas for electricity generation on the island.

Over the past two years, Repsol YPF has tried to position itself to tap opportunities in the Cuban energy business to compliment planned exploration activities there as well as other investment positions elsewhere in the Caribbean and Latin America. Repsol YPF produces over 900,000 b/d in the Americas. At the end of 2000, the Spanish firm announced it would enter into joint venture activities with Cuba's state-owned Union Cuba Petroleum (Cupet) in the areas of exploration, refining, petroleum products sales and distribution, LPG and natural gas marketing and power generation.

Cuba has announced that Spanish firm Repsol-YPF is preparing to begin its exploration in deepwater offshore Cuba later this year and will commence a new seismic study of the area. The Repsol-YPF exploration area is 4,000 square miles, or six out of sixty individual exploration areas on offer by the Cuban government off its northwest coast in between hydrocarbon bearing Mexican and the US waters. Repsol's agreement requires it to finance and drill a minimum of two exploration wells in the concession area. The company is trying to enhance its regional position in Latin America by activating a presence in the Cuban market, now blocked to US competitors, and offering a significant growth potential.

Industry experts believe that the Cuban sector of the Gulf of Mexico could contain as much as 3 to 4 billion barrels of recoverable reserves, mainly in deeper waters. One of Cuba's largest oil fields, the Varadero field, has an estimated 2 billion barrels of oil in place. Some Cuban acreage lies just south of three US mineral management service areas off Florida's Southwest coast where environmental activism has led to US policies blocking exploration and development of this offshore Florida acreage. Development of the Cuban sector, if U.S. sanctions were lifted, would offer U.S. firms already active in the U.S. Gulf of Mexico an interesting opportunity to supplement activities and possibly tap into areas adjacent to the prohibited US acreage regardless of the ban on drilling on the US side of the border.

Cuba's production sharing contracts allow parties to dispose of their share of hydrocarbon production as desired. In the event that the foreign partner's share is sold inside Cuba, the foreign partner is paid the international market price. No royalties are assessed, and there is no tax on exported hydrocarbons. Annual net profits from business transacted in Cuba are taxed at a rate of 30%. The relative percentage of cost oil, that is oil that will be taken as payment to cover reimbursement for the costs of development of the field and profit oil, that is, oil lifted by the foreign company as part of its pay-out for part-stake in the field, are determined by negotiation.

An offshore extension of current Cuban productive zones and its associated basin remain undrilled and represent a potential petroleum-bearing province. Additional potential is seen in traps and reservoirs associated with the Florida and Campeche escarpments.[10]

Development of these areas could produce significant earnings for oil companies. Sherritt International Corp. of Toronto, Canada, has announced that it added 8 million barrels of gross proved reserves in Cuba during 1999 at a finding and development cost of $5.03 a barrel. This cost basis could be expected to decline in the future as technological gains help bring down costs. Realized oil prices for Sherritt's production in the first half of 2000 was $23.40 a barrel against high world oil prices. Previously, in 1999, Sherritt had realized $14 for its Cuban oil production.

Sherritt's experience implies that earnings of $8 to $19 a barrel could be considered as a realistic, high-end revenue for American firms who successfully find oil in Cuban waters. Earnings of at least $3 a barrel would be reasonable even under low oil price scenarios.

[10] Guillermo H. Perez and Jon Frederic Blickwede, "Cuba deepwater exploration opportunities described in southeastern Gulf of Mexico" Oil and Gas Journal, December 11, 2000.

Opportunities for the Future in Cuba's Energy Sector

Repsol's new exploration program raises once again the prospects that Cuba could become an active domain if an end to US sanctions would enhance the attractiveness to finding oil and gas in Cuba's waters. The benefits of a successful Cuban oil and gas offshore sector to the US are large given its proximity to Florida markets. If the introduction of superior drilling technology and methods by the US industry or large supermajors could increase the chances for increased exploration success in Cuba, it would enhance US energy security and supplement an increasingly downgraded outlook for other Latin American supplies. US companies are also barred from exploring in much of Florida's coastal waters, and an opening to Cuban waters would increase the places US companies could operate that are close to US borders but outside the specter of US domestic environmental and local politics. The US Department of Interior announced in February that it would lease offshore tracts in 1.5 million acres of new, previously unexplored deepwater areas of Alabama and Louisiana by 2003 and 2005 but the announcement was met by resistance by some opposition groups in Florida despite their distance to the Florida coastline.

At present, Florida can purchase natural gas supplies from the US Gulf of Mexico via Florida Gas Transmission (FGT), an existing pipeline system running from Texas. This existing onland Gulf coast pipeline capacity to Florida will be expanded by 420 MM cf/d this spring, following a 190 MM cf/d expansion last May. Expansion of FGT pipeline network is expected to grow total capacity to 2.2 billion cf/d by end of 2003, up from 1.66 bcf/d currently.

The US Federal Energy Regulatory Commission (FERC) has also given its final certification for the $1.6 billion, Duke Energy/Williams Gulfstream pipeline project that will carry 1.13 bcf/d from supply areas in Alabama and the Gulf coast to the Tampa area via a 744 mile underwater pipeline. The Tampa landing point will connect by pipeline across the state to Palm Beach. An LNG terminal at Elba Island, Georgia, is also slated to reopen shortly, with a pipeline connection to Florida through the Cypress Pipeline.

The new projects do not appear to be oversubscribed with customers at the moment. Demand for natural gas in Florida is expected to grow significantly in coming years from just under 1.5 bcf/d in recent years to 2 to 4 bcf/d between 2005 and 2015, according to industry estimates. Florida's utilities consume over 300 bcf of natural gas to fuel electricity production for the state, while the industrial sector currently uses another 90 bcf and commercial businesses 50 bcf. Residential use is fairly small at less than 20 bcf but could grow in the coming years.

Much of the seasonal rise in energy use in Florida is now met by imports of refined oil products but this could change over time as more natural gas could be made available to the state, potentially lowering energy costs during periods when international oil prices are rising. Florida Light and Power's Manatee county facility is undergoing a $600 million conversion from an oil-fired facility to a 1,100 MW natural gas fired facility this year. FLP is also adding 800 MW of gas-fired capacity at a facility near Lake Okeechobee that will be on line by 2005.

If a significant level of natural gas supply could be made available from Cuban waters by pipeline into Florida, the Cuban supply would enhance competition in the Florida market and thereby lower average prices paid by Floridians. The addition of additional Cuban sellers with the incentive to market the bulk of their supply to Florida will prompt a lowering of prices so that these additional sellers can find a market for their supplies by increasing the quantity demanded.

The economics for Cuban natural gas supplies aren't likely to be all that different from Texas and Alabama gas. Drilling and other finding costs will likely be similar to deepwater plays along the US Gulf of Mexico and could be lower if Cuba offers more attractive fiscal and royalty terms, depending on the size of any finds and the amount of liquids associated with the natural gas. Pipeline costs to Florida are unlikely to exceed 40 to 50 cents per mcf even for a relatively small discovery of 200 mmcf/d, assuming a 15% rate of return over a 20-year operating period with operating costs of 3% capital cost.

This is in line with transportation costs for existing pipeline infrastructure from natural gas trading hub and storage area Henry Hub and amortized costs for the Gulfstream project.

Cuban gas costs might be slightly higher than those for liquefied natural gas from Trinidad, which is also expected to flow to Florida either from Elba Island or from a new terminal proposed by El Paso in the Bahamas. The latter terminal would connect to a pipeline to Florida of about 800 MMcf/d. The following table shows how average Cuban costs might stake up against the costs of competing supplies to Florida.

Table 7: SAMPLE COSTS FOR NATURAL GAS SUPPLIES TO FLORIDA

Source	Average Production Costs*	Liquefaction Costs	Pipeline/Tanker Costs	Regasification Costs	Total Costs
Cuba	$2.50		$0.40		$2.90
Trinidad	$0.75	$1.00	$0.45	$0.60	$2.80
FGT**	$2.50		$0.40		$2.90
Gulfstream	$2.50		$0.35		$2.85

* Estimated for deepwater gas production and does not include liquids credit or savings from oil-related infrastructure.
**Actual pipeline tariffs are 80c but prevailing spot market for transportation costs is 40c.

The costs in Table 7, however, do not fully reflect the competitiveness of Cuban natural gas. That's because Cuban supplies would likely to be "associated" gas and therefore could presumably be priced to the market. This would set a competitive tone that could lower costs to Florida consumers. Revenue from related oil production from Cuban fields would offset the fixed costs of drilling and producing any associated natural gas, allowing Cuban producers to lower prices in line with marginal cost economics. Cuban sellers, having a transportation linked solely to the Florida market, would be likely to undercut other suppliers to maintain market share, creating a competitive market structure and contributing to lower prices to the state.

At present, Florida has a dynamic energy market, with oil supplies competing against new sources of natural gas. In the coming years, this dynamism could increase as Florida develops more alternative supplies of energy. As US shallow water natural gas

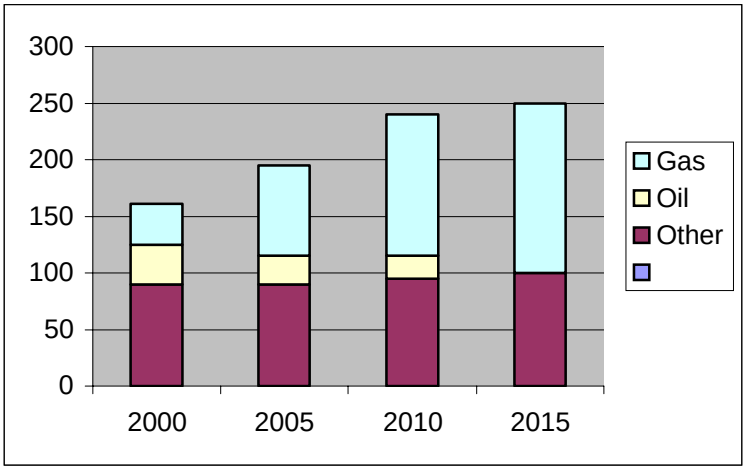
production declines in the coming years, it is forecast to be replaced by more costly deepwater natural gas production and liquefied natural gas from a variety of international sources such as Trinidad and Nigeria. It is assumed that the replacement of cheaper, shallow water sources with these other more expensive alternative sources will lead to an increase in US natural gas prices over time to closer to $3.50 per mmbtu from today's current price below $2.00 per mmbtu. To the extent that Cuban offshore gas could substitute for more expensive, distant LNG supplies such as those from the Middle East, the less likely it is that prices will rise above $3.50 on a sustained basis. This could potentially save Floridians millions of dollars on their supplies if distant LNG was not required in the US after 2005.

For every penny per mm btu saved on natural gas supplies annually, total natural gas costs would fall by $5.5 million at current demand rates. By 2010, each penny of savings could represent lower costs annually of over $10 million. Thus, if additional Cuba supply helped create a market dynamic that shaved 3c off average natural gas prices in the state, then Florida would save over $15 million to $30 million a year. However, the extent of any reduction in prices from access to an incremental low cost gas source, since it is unlikely to be a lower cost source than Trinidad gas, will depend on future energy elasticity of demand for what alternative fuels could earn in markets other than Florida, which is beyond the scope of this paper.

Also, to the extent that Cuban natural gas was able to replace completely the need for expensive, distant Middle East LNG supply which is likely to cost 30-50c more per mm btu than closer domestic supplies or LNG from Trinidad or Africa, then the savings could be as much as $150 million to $300 million since markets would not have to clear to higher prices to attract the distant Middle East supply. Incremental Cuban natural gas supplies might also reduce Florida's oil import needs, saving costs in that fashion as well.

Figure 5 shows how the fuel source for Florida's electricity sector might change over time.

Figure 5: Share by Fuel in Florida's Electricity Sector (BKWH)



Florida would gain in other ways as well from access to additional pipeline supplies of natural gas since more firms would be able to switch to gas, reducing emissions in the state. To convince firms to switch to natural gas, assurance of supply will be important. If proposed pipelines run near 100%, it will be hard to service new customers. Moreover, doubts about the reliability of LNG in light of post-September 11 security concerns about LNG receiving facilities that could be targeted by terrorist groups might argue more in favor of pipeline gas from either Cuba or the US Gulf of Mexico.

Other Aspects of Energy Sector Growth: Cuba as a Trading Entrepot

The Cuban energy market continues to be of interest to European and Latin American energy firms. While the growth potential is not considered large, the country's geographic position near to expanding markets in the U.S. and Mexico make it an interesting possible entrepot for energy project development.

Overall growth possibilities of around 104,000 to 406,000 b/d of oil equivalent by 2015 still represent a solid business opportunity for regional players. There will also be opportunities for investment in the electric power industry. Electricity use in the residential/commercial/public service sector alone is expected to grow by 47% by 2010 and 59% by 2015 under the 0.5%/annum per capita growth scenario. With 2% growth,

electricity demand would increase by 108% and 160% respectively. In 1999, the sector consumed over 61% of total electricity consumed. Of the 4.34 gigawatts of installed capacity, some 2.65 were devoted to satisfying demand for this sector. Hence, expected growth in demand from this sector alone could require the addition of from 1.2 to 2.9 gigawatts of additional capacity by 2010, depending on whether per capita income growth were 0.5% or 2% per annum. By 2015, the required additional capacity would range from 1.6 to 4.2 GW.

The Cuban government has been working to upgrade its refining system to be able to accommodate a blend of imported and domestic crudes. The country has four refineries with nameplate capacity of about 301,000 b/d, with two units, one in Havana (122,000 b/d) and the other in Santiago de Cuba (100,000 b/d), accounting for the bulk of that capacity. A smaller refinery in the Ciego de Avila province produces about 2,000 b/d of lubricants for the local market.

The 76,000 b/d Russian-built Cienfuegos plant, designed in the early 1990s to handle Russian shipments, was not brought on stream due to the collapse in supplies from the former Soviet Union. An estimated $250 million is required to bring it into service. A number of foreign oil firms have been in on-again, off-again discussions with Cuba about establishing joint ventures to reactivate the unit.

Venezuelan state oil firm Petroleos de Venezuela S.A. (PDVSA) initiated discussions in 2001 to make a multi-million dollar investment in the unit to get the Cienfuegos refinery up and running but decided against the investment, reportedly on commercial grounds. The attempt was the second time PDVSA had looked at the investment opportunity and rejected it. Other state oil firms, including Brazil's Petrobras, Mexico's Pemex, Libya's National Oil Co. (NOC) and Colombia's Ecopetrol have also been eyeing opportunities to invest in the plant. So far, nothing has come of the talks.

Were U.S. restrictions to be lifted, Cuba would be an ideal entrepot for energy trading, in refined oil products, natural gas processing and distribution facilities and crude

oil storage for shipments to the U.S. and possibly Mexico. Already, several Caribbean islands play this transshipment role. The Caribbean currently houses independent petroleum storage facilities with a capacity of approximately 100 million barrels of crude oil and refined products tankage.

The U.S. imported over 580,000 b/d from the Caribbean in 2001, almost 90% of which was refined products from the Virgin Islands, the Netherland Antilles, Trinidad and Tobago and Puerto Rico. With domestic U.S. refining capacity said to be reaching its capacity limitations to meet rising U.S. oil demand, and with environmental restrictions making construction of new U.S. domestic facilities unlikely, Caribbean refining ventures remain a promising option for supplying growing future U.S. refined products demand. Refining capacity in the Caribbean exceeds 1.6 million b/d currently. A number of players have shown interest in Cuban refining facilities including Repsol YPF, Venezuela's PDVSA and Mexico's Pemex, but the industry could also represent an interesting opportunity for a U.S. firm. However, not all Caribbean refineries have been profitable. Sunoco has been attempting to sell its Puerto Rico facility, and El Paso Energy has not refurbished its Aruba plant closed after a fire in the spring of 2001.

Conclusion

The changing pattern in energy demand in Cuba reflects both shifting economic policies as well as the consequences of an end to economic assistance from the USSR. Given recent growth rates and the rapid development of a tourist industry, we believe that per capita income growth of 0.5% per annum is possible into the future. A 2% growth rate is probably at the upper end of the spectrum unless there is rapid change in the policy/economic environment in which Cuba operates.

At a conservative 0.5% per capita growth rate, total final energy consumption is expected to grow by 3,270 KTOE by 2010 and by 4,374 KTOE by 2015. Making some assumptions regarding the role of biomass in future energy supply, this increase translates

into 75,000 b/d of oil by 2010 and 104,000 b/d by 2015. This could be met with even modest success in the exploration and development of Cuba's energy sector. Greater expansion of Cuba's own oil industry could mean that further production increases could result in a reduction in the amount of oil imported.

Cuban waters also house natural gas resources. There may be significant amounts of additional gas in offshore areas adjacent to areas off the southwest coast of Florida. The gas is in deep water and would require the expertise of international, and mostly US, oil companies to be developed. If this gas is developed, Cuba could substitute some natural gas for oil imports if investments were made in the industrial and electricity sector to burn gas. Moreover, depending on how much natural gas is found and developed, Cuba could become a source of gas exports to Florida, competing there with imports of LNG.

Even given a modest growth in per capita income, Cuba will need to invest in additional electricity production and refineries. Both of these areas represent potential opportunities for foreign investors.

Finally, Cuba is well situated to become a storage and distribution entrepot for oil and natural gas coming into the US, Mexico and Latin America. Thus, Cuba's energy sector would likely see higher growth as well as attract increased foreign investment, were US economic sanctions to be eased. Such ties would enhance US energy security by diversifying regional sources for petroleum product and oil and gas export supply.

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