CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

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Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

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Energas Varadero Conversion from Open Cycle to Combined Cycle Project
CDM-PDD Version 6,
December 18, 2006

A.2. Description of the project activity:

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1. Purpose of the Project Activity

The project activity converts an open cycle thermal generation facility into a combined cycle facility that adds approximately 75 MW[1] of generating capacity to Cuba's electric power grid with minimal incremental additions to greenhouse gas (GHG) emissions. The equipment used is designed to provide a high level of availability; the project activity is therefore available to supply the grid as a baseload facility. For the foreseeable future, the project activity will allow an equivalent capacity of existing (relatively high GHG emitting) generating units supplying the grid to be taken out of service for such things as scheduled maintenance and/or to conserve (increasingly costly) imported fuel. Over the long term, the facility will continue to displace energy produced by other (relatively high GHG emitting) facilities supplying the grid and may also delay the need to construct additional generating capacity, depending on the country's growth in electricity demand.

2. Background

In early 1997 a Cuban joint venture company, Energas S.A. (Energas) was established with shares distributed in three equal parts among UNE and CUPET[2] (representing the government of Cuba) and Sherritt International (Cuba) Oil and Gas Limited (which was later transferred to Sherritt Utilities Inc.), a wholly-owned subsidiary of Sherritt International Corporation (hereinafter the Sherritt group of companies shall be referred to as "Sherritt" unless otherwise noted). Energas' stated corporate purpose is the construction and operation of integrated gas-fired electrical power generating plants in segregated areas in the Varadero and Boca de Jaruco regions of Cuba, producing power for sale to the national grid. Sherritt, as the only joint venture partner with access to international capital markets, accepted responsibility for contributing 100% of the investment capital required to execute Energas's mandate.

The government of Cuba recognized that the Energas project concept represented an efficient utilization of a valuable national resource that had not previously been used productively, and that electricity produced from raw gas that was previously wasted and waste heat could contribute to a sustainable, more environmentally friendly energy future. The Varadero open cycle facility was to be constructed first, followed shortly by the combined cycle facility. Soon after the open cycle facility was built a number of

[1] This figure includes auxiliary firing of the steam turbine boiler with waste gas.

[2] UNE – Union Electrica (Cuba's national electric utility); CUPET – Union Cubapetroleo (Cuba's state oil entity).

events delayed the actual construction of the combined cycle for a number of years. Despite earlier preparatory engineering and design work, actual construction of the project did not begin until 2002, so that the first steam generated power was not produced until early 2003.

The existing grid supply consists of oil-fired, gas-fired, and biomass-fired thermal facilities, as well as hydroelectric power generation. With the exception of the biomass and hydroelectric units, all other types of generation are recognized as producing GHG emissions in proportion to their contribution to grid supply and according to the carbon content of the fuel used and the efficiency of combustion. In 2003 there were 159 hydroelectric facilities in Cuba, most of which were connected to the national grid but all but one of these were very small (less than 3 MW). There were also over 40 sugarcane cogeneration facilities of various capacities connected to the grid. Although biomass and hydroelectric supply is important for Cuban emission reductions, given that oil & gas-fired generation is close to 90% of the supply fossil fuel generation is expected to dominate the electrical system for many years to come.

When utilizing only waste heat to generate electric power, the project activity produces no GHG emissions. The project activity can also use gas to provide additional heat to the waste heat recovery process and there is surplus gas available for this use. Without the project activity, any surplus gas not needed to generate electricity in the gas turbines would have been flared. There are no other reasonable uses for it and the GHG emissions associated with the combustion of this surplus gas are neither increased nor decreased by its use in the operation of the project activity. Despite this, emissions from its use in the HRSG are included in project emission calculations in the estimate of project emission reductions.

To the extent that generation from the project activity displaces generation from the grid, GHG emission levels from the grid would be lower than would have been obtained in the absence of the project.

3. Contribution of the Project to Sustainable Development:

The project activity contributes to sustainable development in a number of ways.

Reduced air emissions – In 1996 and 1997, about 92% of Cuba's electric power supply was sourced from plants burning either imported 3% sulphur Heavy Fuel Oil (HFO), or 'national crude', which has a 5% sulphur content. This plus an environment where the opportunities for completion of scheduled maintenance are limited makes achievement of a high level of efficiency extremely difficult. Although the project activity uses some fuel for auxiliary firing in the steam generator to supplement the heat from the open cycle gas turbine exhaust, this is kept to minimum requirements and results in lower emission factors than would otherwise result from grid generation utilizing HFO or national crude. Producing power with less fuel consumption will, to the extent that the added capacity lowers the use of oil-fired units, decrease CO_2 emissions. In addition, the more localized environmental impact of sulphur dioxide (SO_2) emissions associated with burning high sulphur fossil fuels will also be reduced, providing a benefit to the tourism industry in the Varadero area.

The implementation of the Energas operations and combined cycle plant has not completely eliminated the use of high sulphur fuel at other locations, or the emission of GHG from those other operations. Prior to the start of combined cycle construction, air testing revealed high H_2S readings at the Varadero site due to fugitive emissions from the oil storage facility beside the plant site. This prompted action to install new covers for the storage facilities and a collection system to gather the gas for transfer to the Varadero site. All of this was done at Energas expense, and resulted in lower H_2S readings. There remain some fugitive emissions from similar offsite sources that cannot be eliminated but they are greatly reduced.

Improved system reliability – Investment in Cuba's electric power generation, transmission and distribution infrastructure has been constrained for many years for a number of reasons, resulting in a decline in the overall reliability of Cuban grid power supply. Investment in new facilities helps reverse this trend. It also allows for better scheduled maintenance on existing generation facilities, allowing them to operate at an efficiency level closer to the optimum and minimizing their emissions. Instilling confidence in grid supply, moreover, will help to stimulate new investment in economic activities that rely on stable supplies of electric power. Reduced grid emissions due to improved maintenance are likely but they have not been included here due to difficulty in measuring such emissions and the need for conservative estimates of total reductions resulting from the project activity.

Opportunities for training and technology transfer – The Energas Varadero Project has provided employment for a number of local workers. It has allowed highly skilled local workers to receive training in the implementation and operation of advanced gas treatment and gas turbine electricity generation technologies. The project activity required equally well-trained local staff for the maintenance and operation of heat recovery steam generators and ancillary facilities, as well as the steam turbine electricity generating unit. Training and mentoring programs have been a priority for Energas from the outset. Cuban staff at the project is working towards Canadian trade certifications.

The transfer of skills and knowledge has extended to non-Energas staff in Cuba as well, thanks to Sherritt's work with various Cuban industry partners. This knowledge transfer has not been limited to technical skills associated with completing a certain task. The Energas operation strives to function in compliance with Canadian standards. This results in all staff, whether Energas or from another Cuban company, gaining familiarity with such standards and operating procedures.

Encouragement of foreign direct investment – In a business environment widely acknowledged as a potential challenge to foreign investors for a number of reasons, the project activity demonstrably overcame an onerous set of obstacles to its implementation: high risk premium required by lenders; 'first of kind' implementation and operation difficulties; exposure to payment risk related directly to Cuba's ability to earn foreign exchange; and difficulty identifying suitable equipment suppliers unaffected by U.S. policy and trade law related to Cuba. Accordingly, the project activity is likely to have had a positive effect on potential investors in the Cuban economy, demonstrating that Cuba is capable of mobilizing modern technology and local resources in order to advance along a sustainable economic development path.

Encouragement of investment in CDM project activities – Substantial investment over a prolonged period is needed to replace and eventually augment existing electricity generation facilities in Cuba. Cuba's power grid should provide Cuban workers and families with the same standard of reliability enjoyed internationally. The project activity is a step toward achieving that goal with sustainable means, and the benefit of GHG emission reductions. There may be a multiplier effect as potential investors in new projects with relatively low or zero GHG emission characteristics may be encouraged to continue in Energas' footsteps.

Quality of life improvement – Reducing the requirement for purchasing fossil fuels for power generation lowers the need for fuel imports, allowing the government of Cuba to allocate a greater share of hard currency earnings to an array of social priorities, including health care and educational services.

Overall improvement to economic growth – Many of the sustainable benefits listed above contribute to the continued economic growth in Cuba. According to Cuba's first National Communication to the UNFCCC in 2001, (available for reference at the following Internet site: http://unfccc.int/essential_background/library/items/3599.php?rec=j&priref=3186) following the fall in GDP from 1989 through to 1993 the economy began its recovery in 1995 and had been growing steadily for 6 consecutive years. Through increasing the supply of reliable electricity the Energas operations were able to play a part in this. The Communication goes on to state that part of the reduction in CO_2 emissions since 1990 was due to a special emphasis on greater efficiency and better use of national energy sources. The development of the Energas operations and especially the combined cycle directly addresses the national sustainability goal.

A.3. Project participants:

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Name of Party Involved (*) (host) indicates a host Party	Private and/or Public Entity(ies) Project Participants (*)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Cuba (Host)	Energas S.A.	No
Canada	Sherritt International Corporation	No
* In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public as the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

Energas S.A. is a Cuban joint venture company established in 1997 with shares distributed in three equal parts among UNE, CUPET and Sherritt Utilities Inc.

CUPET (Union Cubapetroleo) is Cuba's state oil entity and is owned by the Government of Cuba. CUPET supplies raw natural gas to Energas at no cost.

UNE (Union Electrica) is Cuba's national electric utility and is owned by the Government of Cuba. UNE purchase power from Energas at fixed prices under long term contracts.

Sherritt Utilities Inc. is a private company that is a 100% owned subsidiary of Sherritt International Corporation. Sherritt provided 100% of the project financing and technical expertise for the project.

Sherritt International Corporation is a widely held Canadian company which has shares traded on the Toronto Stock Exchange.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

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Republic of Cuba

A.4.1.2. Region/State/Province etc.:

>>
Matanzas Province

A.4.1.3. City/Town/Community etc:

>>
Varadero Region

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

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The Varadero Project is south of the town of Varadero, which is 30 km east of the Provincial capital of Matanzas province. Matanzas Province is the second largest province in Cuba, with a population of about 650,000 people.

The Varadero oil field is located off the coast to the north of the project activity site. The coastline is characterized by numerous small cays, with mangroves near the shoreline. Much of the nearby land area is beach or scrub, not suitable for intensive agricultural use.

The project activity is located at the existing Varadero power generation facility, indicated on the map above. The vicinity is well-developed economically, with oil and gas production, refining, and transportation facilities. A number of sugar cane refineries are located nearby. The wider region has a thriving tourism industry which is of significant importance to the Cuban economy.

A.4.2. Category(ies) of project activity:

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Energy industries (1) – Renewable/non-renewable sources

A.4.3. Technology to be employed by the project activity:

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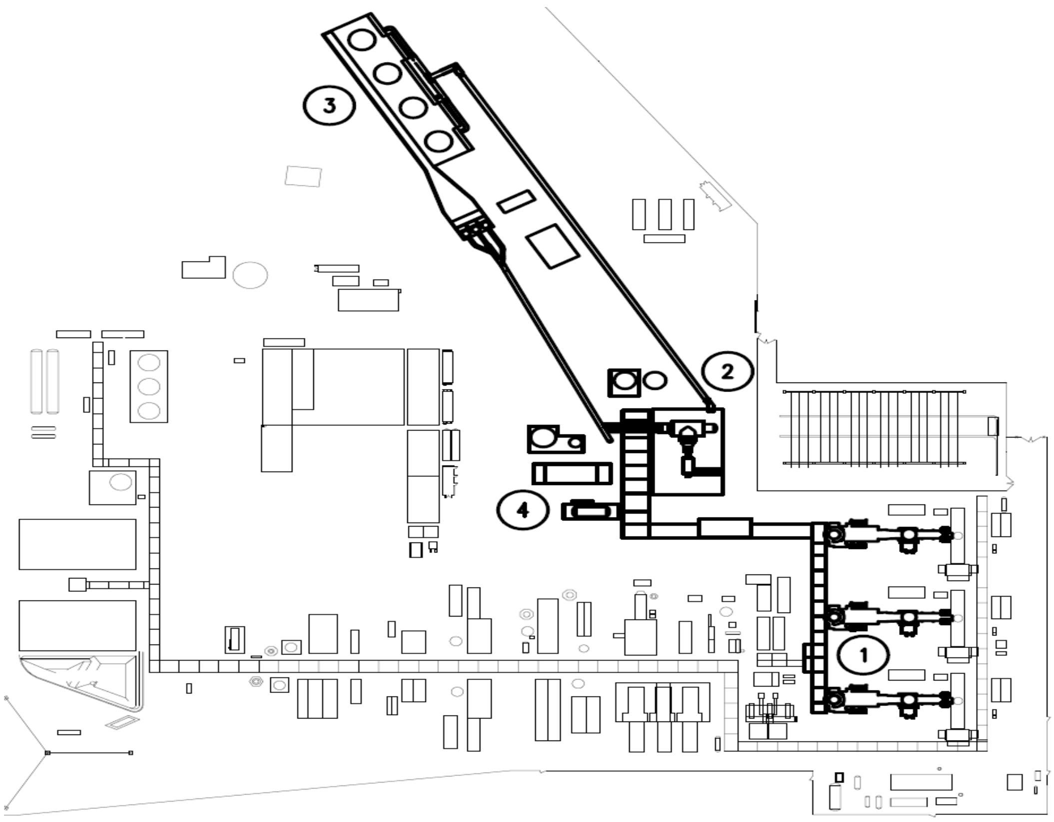
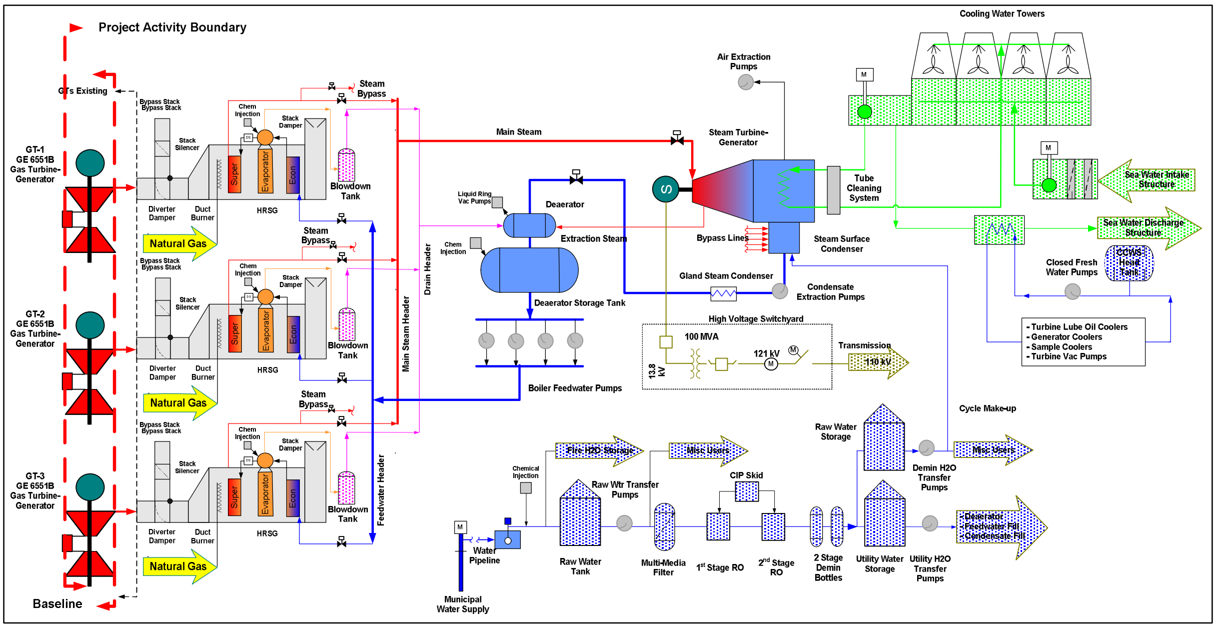
The Varadero Project involves retrofitting each of 3 existing gas turbines (GTs) with a heat recovery steam generator (HRSG marked ① on the site diagram below). (See also the boundary diagram below.) All equipment used was standard to the electrical industry anywhere in the world, subject to its availability for use in Cuba. The HRSGs use water drawn from the municipal water supply that is first treated to remove excess minerals that could damage the equipment (demineralizer marked ④ on site diagram). The water entering the HRSG absorbs heat from the GT exhaust gases through a series of heat exchangers, and is transformed into high pressure steam. The steam is used to power a steam turbine (marked ② on site diagram) which in turn drives an electric generator, producing about 75 MW of electric power. The generation capacity available from the steam turbine can be enhanced, if needed, by burning surplus gas in the HRSG boiler to provide a supplementary source of heat. .



Varadero Project Site Diagram



Energas Varadero Conversion from Open Cycle to Combined Cycle Project Boundary Diagram

In general, generating electric power using waste heat is environmentally preferable to generation requiring primary combustion of any fuel, including renewable biomass or biogas. Whereas the latter are associated with air emissions and (with the exception of natural gas) solid waste residue, utilizing waste heat has little or no fuel-related emissions.

Steam turbines - like most other thermal generation technologies - require process or "feed" water. In the case of the project activity, this is for the purpose of producing steam. At Varadero the spent steam leaving the steam turbine is condensed and pumped back to the HRSGs to be reused as feed water.

Seawater is used to condense the spent steam and is itself cooled in an evaporative cooling tower (marked ③ on site diagram). The seawater cooling water forms a partially closed system, with a makeup seawater stream being added to replace evaporative losses and a blowdown stream being returned to the ocean to keep the dissolved solids in the cooling water below the concentration where solids would precipitate out in the cooling tower.

The feed water/steam circuit similarly forms a partially closed system, but there are small but continuous losses (about 4% of the total stream) that must be replaced. The makeup feed water is supplied from the municipal water supply[3] but before it can be used it must be demineralised so that solids are not deposited when the water is evaporated in the HRSGs. The demineralization process concentrates the naturally occurring dissolved solids in the municipal water into a smaller (about 36%) reject water stream, which is then pumped back into the ocean with the seawater cooling water blowdown stream.

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[3] Originally, a well was dug to provide a backup water supply, but groundwater levels were insufficient so the well is not used.

Operation of the facility involves a large number of pumps, valves and control equipment to ensure the safe production of electricity, the operation of the demineralised water system and the cooling water system. This equipment at the Varadero plant consumes 5.6 MW of the electrical power produced by the facility. This figure is based on the average of the first 3 years of operation of the combined cycle project.

Environmental monitoring of the water treatment and effluent discharge processes must be conducted on a continuous basis. Ground water testing is also continuous to ensure no leakage of sea water from the condenser cooling circuit to the water table. Moreover, the equipment and controls must be maintained to a high standard to ensure reliability. Consequently, Energas has undertaken the extensive program of training mentioned earlier, in order to transfer to local staff the skills required to operate and maintain this equipment, record and analyse monitoring data, and respond to operational situations if and when they occur. Cuban staff on-site is progressing towards attaining Canadian trade certification.

A.4.4 Estimated amount of emission reductions over the chosen crediting period:

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The crediting period chosen is an initial seven (7) years with the intention of renewing for two additional seven (7) year terms. Estimates of annual emission reductions over the crediting period are given below. Due to the lack of alternative uses for the gas on site, if it is not used in the project activity it is burned using conventional flare technology, releasing associated GHG. Emissions from the combustion of this gas in the HRSGs for supplementary heat are included as an emission source within the project boundary as per ACM0007. For purposes of these estimates, registration is assumed to have been completed at the end of March 2007, allowing for an April to March crediting year.

Years	Annual estimation of emission reductions in tonnes of CO_2 *e*
Apr-2007 to Mar-2008	342,235
Apr-2008 to Mar-2009	342,235
Apr-2009 to Mar-2010	342,235
Apr-2010 to Mar-2011	342,235
Apr-2011 to Mar-2012	342,235
Apr-2012 to Mar-2013	342,235
Apr-2013 to Mar-2014	342,235
Total estimated reduction (*tonnes of CO_2 e*)	2,395,645
Total number of crediting years	7
Annual average over the crediting period of estimated reductions (*tonnes of CO_2 e*)	342,235

The total emission reduction over the full 21 years represented by three crediting periods is estimated at 7,186,935 tonnes of CO_2 e.

A.4.5. Public funding of the project activity:

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No public funding was provided for the project activity.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the project activity:

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1. Approved consolidated baseline methodology ACM0007: "Baseline methodology for conversion from open cycle to combined cycle power generation" (Version 01; Sectoral Scope 01; 28 November 2005)

2. Approved consolidated baseline methodology ACM0002: "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (Version 06; Sectoral Scope 01; 19 May 2006)

B.2 Justification of the choice of the methodology and why it is applicable to the project activity:

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ACM0007

This methodology is applicable:

- *When the project developers utilize previously-unused waste heat from a power plant, with a single-cycle capacity, and utilize the heat to produce steam for another turbine – thus making the system combined-cycle.* The project activity generates electricity with waste heat released in the operation of gas turbines running in open cycle and uses it to produce steam for another turbine.

- *When waste heat generated on site is not utilizable for any other purpose on site*. There is no other use for the waste heat at the Varadero plant and the nature of this "resource" is that it cannot be transported over long distances or stored in some way. The warm climate in the host country precludes the use of waste heat for such things as district heating or greenhouses and there are no appropriate buildings in the vicinity anyway. There is a general lack of industrial base in the Varadero area and the closest industry to the project activity is a CUPET oil collection/storage facility. CUPET uses some steam at that facility but the volume of steam that could be available from the Energas operation was greater than they could use and they had already installed a boiler to provide for their needs. There were no other technologies available that we were aware of at the time that could use the waste heat. In the absence of the project activity, the heat would be exhausted to the atmosphere.

- *Where the project activity does not increase the lifetime of the existing gas turbine during the crediting period (i.e. this methodology is applicable up to the end of the lifetime of existing gas turbine, if shorter than crediting period).* The project activity neither increases nor decreases the expected life of the existing gas turbines. The gas turbines at Varadero are expected to operate to well beyond the crediting period.

- *Where project developers have access to appropriate data to estimate the combined margin emission factor, as described in ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources", of the electricity grid to which the proposed project is connected.* One of the project participants is the Cuban national electrical utility (UNE) which purchases the electricity from the project developer. UNE has access to the appropriate data.

ACM0002
This methodology is specifically prescribed in ACM0007, as follows:

"The Baseline emission factor ($EF_{grid,y}$) should be calculated as a combined margin (CM), following the guidance in the section "Baselines" in "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002)." [ACM0007, Page 8]

However, ACM0002 is modified for this methodology as follows:

> "If project proponents use the dispatch data analysis method, as described in ACM0002, the following modification applies:
>
> The group "n" of power plants in the dispatch margin is set of power plants in the top x% of total electricity dispatched by the grid system during hour h, where x% is equal to the greater of either:
> - 10%; or
> - the project generation during hour h expressed as a percentage of the total grid generation for that hour.
>
> Project proponents can use the efficiency of the plant to estimate combined margin emission factor if fuel data for plants is not available. The volume of fuel consumed by each plant can be calculated using the efficiency of the plant and the electricity output. The efficiencies of the units attached to the grid should be from publicly verifiable sources. In the case of multiple sources and values of efficiency one which results in the most conservative estimate of emission factor should be used." [ACM0007, Page 8]

All applicability requirements for these methodologies are met by this project.

B.3. Description of the sources and gases included in the project boundary

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As outlined in ACM0007, the project boundary for conversion projects from open cycle to combined cycle includes:

- CO_2 emissions from on-site consumption of fossil fuels for the operation of the gas turbines; and,
- CO_2 emissions from on-site fuel consumption to supplement the waste heat generated from the gas turbines, in generating steam to operate the steam turbine.

In the Varadero operation, any supplementary firing uses excess gas that is not needed to operate the gas turbines. Were it not for the project activity, excess gas would have been burned in a conventional flare so emissions associated with its use would occur either in supplementary firing or in flaring. However, ACM0007 explicitly states that any emissions associated with the provision of supplementary heat are to be included because they may be an important emission source. Therefore these emissions are included in the calculations for the project.

The baseline as defined by ACM0007 includes:

- CO_2 emissions from all fossil fuel fired power plants connected to the electricity grid, and in the operating and build margin;
- CO_2 emissions from the operation of the project power plant in open cycle.

	Source	Gas	Included?	Justification / Explanation
Baseline	Baseline: Grid electricity generation	CO_2	Yes	Main emission source.
		CH_4	No	Excluded in ACM0007 for simplification. This is conservative
		N_2O	No	Excluded in ACM0007 for simplification. This is conservative
	On-site fossil fuel consumption to operate project power plant in open cycle mode	CO_2	Yes	An important emission source.
		CH_4	No	Excluded in ACM0007 for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded in ACM0007 for simplification. This emission source is assumed to be very small.
Project Activity	On-site fossil fuel consumption to operate the gas turbine of project power plant.	CO_2	Yes	An important emission source.
		CH_4	No	Excluded in ACM0007 for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded in ACM0007 for simplification. This emission source is assumed to be very small.
	On-site fossil fuel consumption to supplement waste heat in operating Steam turbine.	CO_2	Yes	The gas used to supplement the waste heat is surplus to the needs for operating the power plant in open cycle mode. Without the project activity, this gas would have to be flared because there is no other use for it. Despite the fact that emissions from the use of this gas would occur regardless, they are an important emission source and are included in project emissions.
		CH_4	No	Excluded in ACM0007 for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded in ACM0007 for simplification. This emission source is assumed to be very small.

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

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The baseline scenario under ACM0007 requires that in the absence of the project activity, the electricity to meet the demand in the grid system will be generated by:

1. The operation of the existing power plant in open cycle mode;
2. The operation of existing grid connected power plants; and,
3. The addition of new generation sources to the grid.

1. *Identify plausible alternatives to the project activity.*

As noted in Section B2, since the exhaust heat cannot be shipped or saved, aside from the project activity there is only one plausible alternative to be considered. This is to continue the current practice of producing power in open cycle mode with the existing GTs. In this scenario, the waste heat from GT exhaust would simply continue to be released into the atmosphere with no additional power generation or other benefit. This is the baseline scenario.

2. *Evaluate the alternatives for compliance with applicable regulations.*

The operation of the GT generators in open cycle occurs in full compliance with the conditions of the operating licence and within all applicable national, regional and local environmental and administrative regulations and guidelines. There is no regulation requiring the use of waste heat or for specific energy efficiency norms. All appropriate regulations regarding emissions for power plants are met or exceeded. Therefore, there is no regulatory requirement that would prevent the continuation of open cycle generation.

3. *Conduct barrier test analysis considering investment barriers, technological barriers, prevailing practice or other barriers.*

There are significant barriers associated with development of this project. These include risks associated with investing in Cuba, risks associated with the project such as availability of equipment and parts, and risks associated with business partners and currency risks. These will be discussed in full in Section B3 of this Project Design Document (PDD). The existing GTs use gas to generate power. There is no other source of gas in the area for this use. There is gas available that is surplus to the needs of the existing GTs which is available for use in the project activity without compromising the operation of the existing GTs.

The project activity involves the recovery of waste heat from exhaust gases produced by GT electric generators. The waste heat is converted to steam and used to generate additional electricity by driving a traditional steam turbine generator. The project can use the excess gas (after operation of the GTs) to produce additional heat to supplement that from the exhaust but it cannot operate on this supplementary heating alone.

In the absence of this project, electricity would have continued to be produced by the gas turbines in open cycle mode and the hot exhaust gases would be vented to the atmosphere directly from the GT. Electricity requirements that would have been met by the project activity would be met from existing power plants on the grid and by the addition of new generating sources on the grid. Consequently, the only alternative to the project activity is grid generation (including operation of the existing GTs in open cycle mode) which is the baseline.

ACM0007 specifies that the project activity mainly reduces CO_2 emissions through substitution of power generation supplied by the existing generation sources connected to the national grid and likely future additions to the grid. The project emission reduction in any year is the difference between the baseline emissions displaced in the year, the project emissions during the year and any emissions due to leakage during the year. Baseline emissions are emissions from existing generation sources including emission from grid electricity generation plus emissions from operating the existing GTs in open cycle mode.

Project emissions are those resulting from operation of the gas turbines in the project power plant to create the waste heat plus emissions from any gas used to provide additional heat to the HRSGs.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality): >>

Without the Energas operations, Cuba's grid electricity supply would continue to be met primarily by oil-fired units. Generation from the gas-fired Energas Project units has provided the second most important source of supply to the grid, yet the rate of GHG emissions per kWh associated with it are greatly reduced compared with generation using heavy fuel oil (which is the largest source of electricity supplied to the grid). When the project was constructed, the balance of grid supply was provided from biomass/wood fired units and small hydroelectric facilities, all of which are considered 'carbon neutral' for the purposes of the Baseline GHG calculation.

The project activity generates electric power for the Cuban national grid using waste heat, supplemented for auxiliary heat purposes by gas. Even with emissions from the use of gas for auxiliary heating in the HRSGs included, GHG emissions from within the project boundary are lower than would otherwise have been obtained in the Baseline scenario. This is the result of a lower emission factor of any gas used and essentially no additional emissions associated with the use of waste heat from the exhaust.

Consequently, in terms of the Operating Margin, GHG emissions associated primarily with oil-fired units that make up the bulk of Cuba's installed grid generation capacity will be reduced as energy from the project activity is fed into the grid. Similarly, given the Build Margin is a combination of generation technologies already in use, the project activity will reduce incremental GHG emissions as well, albeit to a lesser extent due to the higher contribution of renewables to the Build Margin relative to that of the Operating Margin.

Additionality

Approved Consolidated Methodology ACM0007 specifies that the latest version of the "Tool for the demonstration and assessment of additionality" should be used to demonstrate the additionality of the project. Application of this document follows:

Step 0 - Preliminary screening based on the starting date of the project activity

Step 0(1)a - Evidence that the starting date of the CDM project activity falls between 1 January 2000 and the date of the registration of a first CDM project activity.

The project participants have prepared a memorandum summarizing the history of the project activity, including the date on which it began operations. (see References attached as Annex 5; Ref. 1) In addition to this history, we have compiled several documents that both illustrate the lengthy delays in completion of this project and the final approvals received for it in support of a start date after the year 2000. These documents show a variety of initial and renewed approvals received from the years 1998 through 2002 and are listed in Annex 5. (Ref. 2) The documents themselves are not included here because they are in

Spanish but they will be provided to the DOE for full validation. Supporting the start date in March 2003 is Energas operating data showing the increase in electricity production that corresponds to the start of the steam turbine. (Ref. 3) Commissioning of the facilities commenced in February 2003. Commissioning was effectively completed at the end of February 2003. While some electricity was produced during commissioning, it was not significant, and therefore, March 1, 2003 is used as the project start date for the purposes of estimating emissions reductions for the CDM project activity. Electricity sales data are not unit specific so electricity generated by the combined cycle steam turbine is not separately identified in documentation showing sales to UNE. The DOE will be provided with all operating data to confirm the start date during the validation process.

Step 0(1)b - Evidence that the incentive from the CDM was seriously considered in the decision to proceed with the project activity.

Sherritt has actively sought opportunities to reduce energy consumption and greenhouse gas emissions from their domestic and international operations since 1994. (Ref. 4) In 1995, Sherritt expressed publicly its commitment to “study major emissions reduction projects that may total up to a 6% reduction of 1990 CO_2 emission levels” and to “consider emission reduction projects at rates of return down to the corporate cost of capital”[4]. (Ref. 5) These public undertakings contributed to the corporate vision and objectives of the Energas consortium, which was founded on the concept of using Cuba’s energy resources – including wherever possible the waste by-products thereof - to the fullest extent possible.

The Government of Cuba made a commitment to the mitigation of climate change when it became a signatory to the UNFCCC in 1994. On April 30, 2000 Cuba ratified the Kyoto Protocol of the UNFCCC and in Agreement 4604 the Council of Ministers identified the CDM as a possible contributor to Cuban sustainable development. In November 2001, Cuba published its first National Communication to the UNFCCC. Section 4 of this document (Section 4.3.2) refers to the benefits gained from the Varadero operation of salvaging the raw gas from oil operations and makes specific reference to the use of the combined cycle technology. This document is in Spanish so it has not been attached as a reference, but it is available at http://unfccc.int/essential_background/library/items/3599.php?rec=j&priref=3186 for review.

In his opening speech to a Sustainable Energy Policy Concepts (SEPCo) workshop in Cuba in December 2001, Cuba’s Vice Minister of Economy and Planning remarked that the guarantee of a sustainable and steady energy supply to rural and low-income areas has been a priority for the Cuban Government since its beginning. He also referenced the Rio Summit 10 years earlier in saying that developed countries need to contribute to developing countries to achieve a sustainable energy infrastructure. (Ref. 6) These statements are consistent with the overriding approach in the country towards maximizing all the benefits (economic as well as environmental) that can be gained from any activity or resource.

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[4] For clarity, Sherritt would undertake emission reduction projects at rates of return that reflect the risks associated with the project. For example, a project with a rate of return equal to Sherritt’s corporate cost of capital, would be undertaken if the risks associated with the project were extremely low. On the other hand, a risky project would require a return much higher than the corporate cost of capital before Sherritt would proceed with it. The project activity has many risks associated with it (to be discussed later in this document) and thus must have a rate of return somewhat higher than Sherritt’s corporate cost of capital, otherwise it would not proceed.

A Sherritt affidavit has also been included, which outlines some of this history, acknowledges that the environmental improvement in the Varadero resort area was part of the consideration in the formation of the joint venture and asserts that the project activity was undertaken as part and parcel of Sherritt's long-standing commitment to investigate opportunities for international and domestic "offset" projects. (Ref. 7) These statements are also confirmed in the prospectus for the financing of the Project (Ref. 8, p.24) and in the Association Agreement that established the Energas joint-venture (Ref. 9, p.2) where the environmental benefit to the Varadero region and conservation of the environment was recognised.

Step 1 - Identify alternatives to the project activity consistent with current laws and regulations

Step 1(a)1 - Identify realistic and credible alternative(s) available to the project participants or similar project developers that provide outputs or services comparable with the proposed CDM project activity.

Energas was created in 1997 for the main purpose of processing raw gas and then utilizing this "clean" processed gas as a fuel for electricity generation. (Ref. 8; p.16 and Ref. 9, p.2) Generation with other fuels/technologies was not within the mandate of the joint-venture. Therefore, the only alternative available to the project consortium, other than the proposed project activity not undertaken as a CDM project activity, involves the continuation of the operation of the existing GTs in open cycle. The addition of open cycle facilities with similar capacity to the project activity was not considered to be a realistic and credible alternative due to limited natural gas reserves in the vicinity of the project activity (Ref. 8, p.24).

The possibility of undertaking the project without the benefit of CDM revenues was also considered untenable. When the project was initiated the CDM process was still evolving and there was no way to quantify the potential revenues that might accrue. The series of Energas projects had to be undertaken with the resulting positive change to the Cuban environment in-mind, deferring any consideration of a CDM related financial reward until later. Although the completion and operation of the project for about three and a half years suggests that abandoning any CDM related revenues was a possible alternative, the reality is that it is not necessarily the case.

As a stand-alone project the problems previously identified and the barriers discussed in later sections of this document make project operation without long term benefit of CDM revenues very difficult. The lack of these revenues would reduce the potential for additional economic and social benefits that may result from further investments in electrical generation capacity in Cuba. As these benefits to the sustainability of the Host country were a major consideration in completion of the project, this was not considered to be a viable alternative.

Step 1(b)2 - Show that project activity and alternatives identified in Step 1a are in compliance with all applicable host country legal and regulatory requirements.

The project participants applied for and received the required licenses from the Republic of Cuba, Ministry of Science, Technology and Environment, under Article 11, Chapter 11, Resolution 168/95. The original licenses for Energas are dated 1996 and 1997. As indicated in the history (Ref. 1), early planning for a possible combined cycle expansion resulted in the granting of permits in 1998. As a result of the delays documented in the history, these permits and licenses had to be revised after the year 2000 when project activity recommenced. Examples of these are the Microlocalization certificates from the province of Matanzas and the environmental license issued by the Cuban government in January 2001. (These are part of the list in Ref. 2.)

The Cuban regulatory environment as it pertains to foreign investment in the energy industry was not highly developed when the Energas operations began. This is likely due to a number of reasons, not the least of which would be the lack of need given the low level of foreign investment in the country. Each proposal and application for development has been scrutinized by the appropriate Cuban authorities to ensure that the applicable Cuban regulations have been met. Where it was deemed necessary, changes were requested and made to the project plans. As a result, the Energas operations have been conducted under the specific requirements of project operating permits and environmental licenses.

In order to provide an internal basis for project design the project developers followed regulations that would apply in Canada (more specifically the province of Alberta) in all specifications and designs. This ensured that international standards are met and in most cases was acceptable to Cuban authorities. All equipment used is required to comply with codes as set out by a wide range of Canadian, and US organizations, including the Canadian Standards Association, the Canadian Electrical Code Part One, the Provincial (Alberta) Electrical Protection Act, Provincial (Alberta) Boiler and Pressure Vessels Act and Regulations, the American Iron and Steel Institute, the American National Standards Institute, the American Petroleum Institute and the Electrical and Electronic Manufacturer's Association of Canada.

The alternative to continue with the current situation is also in compliance with all applicable host country legal and regulatory requirements.

Step 2 – Investment Analysis

As specified in the 'Tool for the demonstration and assessment of additionality' either investment analysis or barrier analysis must be applied to assess whether the project activity could be considered the baseline. For the Energas Varadero Conversion from Open Cycle to Combined Cycle Project the project participants have chosen to use barrier analysis to prove additionality.

Step 3 – Barrier Analysis - *Determine whether project activities of the type proposed face barriers that:*
(a) Prevent the implementation of this type of proposed project activity; and
(b) Do not prevent the implementation of at least one of the alternatives.

Step 3a - *Identify barriers that would prevent the implementation of this type of proposed project activity*

1. Investment Barriers

a) Access to direct project financing is extremely rare for Cuban projects. For some years now Cuba has been a relatively challenging market for foreign investment. United Nations statistics on foreign direct investment in the developing world indicate that Cuba's ability to attract foreign direct investment is extremely limited. (Ref. 10) This is attributable, at least in part, to perceived risks in investing in Cuba; risks which are reflected in Cuba's very low credit rating (Ref. 11) and in turn, on the rates of interest international lenders demand for loans for projects in Cuba (Ref. 8; p. 1). The U.S. Dept. of State has observed that "[t]he Cuban Government …

does not have access to credit from international financial institutions like the World Bank, which means [Cuba] must rely heavily on short-term loans to finance imports…Dunn and Bradstreet rate Cuba one of the riskiest economies in the world.” (Ref. 12. p.6). As a result of the lack of third party financing, Sherritt's alternatives for financing the project activity were to provide funds from internal sources or obtain third party financing by providing guarantees and assurances from the parent company. The total funds required for completion of the project were in the order of Canadian $130 million. Funds were primarily raised through an initial public offering for Sherritt Power Corporation, which was established to work towards the development of various energy opportunities in Cuba and elsewhere in the world. (Ref. 8.)

b) Cuba's access to foreign currency is limited and subject to significant variability. The ability of Energas to repay financing provided by Sherritt and to distribute profits (dividends) will depend largely on the level of foreign currency reserves which the government of Cuba and its respective agencies are able to maintain. Cuban imports are generally paid for with foreign currency while Cuba's supply of foreign currency is dependent on exports and tourism both of which tend to be cyclical. As a result, the repayment of financing and payment of dividends may be subject to delays from time to time.

2. Availability and Cost of Expertise, Equipment and Materials

Expertise, equipment and materials are not available for Cuban projects under terms and conditions typical for projects in developed countries. The United States trade embargo established in October of 1960 generally prohibits U.S. based or U.S. owned companies from engaging in transactions involving Cuban companies such as Energas, including the financing of project activities. In addition, U.S. originated technology, U.S. originated goods, and many goods produced from U.S. originated components or with U.S. originated technology cannot under U.S. law be transferred to Cuba or used in the project activity.

Furthermore, companies whose investments in Cuba involve the “trafficking” of property or assets confiscated by the government of Cuba from U.S. citizens or persons who have since become U.S. citizens, may be subject to a claim for damages pursuant to the 1996 *Cuban Liberty and Democratic Solidarity (Libertad) Act* (Ref. 13) in respect of such “trafficking”.

As a result of the above, Sherritt would be forced to source expertise, equipment and materials that generally do not have any link to the U.S. This could potentially cause delays in sourcing the above mentioned resources and increased costs.

Cost premiums can be direct and indirect. Direct cost premiums are due to vendor awareness of the difficulty Cuban project developers face obtaining material and expertise and charge a premium accordingly. Freight, handling, legal and other administrative costs are also higher due to the need to deal with multiple and remote jurisdictions. Indirect cost premiums are related to construction delays attributable to having to hire foreign personnel not familiar with the technology, processes or techniques in use that are otherwise well known to North American technical specialists and technicians; higher wages and salaries for non-North American personnel on an exchange-adjusted basis; and delays associated with acquiring spare parts or specialized technical expertise in the event of unanticipated construction problems. (Ref. 14).

The prolonged delay implementing the project activity was due in part to the effect of the above U.S. laws on non-U.S. based or owned suppliers of goods or services to the project activity. In general it can be said that developers of projects in Cuba are not typically able to use the vendors of their choice, resulting in much higher costs than would otherwise be required if the project were elsewhere. Typically, the absence of access to a competitive market for materials, equipment and expertise results in higher costs.

3. Lack of Prior Experience in Construction and Operation of Similar Facilities

There are no similar facilities in Cuba and there is no base of experience in the construction or implementation of this type of facility in any location. In addition, Sherritt had no previous experience in constructing and operating a combined cycle facility. This lack of experience could result in problems (delays, cost overruns, reduced production) in the construction and operation of the facility.

4. Availability of Natural Gas Supply

a) Cuba does not have surplus of natural gas reserves in the vicinity of the project activity. Proven reserves at the time the project was approved indicated a project life of 7 years, while including probable and possible reserves (which are by definition less certain to be realized) extended the life to 20 years. (Ref. 8, p.24).

b) Natural gas is produced in association with crude oil. Natural gas reserves are not owned by Sherritt or Energas. The extraction of these reserves is controlled by CUPET. CUPET is obligated to provide natural gas produced from specified oil fields to Energas subject to specified daily maximums based on plant capacity, however, oil production is given preference over natural gas production. As a result, CUPET may operate the oil fields such that oil production is maximized without consideration of the impact on natural gas production. This may result in insufficient natural gas to meet the ongoing plant requirements.

5. Infrastructure

a) Access to land transportation for equipment and materials is sometimes limited in Cuba. As a result, delivery of equipment and materials to the plant site could be delayed. This could in turn delay the completion of the project and limit day to day production.

b) The reliability of the electrical grid is generally not up to the standards of industrial countries. As a result, the project may not always be able to operate at full capacity

6. Weather

The frequency of severe weather such as hurricanes and thunderstorms could cause delays in delivery of equipment, delays in construction and periods during which the facilities will not be able to safely operate.

Step 3b - Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity):

There are no barriers to the alternative of continuing with only the existing open cycle facilities.

Barrier Analysis Conclusion - The barriers presented would make it unlikely that the project activity as described would proceed on a standalone basis, if not registered as a CDM activity. The additional revenue stream provided by CER's, if this project is registered as a CDM activity, would mitigate these barriers and increase the potential for the project to earn a reasonable rate of return.

Step 4 - Common Practice Analysis

Step 4a - Analyze other activities similar to the proposed project activity

The investment climate in Cuba is dramatically different from other countries in the Caribbean region. Consequently there are no other projects existing or underway that might be considered similar or comparable as outlined in the 'Tool for the demonstration and assessment of additionality (version 2)'.

The Energas Varadero combined cycle facility is the first of its kind in Cuba. There are no similar facilities existing or, to our knowledge, under construction in Cuba. The project is further unique in that the waste heat utilized and additional heat supplied is produced with natural gas produced on-site from the treatment of raw gas from petroleum production facilities nearby.

Step 4b – Discuss any similar options that are occurring

No similar activities have been observed in Cuba.

Conclusion – There are no activities similar to the project activity. Other power generation activities have been developed or considered (in Cuba), but none involve electricity generation from waste heat.

Step 5 - Impact of CDM Registration

T*he approval and registration of the project activity as a CDM activity, and the attendant benefits and incentives derived from the project activity, will alleviate the identified barriers (Step 3).*

1. Anthropogenic greenhouse gas emission reductions – The project activity is capable of reducing GHG emissions associated with electricity generation for the Cuban grid by over 342 kT/year.

2. The financial benefit of the revenue obtained by selling CERs – Project participants will utilize the net sales revenue from that portion of the CERs they choose to sell to meet existing debt service obligations and to invest in capital maintenance in order to keep existing assets operating optimally.

3. The project activity is a small step toward much needed replacement and augmentation of existing electricity generation facilities in Cuba. The financial benefit and risk mitigation that the CDM

registration provides may encourage other developers to consider low or zero GHG emission projects in Cuba, whether for grid supply, or to provide essential service to off-grid rural communities.

4. The CDM registration and successful certification of CERs will increase the likelihood for other similar projects to be developed in Cuba. This in turn will allow the transfer of technology and skills to Cuba.

5. The sale of CER's will introduce a cash flow that can be sourced from outside of Cuba. While the quantity of CER's available for sale will still be subject to the risks of completing a project of this type in Cuba, this non-Cuban cash flow will likely be seen by lenders as being more secure than Cuban based cash flows and would therefore result in more attractive financing opportunities than would otherwise be available.

Additionality Conclusion:

The above multi-step analysis shows that the project activity faced significant barriers to completion. The option to continue operating the existing open cycle facilities, with no conversion to combined cycle, did not face these barriers. As a result, the project activity would not be a likely choice as the baseline.

The project activity's contributions to the overall reduction of GHG emissions, its benefits for the local environment and to the local economy were serious considerations in the decision by all project participants to implement the project. Based on the use of the tool for the demonstration and assessment of additionality, it is evident that the project activity is additional and is not the baseline scenario.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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This methodology is used in conjunction with approved consolidated baseline methodology ACM0007. The same applicability conditions apply as in baseline ACM0007.

The methodology will monitor:

- Electricity generation from the project activity;
- Electricity consumption by the project activity
- Electricity sales by the project activity
- Fuel consumption associated with the project activity;
- Data needed to recalculate the emissions attributable to the operation of the gas turbines in open cycle under the baseline scenario, consistent with baseline methodology "Baseline methodology for replacing grid-based power by emissions-neutral power from existing fossil-fuel powered facilities using previously unused waste heat";

The data required for monitoring the Electricity generation from the project activity, the electricity consumption of the project, the electricity sales of the project, the fuel consumption associated with the project activity, and the data required to calculate the emissions attributable to open cycle are all collected within the plant. A computer model has been generated to consolidate and calculate the required parameters. A copy of the model has been attached in Annex 3 in spreadsheet form.

All data required to calculate grid baseline information is provided and verified by the Cuban national electrical utility (UNE). Similarly a computer model has been generated to calculate all of the required grid baseline components; a copy of this model is also attached in Annex 3.

Project emissions (PE_y) are calculated using the formula:

$$PE_y = (FGT_{NG,y} + FST_{NG,y}) * COEF_{NG,y}$$

Where: $FGT_{NG,y}$ is the amount of natural gas (in Nm^3) used to operate the gas turbines at the project in year y and $FST_{NG,y}$ is the amount of natural gas (in Nm^3) used to add supplementary heat in the HRSG for production of steam to operate the steam generator at the project in the year y. $COEF_{NG,y}$ is the CO_2 coefficient for natural gas used in the project, in tCO_2/Nm^3.

$$COEF_{NG,y} = EF_{CO2,NG,y} * OXID_{NG,y} * NCV_{NG,y}$$

$EF_{CO2,NG,y}$ is the CO_2 emission factor per unit of volume of natural gas (tCO_2/GJ), $OXID_{NG}$ is the oxidation factor of natural gas (0.995 as per the IPCC), and $NCV_{NG,y}$.is the Net Calorific Value of natural gas (GJ/Nm^3).

Baseline emissions for the year (BE_y) are calculated according to ACM0007 using the following formula:

$$BE_y = (EF_{OC,y} * OG_y) + (EF_{grid,y} * CG_y)$$

Where $EF_{OC,y}$ is the emission factor for the plant operating in open cycle mode, OG_y is the electricity generated by the plant operating in open cycle for the year, $EF_{grid,y}$ is the emission factor for the electricity grid during the year calculated using the "Consolidated baseline methodology for grid connected electricity generation from renewable sources (ACM0002) and CG_y is the electricity generated from the use of waste heat in the year.

The emission factor for the plant operating in open cycle mode is calculated using the formula:

$$EF_{OC,y} = \frac{FC_{HIST,y} \times COEF_{NG,HIST,y}}{HG_{OC,HIST,y}}$$

Where $FC_{HIST,y}$ is the annual average fuel use of the gas turbines over the three (3) years prior to the project activity, $HG_{OC,HIST,y}$ is the average net annual generation from operation of the plant in open cycle mode over the three (3) years prior to the start of the project activity and $COEF_{NG,HIST,y}$ is the GHG coefficient per unit of fuel (natural gas) for the open cycle gas turbine based on the 3 years before the project.

The electricity generated in open cycle mode in the baseline (OG_y) comes from the following formula, where OC_y is the net capacity of the open cycle GTs in MW and time (T) is the number of hours the plant operated in the year:

$$OG_y = PLF_y * OC_y * T$$

ACM0007 outlines two options for calculating the plant load factor (PLF_y), the first of which is used here. For this application;

$$PLF_y = \frac{HG_{OC,HIST,y}}{OC_{HIST,y} \times 8760}$$

Where $HG_{OC,HIST,y}$ is the average net annual generation from the operation of power plant in open cycle mode based on 3 years of generation records previous to the start of the project (in MWh) and $OC_{HIST,y}$ is the net historic capacity of the plant's open cycle GT (in MW) over the 3 years before the project. (8760 = hours in a full year)

The electricity generation attributable to the use of waste heat to produce steam during the year (CG_y) is calculated as the total electricity generated by the project using both gas turbine generators and steam generator (PG_y) less the electricity generated by the gas turbines alone in open cycle as calculated in the baseline (OG_y).

$$CG_y = PG_y - OG_y$$

Finally, ACM0007 specifies that the baseline emission factor ($EF_{grid,y}$) is calculated as a combined margin (*CM*) using the baseline section of ACM0002, "Consolidated baseline methodology for grid-connected electricity generation from renewable sources". In this case it is fixed ex ante. The *CM* is a combination of the Operating Margin (*OM*) and the Build Margin (*BM*) for the grid. There are four options for calculating the *OM* but the preferred method is using Dispatch Data. Due to limitations in the data available for the Cuban electrical grid, it was felt that using this method would produce a less reliable figure. Based on the average of the 3 years prior to the project start (the most recent 3 years for which data are available at the time of PDD submission), about 90% of the supply of power to the Cuban grid came from oil and gas-fired generation. The balance came from low-cost/must run resources so the Simple emission rate Method was used for calculating *OM*.

Using the Simple emission rate Method, the emission factor for the OM in the year is calculated as follows:

$$EF_{OM,y} = \frac{\sum_{i,j} F_{i,j,y} \times COEF_{i,j}}{\sum_{j} GEN_{j,y}}$$

Where $F_{i,j,y}$ is the total amount of fuel (*i*) used by all relevant power sources (*j*) in the year. Relevant power sources include all generating sources serving the grid not including those that have low operating costs or which are must-run plants (like solar, hydro, nuclear, solar, etc.). $GEN_{j,y}$ is the amount of electricity delivered to the grid by each source (*j)* and $COEF_{i,j,y}$ is the CO_2 emission coefficient for each fuel (*i*) used at each power source (*j*) in year (y).

$COEF_{i,j,y}$ is calculated as the product of the net calorific value, the oxidation factor and the CO_2 emission factor of each fuel.

Continuing to follow ACM0002, the BM emission factor for the baseline ($EF_{BM,y}$) is the generation-weighted average emission factor (tCO_2/MWh) of a sample of power plants *m* as follows:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \times COEF_{i,m,y}}{\sum_{m} GEN_{m,y}}$$

Where $F_{i,m,y}$, $COEF_{i,m,y}$ and $GEN_{m,y}$ are analogous to the variables described for the Simple OM method above for plants *m*.

Project participants are to select one of two options, selection of the sample and calculation of $EF_{BM,y}$ before hand (ex-ante) or after the first crediting period (ex-post). The sample can not change during the crediting period. For this project, the sample of plants is chosen in advance (Option 1) as the most straightforward method. The sample is to consist of either the five power plants that have been built most recently, or the most recent power plant additions that comprise 20% of the system generation (in MWh). The option that produces a sample group that comprises the larger annual generation is to be used. In this case, because the grid power plants consist of units that were brought on-line at different times, we have used individual units rather than plants. Consequently in order to ensure a large enough sample the most recently installed units comprising at least 20% of generation has been used.

The baseline emission factor ($EF_{grid,y}$) is a weighted average of the OM and BM as calculated above. This project uses the recommended weights of 50% for each of the operating and build margins. The formula is as follows:

$$EF_{grid,y} = w_{OM} * EF_{OM,y} + w_{BM} * EF_{BM,y}$$

Where *w* is the weight applied for each of the emission factors (*OM* & *BM*)

Leakage:
ACM0007 specifies that leakage during construction need not be considered and that CH_4 emissions can be ignored if project proponents demonstrate that these are a negligible fraction of the baseline. The methodology excludes CH_4 emissions from the baseline and the project emission calculations as a simplification since they are assumed to be very small. The approved monitoring methodology specifically states that no data are required as Leakage is assumed negligible. [ACM0007, page 15]. .

B.6.2. Data and parameters that are available at validation:

The following data are available at validation and are not monitored throughout the crediting period.

Data / Parameter:	$\mathbf{w_{OM}}$
Data unit:	%
Description:	Operating margin weighting factor
Source of data used:	UNFCCC – Approved Consolidated Baseline Methodology ACM0002
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	Weighting taken to be the default value as specified in the Approved Consolidated Baseline Methodology ACM0002.
Any comment:	This Value is to be fixed for the crediting period.

Data / Parameter:	$\boldsymbol{w_{BM}}$
Data unit:	%
Description:	Build margin weighting factor
Source of data used:	UNFCCC – Approved Consolidated Baseline Methodology ACM0002
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	Weighting taken to be the default value as specified in the Approved Consolidated Baseline Methodology ACM0002.
Any comment:	This Value is to be fixed for the crediting period.

Data / Parameter:	$\mathbf{OXID_{NG,HIST,y}}$
Data unit:	%
Description:	Average Oxidation factor of natural gas in the previous 3 years.
Source of data used:	IPCC
Value applied:	0.995
Justification of the choice of data or description of measurement methods and procedures actually applied :	Data to be used with emission factor and net calorific value to calculate GHG Coefficient.
Any comment:	These data are provided by IPCC (IPCC 1996 Revised National GHG Inventory) value fixed throughout crediting period.

Data / Parameter:	**EF_{grid}**
Data unit:	tCO_2/MWh
Description:	Average CO_2 Emission Factor for all units on the grid.
Source of data used:	Calculated
Value applied:	0.906tCO_2/MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated as a combined margin using a combination of the Operating Margin (*OM*) and the Build Margin (*BM*) for the grid and is fixed ex ante.
Any comment:	

Data / Parameter:	**$HG_{OC,HIST,y}$**
Data unit:	MWh
Description:	Historical average annual net generation in open cycle for 3 years before project activity.
Source of data used:	Metered on-site by Energas
Value applied	725,585 MWh
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is historical data based on the 3 years before the project activity. As historical data it does not change in future. For calculation of the Plant Load Factor for open cycle
Any comment:	

Data / Parameter:	**$OC_{HIST,y}$**
Data unit:	MW
Description:	Historical average net capacity of the plant in open cycle for 3 years before project activity.
Source of data used:	Calculated
Value applied	99.23. Based on Mar 2000 – Feb 2003
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is historical data based on the 3 years before the project activity. As historical data it does not change in future. For calculation of the Plant Load Factor for open cycle
Any comment:	

Data / Parameter:	**$FC_{HIST,y}$**
Data unit:	Nm^3
Description:	Average annual fuel used in the GT's for the 3 years before project activity
Source of data used:	Calculated
Value applied	260,872,645 for all years
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is historical data based on the 3 years before the project activity. As historical data it does not change in future. For calculation of emission factor in open cycle mode.
Any comment:	

Data / Parameter:	**OC_y**
Data unit:	MW
Description:	Net capacity of the plant in open cycle in year 'y'
Source of data used:	Calculated
Value applied	106.2 for all years
Justification of the choice of data or description of measurement methods and procedures actually applied :	For calculation of electricity generated by open cycle in the baseline.
Any comment:	This value is to be fixed for the crediting period.

Data / Parameter:	**OG_y**
Data unit:	MWh
Description:	Electricity Generated by the open cycle in year 'y'
Source of data used:	Metered/Calculated
Value applied	725,585. Based on Mar 2000 – Feb 2003
Justification of the choice of data or description of measurement methods and procedures actually applied :	These data are to be fixed for the crediting period. For calculation of electricity generated by open cycle in the baseline
Any comment:	

Data / Parameter:	**$NCV_{NG,HIST,y}$**
Data unit:	GJ/Nm^3
Description:	Average Net Calorific Value for natural gas in the previous 3 years.
Source of data used:	Calculated
Value applied	0.0346
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is historical data based on the 3 years before the project activity. As historical data it does not change in future. For calculation of historical GHG coefficient for natural gas used during open cycle generation.
Any comment:	

Data / Parameter:	**$EF_{CO2NG,HIST,y}$**
Data unit:	tCO_2/Nm^3
Description:	Average emission factor for natural gas in the previous 3 years
Source of data used:	Calculated by Energas
Value applied	0.0618
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is historical data based on the 3 years before the project activity. As historical data it does not change in future. For calculation of historical GHG coefficient for natural gas used during open cycle generation.
Any comment:	

Data / Parameter:	**$F_{i,j,y}$**
Data unit:	l, t, Nm^3
Description:	Amount of fuel (i) used at power sources (j) in the year
Source of data used:	UNE
Value applied	For fuel types: Extra Heavy Fuel Oil = 381,105 t_{fuel} Crude 650 = 960,286 t_{fuel} Fuel oil = 131,886 t_{fuel} Crude 1100 = 897,110 t_{fuel} Crude 1400 = 972,865 t_{fuel} Natural Gas = 398,432,488 Nm^3
Justification of the choice of data or description of measurement methods and procedures actually applied :	For calculation of CO_2 emission factor, based on the grid. As per ACM0002 this parameter is fixed ex ante.
Any comment:	

Data / Parameter:	**$NCV_{i,y}$**
Data unit:	GJ/t_{fuel} for oil or GJ/Nm^3 for gas
Description:	The net calorific value for the fuels used at power sources on the grid
Source of data used:	UNE
Value applied	All fuel types: Extra Heavy Fuel Oil = 40.821 GJ/t_{fuel} Crude 650 = 40.193 GJ/t_{fuel} Fuel oil = 41.868 GJ/t_{fuel} Crude 1100 = 40.193 GJ/t_{fuel} Crude 1400 = 40.193 GJ/t_{fuel} Natural Gas = 0.035 GJ/Nm^3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Used in calculation of CO_2 emission coefficient for the fuel used elsewhere on the grid. As per ACM0002 this parameter is fixed ex ante.
Any comment:	

Data / Parameter:	**$EF_{CO2,i,y}$**
Data unit:	tCO_2/GJ
Description:	The CO_2 emission factor per unit of energy for each power source on the grid
Source of data used:	IPCC
Value applied	0.07333tCO_2/GJ
Justification of the choice of data or description of measurement methods and procedures actually applied :	Used in calculation of CO_2 emission coefficient for the fuel used elsewhere on the grid. As per ACM0002 this parameter is fixed ex ante.
Any comment:	Applied to all Crude oil, Fuel oil and Extra Heavy Fuel oil consumed in the grid.

Data / Parameter:	**$OXID_j$**
Data unit:	%
Description:	The oxidation factor for each power source on the grid
Source of data used:	IPCC
Value applied	0.99
Justification of the choice of data or description of measurement methods and procedures actually applied :	Used in calculation of CO_2 emission coefficient for the fuel used elsewhere on the grid. As per ACM0002 this parameter is fixed ex ante.
Any comment:	Applied to all Crude oil , Fuel oil and Extra Heavy Fuel oil consumed in the grid.

B.6.3 Ex-ante calculation of emission reductions:

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There are only a limited number of emission sources that are directly associated with the project activity. As outlined in ACM0007, the project boundary includes emissions associated with the operation of the gas turbines that produce the waste exhaust gas for the project. This is appropriate since this gas is passed through the project's HRSGs to produce steam before being released to the atmosphere. In addition to this, there will be emissions associated with any use of natural gas that is used to supplement the heat from the exhaust gasses. These are not incremental increases in emissions from the site due to flaring of surplus gas outside the project boundary but they are included in the project emissions as specified in ACM0007. Beyond the HRSGs, there is no use of fossil fuel in the process so additional emissions will be negligible. This is reflected in the lack of leakage in the project.

As noted in Section B.5 earlier, the project started in March 2003 and data have accumulated since then. The most attainable start for crediting period, however, is April 1st 2007 so in preparation of the project emissions, annual periods of 12 months were used, based on this crediting start. The baseline data is based on the period before the project started, when only open cycle production was available. Given these factors, the first year of the crediting period will be from April 2007 to March 2008.

Project Emissions:

Project Emissions are given by the formula:

$$PE_y = \left(\sum FGT_{NG,y} * COEF_{NG,y}\right) + \left(\sum FST_{NG,y} * COEF_{NG,y}\right)$$

$$COEF_{NG,y} = NCV_{NG,y} * EF_{CO2,NG,y} * OXID_{NG,y}$$

All fuel burned in the GT and HRSG is natural gas refined at the same site from formerly wasted raw gas so coefficients and other characteristics of the fuel are the same for each emission source. The characteristics of this fuel are consistent from year to year. Net Calorific Value (*NCV*) is 0.0346 GJ/Nm^3, the CO_2 Emission Factor (EF_{CO2}) is 0.0618 tCO_2/GJ and the Oxidation factor (*OXID*) is 0.995. These data produce a GHG coefficient for the fuel (*COEF*) at the Varadero Conversion from Open Cycle to Combined Cycle Project of 0.0021 tCO_2/Nm^3.

PE_y = 728,666tCO_2

Combining the coefficient data with actual fuel use produces the following table of project emissions. The most recent complete year of project operating data is for the 2005-2006 operating year. This has been used as the basis for estimating the future years in the crediting period.

Year	**Estimated Project Emissions (PE_y) (tCO_2)**
Apr-2007 to Mar-2008	728,666
Apr-2008 to Mar-2009	728,666
Apr-2009 to Mar-2010	728,666
Apr-2010 to Mar-2011	728,666
Apr-2011 to Mar-2012	728,666
Apr-2012 to Mar-2013	728,666
Apr-2013 to Mar-2014	728,666

Leakage Emissions:
As noted earlier, ACM0007 specifies that there is no data required for potential leakage as it is assumed to be negligible.

Baseline Emissions:
As outlined in the baseline methodology ACM0007, baseline emissions are calculated as electricity that would be generated by the project in open cycle mode and by existing (and likely future) grid-connected power plants. The formula for this is:

$$BE_y = (EF_{OC,y} * OG_y) + (EF_{grid,y} * CG_y)$$

The components of this formula are calculated below, based on the formulae provided.

Step 1.
The average net annual generation of the power plant in open cycle mode, based on the three years previous to the project activity (OG_y) is:

$$OG_y = \left(725{,}585MWh/\left(99.23MW * 8760\ h\right)\right) * 99.23\ MW * 8760\ h$$
$$= 725{,}585\ MWh/y$$

Step 2,
The average emission factor for the power plant operating in open cycle mode for the three years previous to the project activity ($EF_{OC,y}$) is:

$$EF_{OC,y} = (260{,}872{,}645Nm^3 / 725{,}585\ MWh) * 0.002130\ tCO_2/Nm^3$$
$$= 0.766\ tCO_2/MWh$$

Historic data for COEF is as provided above. Although these characteristics are essentially the same from year to year, they will be measured on a regular basis for verification.

Step 3,
The electricity generation attributable to the use of waste heat to produce steam during the year (CG_y) is calculated as the total electricity generated by the project using both gas turbine generators and steam generator (PG_y) less the electricity generated by the gas turbines alone in open cycle (OG_y) and is:

$$CGy = 1{,}293{,}782\ MWh – 725{,}585MWh$$
$$= 568{,}197\ MWh$$

Step 4,
The baseline emission factor ($EF_{grid,y}$) is a weighted average of the OM and BM as calculated above. This project uses the recommended weights of 50% for each of the operating and build margins. The baseline emission factor is based on 3 years of data prior to the start of the project activity and is:

$$EF_{grid,y} = [((0.9347+0.9185+0.9465)/3)*0.5] + (0.8780 * 0.5)]$$
$$EF_{grid,y} = 0.906tCO_2/MWh$$

Step 5,
The baseline emissions for the year (y) are calculated as:

BE_y = (0.766 tCO_2/MWh * 725,585MWh) + (0.906 tCO_2/MWh * 568,197 MWh)
= 1,070,901 tCO_2/year

Project Emission Reductions:
ERy = BE_y – PE_y - L_y
= 1,070,901tCO_2 – 728,666 tCO_2 – 0
= 342,235 tCO_2/year

B.6.4 Summary of the ex-ante estimation of emission reductions:

>>

The following table shows emissions from the project, from the baseline and the resulting emission reductions. Annex 3 contains the data used in these calculations.

Year	Project Emissions (PE_y) (tCO_2)	Baseline emissions (BE_y) (tCO_2)	Leakage (L_y) (tCO_2)	Reduction of Emissions (ER_y) (tCO_2)
Apr-2007 to Mar-2008	728,666	1,070,901	0	342,235
Apr-2008 to Mar-2009	728,666	1,070,901	0	342,235
Apr-2009 to Mar-2010	728,666	1,070,901	0	342,235
Apr-2010 to Mar-2011	728,666	1,070,901	0	342,235
Apr-2011 to Mar-2012	728,666	1,070,901	0	342,235
Apr-2012 to Mar-2013	728,666	1,070,901	0	342,235
Apr-2013 to Mar-2014	728,666	1,070,901	0	342,235
Total (Tonnes of CO_2 e)	5,100,662	7,496,307	0	2,395,645

B.7 Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**$FGT_{NG,y}$**
Data unit:	Nm^3
Description:	Project activity consumption of natural gas to operate the gas turbine for the year (y)
Source of data to be used:	Metered on site by Energas
Value of data applied for the purpose of calculating expected emission reductions in section B.5	260,872,645 for all years Details for each unit are in tables in Annex 3.
Description of measurement methods and procedures to be applied:	Gas input to each turbine is continuously monitored and recorded daily. Data will be downloaded and consolidated for input to the monitoring data model annually or when periodic verification is required. Measure to be used with the GHG Coefficient to calculate project emissions from GTs.
QA/QC procedures to be applied:	These data are measured on-site continuously and recorded daily, based on AGA 3 metering technology. The results are compared to energy balance data over the year.
Any comment:	

Data / Parameter:	**$FST_{NG,y}$**
Data unit:	Nm^3
Description:	Project activity consumption of natural gas used for supplementary heat in the HRSG for the year (y).
Source of data to be used:	Metered on site by Energas
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Mar 2005 – Feb 2006 = 77,707,725. Used as the basis for all future years Details for each unit are in tables in Annex 3.
Description of measurement methods and procedures to be applied:	Gas input to each HRSG is continuously monitored and recorded daily. Data will be downloaded and consolidated for input to the monitoring data model annually or when periodic verification is required. Measure to be used with the GHG Coefficient to calculate project emissions from STs.
QA/QC procedures to be applied:	These data are measured on-site continuously and recorded daily, using Foxboro Model 83W-A03S1SSSTNE-N Vortex meters with pressure and temperature compensation. The results are compared to energy balance data over the year.
Any comment:	

Data / Parameter:	$NCV_{NG,y}$
Data unit:	GJ/Nm^3
Description:	Project activity Net Calorific Value of natural gas.
Source of data to be used:	Calculated by Energas
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Mar 2005 – Feb 2006 = 0.0348. Used as the basis for all future years Details for each unit are in tables in Annex 3.
Description of measurement methods and procedures to be applied:	Data to be used with emission factor and oxidation factor to calculate GHG Coefficient.
QA/QC procedures to be applied:	These data are calculated by Energas based on monthly testing on-site
Any comment:	

Data / Parameter:	$EF_{CO2,NG,y}$
Data unit:	tCO_2/GJ
Description:	Project activity CO_2 Emission Factor of natural gas
Source of data to be used:	Calculated by Energas
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Mar 2005 – Feb 2006 = 0.0622. Used as the basis for all future years Details for each unit are in tables in Annex 3.
Description of measurement methods and procedures to be applied:	Data to be used with net calorific value and oxidation factor to calculate GHG Coefficient.
QA/QC procedures to be applied:	These data are calculated by Energas based on monthly testing on-site
Any comment:	

Data / Parameter:	$OXID_{NG,y}$
Data unit:	%
Description:	Project activity oxidation factor of natural gas
Source of data to be used:	IPCC
Value of data applied for the purpose of calculating expected emission reductions in section B.5	0.995 for all years Details for each unit are in tables in Annex 3

Description of measurement methods and procedures to be applied:	Data to be used with emission factor and net calorific value to calculate GHG Coefficient
QA/QC procedures to be applied:	These data are provided by IPCC (IPCC 1996 Revised National GHG Inventory) and will be verified annually to ensure that the data used will reflect most recent IPCC estimates.
Any comment:	

Data / Parameter:	**PG_y**
Data unit:	MWh
Description:	Actual electricity generated by project in the year
Source of data to be used:	Metered
Value of data applied for the purpose of calculating expected emission reductions in section B.5	Mar 2005 – Feb 2006 = 1,293,783. Used as the basis for all future years Details for each unit are in tables in Annex 3.
Description of measurement methods and procedures to be applied:	For calculation of electricity generated from waste heat.
QA/QC procedures to be applied:	These data are measured on-site by Energas, based on ION 7331 meters. The results are verified by UNE.
Any comment:	

Additional tables formatted as per ACM0007 are attached in Annex 4.

B.7.2 Description of the monitoring plan:

>>

The monitoring plan for the project addresses the need to ensure that the desired impacts on sustainable development are achieved, as well as to ensure that the required data is collected to determine and verify the expected emission reductions. Both these requirements are discussed here. Table B.7.2.1 provides an outline of parameters that have been monitored and the person or organization responsible for them in the construction and operating phases of the project activity.

Data generated in monitoring the project will be kept and archived for the operational lifetime of the project. As will be stated in Section C. of this document, this is expected to be greater than 25 years.

Environmental Indicators:
The project operators track changes in such indicators as ambient air quality, groundwater quality, noise generation and waste removal. This has been part of standard operations since the project began operations and it will be maintained in the future as long as the project operates. There are few additional environmental measures that can be monitored that are specific to the project activity.

Socio-Economic Indicators:
There are a number of socio-economic areas that are impacted by the project activity. Where possible these are monitored as well, though there is not always a quantified measure available for them.

Job creation - Aside from local contractors that were used in construction of the project activity, there were 13 more operators hired in order to meet the requirements of the Combined Cycle plant. There are also a number of services required by the Energas facility that are supplied by Cuban contractors. This work would not have been available had it not been for the project activity and may have resulted in additional staff hired. These services include such things as provision of food supplies, paper products and stationary, construction/repair materials and removal of waste and trash. Provision of these services adds revenue to the local and regional economy.

Knowledge/Technology transfer – Both the additional staff and the existing workers require technical knowledge and skills that were not readily available in the local community around the plant. As a result, Cuban staff receives training to ensure that the plant operates correctly. As part of the basic agreement for the operations, all staff receives lessons in English to a level that enables them to operate in that language and to understand the written operating procedures for the combined cycle project.

Training has also included skills such as steam engineering, gas plant operations, and apprenticeship courses in Electrical, Instrumentation and Millwright programs. Records are maintained at the Energas site to track the progress of staff in various training programs, some of which require regular renewals for certification. Apprenticeship programs are provided through the Northern Alberta Institute of Technology in Edmonton Alberta and all programs adhere to Alberta Standards.

The following regular training is also provided to all staff:

- Fire Training - For all types of fires, (electrical, gas, liquids, and combustibles). This follows the Cuban Agency for fire protection (APCI) guidelines.
- First Aid -Taught by a local doctor.
- H_2S Training (The instructor is certified through the Petroleum Institute of Technology in Edmonton, Alberta) – To ensure that employees know what H_2S is and how to protect themselves and others.
- Unit Indoctrinations - Facility specific indoctrination which includes all products and quantities that are handled, stored or produced at the site. It includes operations training for each unit what is done there and how it is done), what engineering and Standard operating procedures are in place to protect the general public and employee's. Discussion of risks and dangers associated with the plant, and information on controls, emergency escape routes and warnings.
- Workplace Hazardous Materials Information System (WHMIS) – Training in the WHMIS program, how to identify and treat hazardous materials.
- Transportation of Dangerous Goods – To ensure that both employees and public are protected.
- Confined Space Entry – Proper procedures for work in confined spaces.
- Equipment Training – Proper and safe operation of equipment such as fork lifts and man lifts.

These benefits are in addition to the less direct but equally significant benefit from a reliable source of power to maintain economic growth in the area. The Energas facilities have proven to be very reliable and the Varadero plant has often been one of the first facilities to re-start in the event of an outage due to hurricane or other major event. This improved reliability is a benefit to both the important tourism industry in the area as well as the local population and industries.

The Energas operations in Cuba have been designed to include procedures for monitoring and control of gas handling and electrical generation. Production, handling and use of gas is tightly controlled for environmental, health and safety reasons. Volumes of gas used and electricity produced are measured constantly and recorded for accounting purposes.

Equipment is maintained to the highest standards possible.

Controls include regular site inspections by Cuban government staff.

Table B.7.2.1 outlines the individuals responsible for mitigation, monitoring and training.

The Plant Manager is responsible for operation of the Varadero facility. Within this responsibility is the preparation of daily and weekly production reports. The production report captures the following information which is pertinent to the combine cycle power production and overall CO_2 emissions:

- Gross power produced GT #1.
- Gross power produced GT #2.
- Gross power produced GT #3.
- Gross power produced ST #1.

- Net power shipped Bay 1.
- Net power shipped Bay 2.
- Net power shipped Bay 3.
- Net power shipped Bay 4.
- Net power shipped Cupet 1.
- Net power shipped Cupet 2.

- Overall Net Power shipped.
- Plant power usage.
- Total gas consumption.
- Steam production.
- Cooling water balance.
- All other operating parameters of the combined cycle project.

Sherritt also has a full time expatriate EH&S (Environmental, Health and Safety) manager in Cuba. The EH&S manager is autonomous, reports directly to senior management and is responsible to monitor and audit the EH&S performance of all the facilities.

Due to the operation of the Combined Cycle plant since March 2003, a full complement of procedures for operating the plant in a safe, sound and efficient manner had to be provided. As a part of a larger existing operation, most of these procedures were already established but some have more recently been formalized. Application of these procedures will ensure that the expected reductions can be realized. These include the following:

- Procedures for training of monitoring personnel.
- Procedures for emergency preparedness in case of unintended emissions.

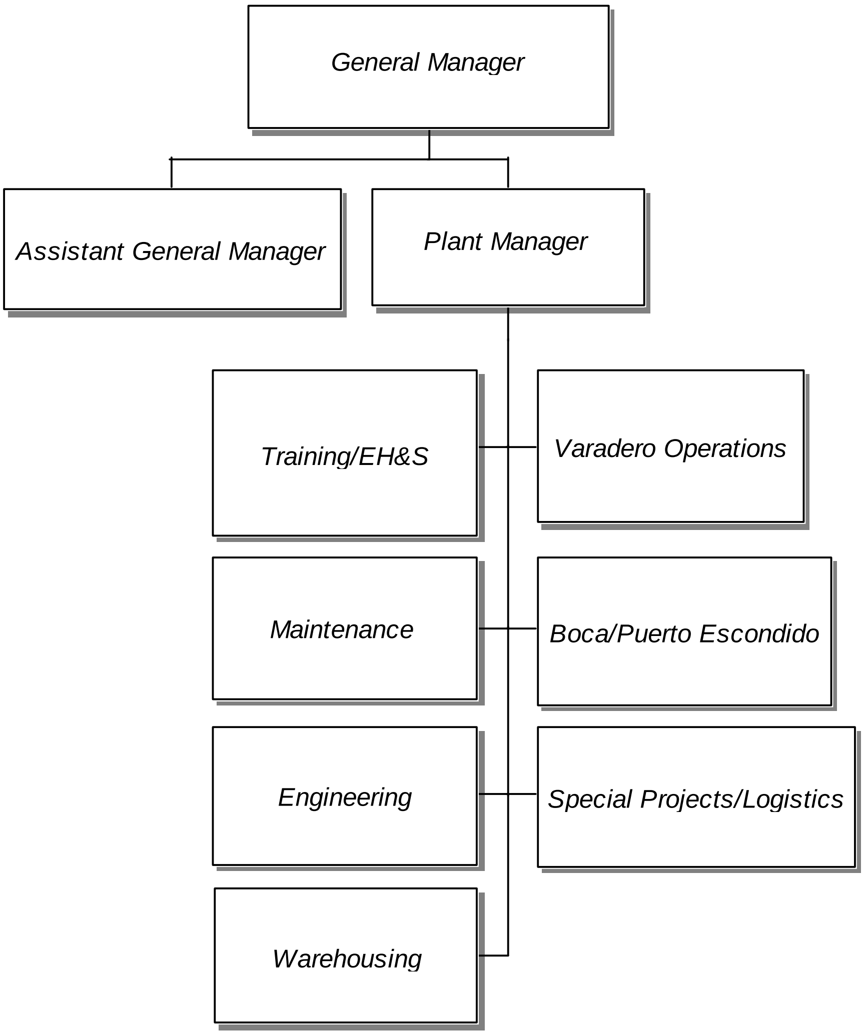
- Procedures for installation and correct operation and maintenance of equipment.
- Procedures for monitoring, measurements and reporting operating results and for review of reported results.
- Procedures for record handling and for dealing with possible monitoring data adjustments and uncertainties.
- Procedures for internal audits.
- Procedures for project performance reviews and for corrective actions.
- The equipment that will be used for monitoring has been identified, along with the procedure for calibration of equipment.

Due to the extensive nature of these procedures and provisions they have not been included here. They are available, however, for review by the DOE during the validation process.

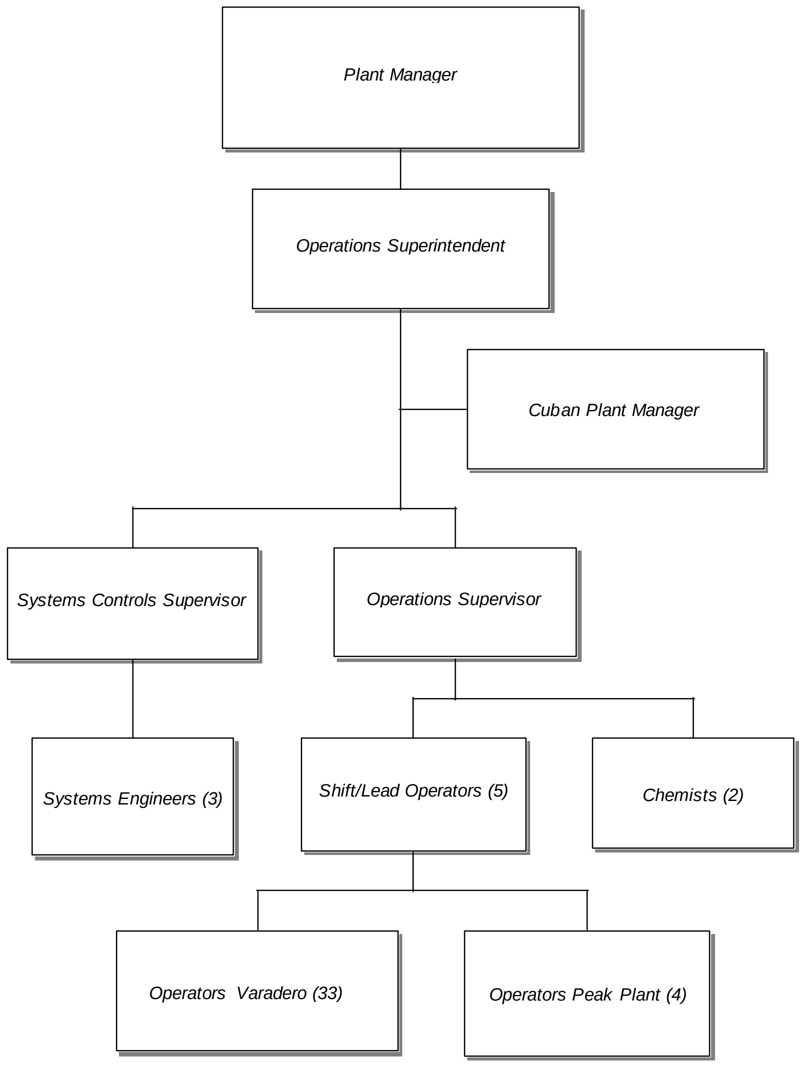
Table B.7.2.1 Management Responsibilities for Mitigation, Monitoring and Training		
Activity/Component	**Description**	**Responsibility**
Construction Mitigation		
Civil Works	Secondary containment structures	Construction Manager/ Engineering Management
Relocation	Relocation any potentially affected residents.	Cuban Authorities/Regulators
Pipeline	Route selection, compensation of residents, restoration, etc.	EH&S, Cuban Authorities/Regulators
Transmission Line	Route selection, compensation of affected residents, etc.	UNE, Cuban Authorities/Regulators
Operations Mitigation		
Surface Runoff	Spill response, site maintenance	Plant Manager/EH&S Manager
Groundwater quality	Spill response, site maintenance	Plant Manager/EH&S Manager
Groundwater quantity	Off-site water supply	Plant Manager/EH&S Manager
Noise	Equipment maintenance and response to problems	Plant Manager/EH&S Manager
Air Quality	Ensuring all processes are functioning correctly to minimize airborne contaminants	Plant Manager
Emergency Response	Plan to address and mitigate emergency situations	General Manager
Occupational Health and Safety	Noxious gas exposure, noise exposure, fire safety	Plant Manager/Sherritt Health and Safety Dept.
Pipeline	Remediation and maintenance	CUPET
Transmission Line	Remediation and maintenance	UNE
Monitoring		
Noise	Off-site noise surveys	EH&S Manager
Air Quality	Off-site air quality surveys	EH&S Manager
Groundwater quality	Regular bore hole chemical analysis	EH&S Manager
Waste	Recycling of and/or environmentally sound disposal of liquid and solid waste	EH&S Manager
Occupational Health and Safety	On-site noise survey, noxious and combustible gas monitors, fire and smoke detectors	EH&S Manager / Sherritt Health and Safety Dept.
Staff Training		
Emergency Response	Selection of staff for emergency response training	Plant Manager
Health and Safety	Monthly safety meetings, Health and Safety Manuals	Plant Manager /EH&S Manager
On-the-job training	Spill response, general environmental training	Senior Staff/EH&S Manager
General	Upgrade to Canadian standards	Plant Manager /Senior Management

The Energas and Varadero organizations are shown in the charts below.

ENERGAS S.A
OPERATIONS



ENERGAS S.A.
VARADERO OPERATIONS



B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

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Date of completion of baseline study and monitoring methodology: August 11, 2006

Responsible person:

Chris Sloof, P. Eng,
Suite 900, 355 – 4th Avenue S.W.
Calgary, Alberta,
Canada T2P 0J1

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>

Starting date of the project activity is March 1, 2003.

C.1.2. Expected operational lifetime of the project activity:

>>

Greater than 25 years.

The authorized term of Energas S.A. for the Varadero Combined Cycle Project expires in March 2018, but may be extended by agreement of the shareholders, subject to the approval of the government of Cuba.

C.2 Choice of the crediting period and related information:

The project will use a renewable crediting period.

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

>>

01/04/2007

C.2.1.2. Length of the first crediting period:

>>

Seven (7) years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>

N/A

C.2.2.2. Length:

>>

N/A

SECTION D. Environmental impacts

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D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

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Due to the fact that this project was built as part of an existing power generation facility, many of the studies done and steps taken to protect the local and national environment were included as part of the larger physical operation. The possibility of the project activity was seen far enough in advance to reflect any possible impacts in the larger work.

Energas operations are conducted in full compliance with the terms and conditions of the operating permits and environmental licenses granted in relation to the project as well as applicable Cuban regulations. In the absence thereof, Canadian standards are the goal.

Potential impacts on the environment were a definite consideration in planning for the project, partly with regard to the potential benefits to the area. This is illustrated by the fact that a commitment to conservation of the environment was embedded in the association agreement for the Energas joint-venture. There is an extensive program of semi annual ground water testing in-place to ensure that there is no escape of sea water into the water table and that the operation is not contributing in any way to the contamination of the fresh water aquifer or the surrounding environment.

The area in the vicinity of the Varadero plant has been used for the development and production of petroleum and natural gas for over 25 years. Some environmental degradation may have resulted from this use over the years. Energas retained the services of an independent engineering firm to conduct a baseline environmental study which is updated every year. The reports from these studies indicate that the Energas operations have not resulted in any environmental contamination. Copies of these reports are sent to the Cuban authorities as well. The reality is that while the operations have had no detrimental impact on the local environment, there has been a marked improvement in air quality as a result of the reduction in sulphur and GHG emitted from the original flaring operations.

In 2001 Energas received an award from the Cuban authorities in appreciation of its efforts to preserve and improve the environment. The certificate is not in English so it has not been attached here but it will be available to the DOE if desired.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

>>

As noted in Section D.1, this project was originally considered as part of a larger package of projects and all environmental requirements of the host country were complied-with before the operating permits and environmental license were granted. There is no question that the environmental impacts of the group of projects were significant to both the project participants and the host country. This is evidenced by the embedded references to it in the Energas agreement and the award to Energas for its positive contributions. Impacts of the project have been overwhelmingly positive since operation began.

SECTION E. Stakeholders' comments

>>

E.1. Brief description how comments by local stakeholders have been invited and compiled:

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In Cuba "local stakeholders" are comprised primarily of agencies of the government of Cuba. Within the Cuban system, the interests of private citizens are considered to be represented and protected by such government agencies and, therefore, there are no private stakeholder groups as we would know them in Canada and other countries.

Both at the project proposal/negotiation stage and subsequently in connection with the issuance of the applicable environmental license, project review by a broad spectrum of agencies of the government of Cuba is a mandatory part of the government approval process. Public consultation and community participation in decision making are legal principles embedded in Cuban environmental laws. This is purely an internal government process in respect of which the foreign applicant is not allowed to participate directly. Following the internal government review, any resulting comments pertaining to social or economic impacts of the project, to the extent that they are not resolved internally, are relayed to the applicant by the government agencies that have been directed to take the lead in the project (UNE in this case).

To the extent that comments or queries are received, they must be adequately dealt with by the applicant prior to issuance of operating permits and environmental licenses for the project. In the case of the Varadero Combined Cycle Project, the proposed work was an expansion of existing facilities. To a significant extent, the stakeholder consultation process had already occurred as part of the original proposal so that discussions around the project activity could review those that took place earlier. There were no negative comments relayed to the project developers with regard to the combined cycle project or other Energas projects.

E.2. Summary of the comments received:

>>

As noted, the stakeholder process in Cuba is kept entirely internal to government agencies. Any stakeholder concerns that may have been expressed were addressed by the appropriate Cuban authorities and were not reported.

E.3. Report on how due account was taken of any comments received:

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Due to the nature of the Cuban system, Sherritt was not allowed to deal directly with any of the stakeholders. If any action was necessary in response to any comments received with regard to the project activity, this information would be conveyed to Sherritt by the government agency (UNE) that was directed to take the lead in the project.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Sherritt International Corporation
Street/P.O. Box:	5th Floor, 1133 Yonge Street
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FAX:	416-935-5015
E-Mail:	
URL:	www.sherritt.com
Represented by:	James Peart
Title:	Manager, Environmental Development
Salutation:	Mr.
Last Name:	Peart
First Name:	James
Department:	Sherritt Power Division
Personal E-Mail:	jpeart@sherritt.com

Organization:	Energas, S.A.
Street/P.O. Box:	5ta Ave. esq a 78
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City:	Miramar Playa, Ciudad Habana
Country:	Cuba
Telephone:	53-07-204-6484
FAX:	53-07-204-6486
E-Mail:	
URL:	
Represented by:	Elvin Saruk
Title:	General Manager
Salutation:	Mr.
Last Name:	Saruk
First Name:	Elvin

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There has been no public funding used in the development of this project.

Annex 3

BASELINE INFORMATION

See tables on accompanying pages.

Table 3.1: Electrical production and consumption data along with natural gas consumption data used in the development of the baseline for the third most recent year of Open Cycle generation, March 2000 to February 2001, prior to the start of combined cycle generation.

Month	March-2000 to February-2001										
	GT 1 Gross Generation (MWh)	GT 2 Gross Generation (MWh)	GT 3 Gross Generation (MWh)	Cupet A Power Consumed (MWh)	Cupet B Power Consumed (MWh)	UNE 34.5kV Feed Net (MWh)	Substation Bay 1 Net Power Supplied (MWh)	Substation Bay 2 Net Power Supplied (MWh)	Substation Bay 3 Net Power Supplied (MWh)	Total Gas consumed by GT 1/2/3 ($N10^3m^3$)	Auxiliary Power Consumed by Plant (MWh)
Mar. Totals:	25810.0	25678.0	25652.0	0.0	0.0	0.0	23639.9	23788.9	25492.2	24490.3	4219.0
Apr. Totals:	24779.0	25119.0	24665.0	0.0	0.0	0.0	22812.7	23407.6	24524.9	23933.3	3817.8
May Totals:	25180.0	25218.0	24082.0	0.0	0.0	0.0	23175.2	23505.1	23979.8	24123.6	3819.9
Jun. Totals:	24187.0	21447.9	23636.0	0.0	0.0	0.0	21979.4	19944.1	23492.8	22070.2	3854.6
Jul. Totals:	19826.0	25577.7	23167.0	0.0	0.0	0.0	18212.2	23204.5	23819.1	22716.6	3334.9
Aug. Totals:	25715.0	21632.0	24750.0	0.0	0.0	0.0	23526.2	20258.9	24606.7	23189.7	3705.2
Sep. Totals:	24730.0	24540.4	22639.0	0.0	0.0	0.0	21073.0	24437.1	23218.0	23643.8	3181.3
Oct. Totals:	25408.0	25057.0	23478.0	0.0	0.0	0.0	21629.6	24753.4	23351.6	24013.0	4208.4
Nov.Totals:	24189.0	18242.0	22756.0	0.0	0.0	0.0	21547.1	17798.1	22608.1	21966.0	3233.7
Dec. Totals:	25568.0	25630.0	24634.0	0.0	0.0	0.0	25581.0	20413.9	24490.6	25001.3	5346.5
Jan. Totals:	25897.0	26806.0	19254.0	0.0	0.0	0.0	25801.5	22246.7	19140.1	24069.6	4768.7
Feb. Totals:	15350.0	14598.5	10177.0	0.0	0.0	0.0	14220.2	12816.8	10121.9	13284.8	2966.6
Annual Totals:	286639.0	279546.5	268890.0	0.0	0.0	0.0	263198.0	256575.1	268845.8	272502.2	46456.6
	Open Cycle Year 1										

Table 3.2: Electrical production and consumption data along with natural gas consumption data used in the development of the baseline for the second most recent year of Open Cycle generation, March 2001 to February 2002, prior to the start of combined cycle operations.

Month	March-2001 to February-2002										
	GT 1 Gross Generation (MWh)	GT 2 Gross Generation (MWh)	GT 3 Gross Generation (MWh)	Cupet A Power Consumed (MWh)	Cupet B Power Consumed (MWh)	UNE 34.5kV Feed Net (MWh)	Substation Bay 1 Net Power Supplied (MWh)	Substation Bay 2 Net Power Supplied (MWh)	Substation Bay 3 Net Power Supplied (MWh)	Total Gas consumed by GT 1/2/3 ($N10^3m^3$)	Auxiliary Power Consumed by Plant (MWh)
Mar. Totals:	25102.0	26451.0	0.0	303.8	0.0	0.0	22886.1	24087.0	0.0	16335.9	4883.7
Apr. Totals:	23113.0	21429.0	16708.0	259.8	0.0	0.0	22479.7	20618.2	16643.5	20658.9	1768.4
May Totals:	25372.0	26297.0	25300.0	289.5	0.0	0.0	22978.1	22596.7	25172.8	24677.9	6510.9
Jun. Totals:	22738.0	24387.0	23566.0	350.0	0.0	0.0	20502.8	20487.1	23421.5	22819.5	6629.6
Jul. Totals:	21268.0	24916.0	24210.0	335.6	0.0	0.0	19395.8	20335.7	24019.0	23201.4	6979.1
Aug. Totals:	25019.0	24491.0	23765.0	371.0	0.0	0.0	22516.8	20758.7	23627.4	23804.1	6743.1
Sep. Totals:	24271.0	25208.0	23733.0	346.2	0.0	0.0	22070.0	21023.2	23571.2	23458.1	6893.8
Oct. Totals:	25137.0	25674.0	24314.1	413.2	0.0	0.0	24030.5	21776.5	24446.6	24017.9	5284.7
Nov.Totals:	20031.0	19889.0	15517.1	363.1	0.0	0.0	18558.5	17639.9	15585.6	18243.2	4016.2
Dec. Totals:	21884.0	22714.0	24257.0	128.4	0.0	0.0	20752.4	18743.6	24068.1	22575.6	5419.3
Jan. Totals:	17226.0	24249.0	19395.9	23.8	0.0	0.0	17147.2	18247.9	19304.5	20830.0	6195.1
Feb. Totals:	21827.9	22732.2	21219.2	0.0	0.0	0.0	21745.8	18162.1	21095.4	21950.4	4776.0
Annual Totals:	272988.9	288437.2	241985.3	3184.4	0.0	0.0	255063.7	244476.6	240955.6	262573.0	66099.9
	Open Cycle Year 2										

Table 3.3: Electrical production and consumption data along with natural gas consumption data used in the development of the baseline for the most recent year of Open Cycle generation, March 2002 to February 2003, prior to the start of combined cycle operations.

Month	March-2002 to February-2003										
	GT 1 Gross Generation (MWh)	GT 2 Gross Generation (MWh)	GT 3 Gross Generation (MWh)	Cupet A Power Consumed (MWh)	Cupet B Power Consumed (MWh)	UNE 34.5kV Feed Net (MWh)	Substation Bay 1 Net Power Supplied (MWh)	Substation Bay 2 Net Power Supplied (MWh)	Substation Bay 3 Net Power Supplied (MWh)	Total Gas consumed by GT 1/2/3 ($N10^3m^3$)	Auxiliary Power Consumed by Plant (MWh)
Mar. Totals:	23611.3	21883.6	18462.9	293.5	75.3	0.0	18995.0	20655.2	18366.8	21694.3	6309.6
Apr. Totals:	23160.2	23928.0	22644.6	0.0	334.9	0.0	23103.3	18026.7	22546.7	23205.0	6391.0
May Totals:	17495.3	12311.0	20766.7	210.6	125.4	0.0	15237.7	9669.4	20992.8	17100.9	5009.1
Jun. Totals:	17489.3	22541.0	18215.3	408.0	0.0	0.0	12733.6	22323.9	18114.0	19674.2	5482.1
Jul. Totals:	21661.5	23768.9	23358.5	383.5	0.0	0.0	16813.6	23537.0	23280.6	23587.6	5541.2
Aug. Totals:	22338.1	23318.2	21809.6	404.6	0.0	0.0	17474.5	23056.6	21684.6	23028.4	5654.8
Sep. Totals:	17710.5	22166.0	23491.9	420.9	0.0	0.0	12743.3	21941.2	23408.3	21870.9	5696.5
Oct. Totals:	21901.7	23143.5	23434.6	418.6	0.0	0.0	16700.1	22904.7	23345.1	23228.9	5948.5
Nov.Totals:	21138.9	22098.0	20767.0	172.3	211.8	0.0	16971.0	20570.2	20717.4	22308.2	6129.4
Dec. Totals:	24739.0	24450.0	9420.3	3.0	396.0	0.0	21995.0	21544.0	9328.7	20353.2	6140.6
Jan. Totals:	22723.1	23274.0	0.0	2.0	383.4	0.0	20197.0	20094.0	0.0	16291.5	6091.5
Feb. Totals:	20824.0	21387.0	0.0	1.9	378.3	0.0	18643.0	18136.0	-401.1	15199.8	6213.3
Annual Totals:	254792.9	264269.2	202371.4	2718.9	1905.1	0.0	211607.1	242458.9	201383.9	247542.8	70607.6
	Open Cycle Year 3										

Table 3.4: Sales gas composition, determined using an on-site gas chromatograph, used to calculate the Net Calorific Value as well as the CO_2 Emission factor in development of the baseline.

										Butanes			Pentanes Plus				
		Composition	N2 %	CO2 %	H2S %	H2O %	C1 %	C2 %	C3 %	iC4 %	nC4 %	Total Butanes	iC5 %	nC5 %	C6 %	C7 %	Total Pentane Plus
		PM	28.016	44.010	34.076	18.015	16.042	30.068	44.094	58.120	58.120		72.15	72.15	86.17	100.20	
		Gas Type															
VGP	1-Aug-03	Sales Gas	0.9600	4.6707	0.0000	0.0000	88.7887	3.1541	1.6481	0.2688	0.3673	0.6361	0.0960	0.0309	0.0112	0.0000	0.1381
Cupet	3-Oct-03	Sales Gas	0.0000	5.1665	0.0000	0.0000	89.2757	3.5614	1.5650	0.2006	0.2107	0.4113	0.0201	0.0000	0.0000	0.0000	0.0201
Cupet	3-Oct-03	Sales Gas	0.0300	5.1600	0.0000	0.0000	88.9300	3.4900	1.5400	0.2100	0.2200	0.4300	0.0500	0.0100	0.3600	0.0000	0.4200
Cupet	3-Oct-03	Sales Gas	0.0300	5.0800	0.0000	0.0000	89.2200	3.3100	1.5100	0.2100	0.2200	0.4300	0.0500	0.0000	0.3800	0.0000	0.4300
Average 2003 used in baseline			***0.255***	***5.019***	***0.000***	***0.000***	***89.054***	***3.379***	***1.566***	0.222	0.254	***0.477***	0.054	0.010	0.188	0.000	***0.252***

Table 3.5: Cuban data for grid connected power plants used in developing the baseline, including annual fuel consumed, CO2 emission coefficient for the fuel, and the annual electricity supplied to the grid for the three most recent years prior to the start of combined cycle operations.

						Mar-2000 to Feb-2001 Open Cycle Year 1			Mar-2001 to Mar-2002 Open Cycle Year 2			Mar-2002 to Feb-2003 Open Cycle Year 3		
Name	Location	Date Commissioned (mm/yyyy)	Installed Capacity (MW)	Net Capacity (MW)	Fuel Type	Annual Fuel Consumed (t)	CO_2 Emission coefficient (tCO_2/t_{fuel})	Annual Energy Delivered to grid (MWh)	Annual Fuel Consumed (t)	CO_2 Emission coefficient (tCO_2/t_{fuel})	Annual Energy Delivered to grid (MWh)	Annual Fuel Consumed (t)	CO_2 Emission coefficient (tCO_2/t_{fuel})	Annual Energy Delivered to grid (MWh)
CTE Antonio Maceo #2	Rente, Santiago de Cuba	12/1967	50	45	Extra Heavy Fuel Oil	26532.53	2.963	72630	20454.35	2.963	48570	6817.15	2.963	13620
CTE Antonio Maceo #3	Rente, Santiago de Cuba	07/1978	100	95	Extra Heavy Fuel Oil	53373.27	2.963	153600	43442.86	2.963	112160	157401	2.963	452230
CTE Antonio Maceo #4	Rente, Santiago de Cuba	01/1980	100	95	Extra Heavy Fuel Oil	104063.91	2.963	287510	29861	2.963	84570	52258.06	2.963	136730
CTE Antonio Maceo #5	Rente, Santiago de Cuba	12/1982	100	95	Extra Heavy Fuel Oil	127525.03	2.963	369020	112520.47	2.963	331870	104709.15	2.963	291670
CTE Antonio Maceo #6	Rente, Santiago de Cuba	09/1984	100	100	Extra Heavy Fuel Oil	82690.19	2.963	219690	129109.31	2.963	395600	92557.71	2.963	284280
Lidio Ramon Perez #1	Felton, Municipio Mayari Arriba, Holguin, Cuba	07/1997	250	250	Crude 650	306530.5	2.918	972180	268266.38	2.918	799250	361008.27	2.918	1146200
Lidio Ramon Perez #2	Felton, Municipio Mayari Arriba, Holguin, Cuba	12/2000	250	250	Crude 650	49210.69	2.918	NO DATA	330107.1	2.918	829300	348120.99	2.918	1139570
Diez de Octubre #3	Punta Domingo Nuevitas, Camaguey	02/1978	64	60	Fuel Oil	45643.9	3.0396	124680	25564.58	3.0396	61320	26565.77	3.0396	75660
Diez de Octubre #4	Punta Domingo Nuevitas, Camaguey	08/1994	125	115	Crude 1100	153394.07	2.918	472700	46084.33	2.918	476210	161941.56	2.918	453140

Diez de Octubre #5	Punta Domingo Nuevitas, Camaguey	11/1985	125	125	Crude 1100	165976.99	2.918	478530	186341.65	2.918	538640	52485.51	2.918	546630
Diez de Octubre #6	Punta Domingo Nuevitas, Camaguey	10/1998	125	125	Crude 1100	84665.07	2.918	214020	187785.31	2.918	547830	143829.31	2.918	449050
Carlos Manuel de Cespesdes #1	Carretera Oburque S/N, Zona Industrial, Cienfuegos	09/1968	33	28	Fuel Oil	11696.57	3.0396	25950	16947.97	3.0396	48270	5252.4	3.0396	66270
Carlos Manuel de Cespesdes #2	Carretera Oburque S/N, Zona Industrial, Cienfuegos	12/1971	33	28	Fuel Oil	4125.01	3.0396	9810	6912.4	3.0396	17680	22277.78	3.0396	65460
Carlos Manuel de Cespesdes #3	Carretera Oburque S/N, Zona Industrial, Cienfuegos	11/1978	158	158	Crude 650	208172.57	2.918	703400	188580.17	2.918	629570	214588.39	2.918	798680
Carlos Manuel de Cespesdes #4	Carretera Oburque S/N, Zona Industrial, Cienfuegos	06/1979	158	158	Crude 650	209985.91	2.918	734760	209452.99	2.918	716100	186835.9	2.918	688680
Antonio Guiteras	Zona Industrial Final Pta del Uvero, Matanzas, Cuba	06/1988	330	310	Crude 1400	453947.27	2.918	1710790	416898.96	2.918	1665350	254154.64	2.918	697370
Este Habana #1	Via Blanca Km 45, Santa Cruz, Prov. Hab.Cuba	10/1987	100	100	Crude 1100	154778.06	2.918	438660	131373.89	2.918	345070	176660.97	2.918	514480
Este Habana #2	Via Blanca Km 45, Santa Cruz, Prov. Hab.Cuba	01/1990	100	100	Crude 1100	184896.26	2.918	530900	169544.74	2.918	491610	161860.61	2.918	453800
Este Habana #3	Via Blanca Km 45, Santa Cruz, Prov. Hab.Cuba	05/1996	100	100	Crude 1100	186892.68	2.918	538450	190624.15	2.918	550630	152197	2.918	389330
Maximo Gomez #4	Calle 90 S/N, La Boca, Mariel, Prov. Habana, Cuba	12/1968	50	45	Crude 1400	12229.26	2.918	24890	9199.91	2.918	22010	62750.32	2.918	111620
Maximo Gomez #5	Calle 90 S/N, La Boca, Mariel, Prov. Habana, Cuba	01/1977	100	95	Crude 1400	106360.39	2.918	277810	141197.49	2.918	361380	164439.58	2.918	492060
Maximo Gomez #6	Calle 90 S/N, La Boca, Mariel, Prov. Habana, Cuba	02/1978	100	90	Crude 1400	120536.88	2.918	314610	122581.66	2.918	369600	107270.04	2.918	238700

Mazimo Gomez #7	Calle 90 S/N, La Boca, Mariel, Prov. Habana, Cuba	03/1979	100	90	Crude 1400	107007.50	2.918	286810	27442.73	2.918	72880	175335.2	2.918	510230
Mazimo Gomez #8	Calle 90 S/N, La Boca, Mariel, Prov. Habana, Cuba	05/1982	100	90	Crude 1400	152187.43	2.918	430650	150130.36	2.918	397710	152837.15	2.918	455680
Jose Marti #3	Carretera Zona Industrial S/N, Matanzas, Cuba	12/1966	33	30	Crude 1400	45107.81	2.918	118810	53873.55	2.918	134481	83108.89	2.918	158260
Otto Parellada #7	Diaria #201, Esquina Alambique, Hab. Vieja, Cuba	11/1972	64	64	Fuel Oil	46665.46	3.0396	122630	83487.49	3.0396	235760	100518.87	3.0396	240790
Robustiano Leon #2	Salto de Hanabanilla, Manicaragua, Villa Clara, Cuba	04/1963	16.5	16.5	Hydro									
Robustiano Leon #3	Salto de Hanabanilla, Manicaragua, Villa Clara, Cuba	01/1968	16.5	15	Hydro									
Energas Phases I,II	Varadero, Cuba	03/1999	106.2	101.2	Natural Gas	272502200 (Nm^3)	0.00213 (tCO_2/Nm^3)	788619	262573000 (Nm^3)	0.00213 (tCO_2/Nm^3)	740496	247542800 (Nm^3)	0.00213 (tCO_2/Nm^3)	655456
Energas Phase IV	Boca de Jaruco, Cuba	03/1999	35.4	33.7	Natural Gas	85100100 (Nm^3)	0.00213 (tCO_2/Nm^3)	272309	87557800 (Nm^3)	0.00213 (tCO_2/Nm^3)	283015	86985000 (Nm^3)	0.00213 (tCO_2/Nm^3)	272886
Energas Phase V (Peak Plant)	Varadero, Cuba	03/2000	25	20	Natural Gas	52181416 (Nm^3)	0.00213 (tCO_2/Nm^3)	139313	51020010 (Nm^3)	0.00213 (tCO_2/Nm^3)	134849	49835138 (Nm^3)	0.00213 (tCO_2/Nm^3)	130102

Table 3.6: Cuban data for grid connected power plants used in developing the Build Margin for the baseline, including annual fuel consumed, CO2 emission coefficient for the fuel, and the annual electricity supplied to the grid for the three most recent years prior to the start of combined cycle operations.

						Mar-2002 to Feb-2003 Open Cycle Year 3		
Name	**Location**	**Date Commissioned (mm/yyyy)**	**Installed Capacity (MW)**	**Net Capacity (MW)**	**Fuel Type**	**Annual Fuel Consumed (t)**	**CO_2 Emission coefficient (tCO_2/t_{fuel})**	**Annual Energy Delivered to grid (MWh)**
Lidio Ramon Perez #2	Felton, Municipio Mayari Arriba, Holguin, Cuba	12/2000	250	250	Crude 650	348120.99	2.918	1139570
Diez de Octubre #3	Punta Domingo Nuevitas, Camaguey	02/1978	64	60	Fuel Oil	26565.77	3.0396	75660
Lidio Ramon Perez #1	Felton, Municipio Mayari Arriba, Holguin, Cuba	07/1997	250	250	Crude 650	361008.27	2.918	1146200
Energas Phases I,II	Varadero, Cuba	03/1999	106.2	101.2	Natural Gas	247542800 (Nm^3)	0.00213 (tCO_2/Nm^3)	655456
Energas Phase IV	Boca de Jaruco, Cuba	03/1999	35.4	33.7	Natural Gas	86985000 (Nm^3)	0.00213 (tCO_2/Nm^3)	272886
Energas Phase V (Peak Plant)	Varadero, Cuba	03/2000	25	20	Natural Gas	49835138 (Nm^3)	0.00213 (tCO_2/Nm^3)	130102

Table 3.7: Summary of the Operating Margin (OM) and the Build Margin (BM) emissions factors as well as the emission factor for the electricity displaced due to the project activity ($EF_{grid,y}$) for the Cuban data.

	Mar-00 to Mar-01	Mar-01 to Feb-02	Mar-02 to Feb-03
	OC Year 1	**OC Year 2**	**OC Year 3**
$EF_{OM,y}$ (tCO_2/MWh)	0.946	0.918	0.934
$EF_{BM,y}$ (tCO_2/MWh)			0.878
w_{OM}	0.5	0.5	0.5
w_{BM}	0.5	0.5	0.5
$EF_{grid,y}$ (tCO_2/MWh)			**0.906**
$EF_{grid,y}$ (tCO_2/MWh)	**0.906**		

Table 3.8: Summary of data used to calculate the project baseline. The project baseline is based on the three years of data prior to the start of combined cycle operations. The third year of project operations is the most recent complete year available on which to base the first crediting year and the years beyond.

	Date	Mar-00 to Feb-01	Mar-01 to Feb-02	Mar-02 to Feb-03	Apr-07 to Mar-08
Variable	Unit	OC Year 1	OC Year 2	OC Year 3	Crediting Year 1
$COEF_{NG,Y}$	(tCO_2/Nm^3)	0.0021	0.0021	0.0021	0.0022
$NCV_{NG,Y}$	(GJ/Nm^3)	0.0346	0.0346	0.0346	0.0348
$OXID_{NG,Y}$		0.995	0.995	0.995	0.995
$EF_{CO2,NG,Y}$	(tCO_2/GJ)	0.0618	0.0618	0.0618	0.0622
PE_y	**(tCO_2)**	**580,659**	**559,502**	**527,475**	**728,666**
$EF_{OC,Y}$	(tCO_2/Mwh)	N/A	N/A	N/A	0.766
$FC_{HIST,Y}$	(Nm^3)				260,872,645
OG_Y:	(MWh)				725,585
$EF_{grid,Y}$	**(tCO_2/Mwh)**				**0.906**
CG_Y:	(MWh)				568,197
$HG_{OC,HIST,Y}$:	(MWh)				725,585
$OC_{HIST,Y}$:	(MW)				99.23
PLF_Y:					0.835
$COEF_{NG,HIST,Y}$	(tCO_2/Nm^3)				0.0021
$NCV_{NG,HIST,Y}$	(GJ/Nm)				0.0346
$OXID_{NG,HIST,Y}$					0.995
$EF_{CO2,NG,HIST,Y}$	(tCO_2/GJ)				0.0618
BE_y	**(tCO_2)**				**1,070,901**
ER_y	**(tCO_2)**				**342,235**

Annex 4

MONITORING INFORMATION

Background

Energas Varadero Combined Cycle Project

The generation of electricity from Energas' Varadero combined cycle plant is developed from two sources. The open cycle facility consists of 3 GE-6551B gas turbine (GT) generator sets. The steam turbine is an ABB ATP 4 V80 – C500 c/w Brush Generator. The gas turbines each produce 34.5 MW of electricity and the steam turbine generates a 75MW of electricity.

The generation of power by the combined cycle plant displaces the power generated by existing grid (primarily oil-fired) power plants. The displaced units generate substantially more CO_2/MW when compared to the combined cycle facility. Thus for every MW produced by this facility a certain amount of CO_2 is not emitted to the atmosphere elsewhere.

Purpose

The purpose of this monitoring plan is to provide the methodology to calculate the quantity of CO_2 that is not emitted to the atmosphere due to the operation of the Varadero combined cycle plant.

Source of the data

The data used in the calculation comes from Energas, CUPET, UNE and IPCC. In all calculations a conservative approach is taken.

Energas

Method of monitoring.

The methodology to determine the total reduction in CO_2 emissions is described below. The first step in determining the CO_2 emissions is to gather accurate data. The Varadero combined cycle facility is equipped to accurately measure power production, fuel gas consumption and fuel gas composition. Specific description of the measurement techniques are detailed below. Following the data acquisition the CO_2 emissions from the facility are calculated using the methodology in ACM0007.

1. Measure power production

The combined cycle facility is equipped with Ion 7330 power meters which continuously record the net power shipped. The power sales are totalled daily and recorded. These meters are accurate to within 0.6%.

2. Determine fuel gas consumption associated with the power generation.

The fuel gas feed to the GTs, the combined cycle facility as well as an offsite GE Frame 5 gas turbine (GT #5) is measured using a meter run. The fuel gas flow is recorded continuously and is totalized daily and recorded.

The gas consumed by the GT #5 is estimated using power production versus fuel gas consumption. This gas flow is intentionally limited to produce a conservative value for the emissions generated by the combined cycle facility.

In addition to measuring the total fuel gas to the combined cycle facility there are additional gas meters which measure the gas to each individual gas turbine and to each duct burner. The fuel gas feed to each GT is measured using meter runs which are compliant with AGA 3 -2000. The supplementary fuel gas burned in each HRSG increases the total power produced by the combined cycle facility. This fuel gas is measured by 3 Foxboro Model 83W-A03S1SSSTNE-N Vortex meters one on each HRSG.

3. Determine net calorific value of gas.

The fuel to the combined cycle facility is natural gas produced from Energas's adjacent gas processing facility. The composition of the gas is analysed on a monthly basis. The net calorific value is calculated monthly and an annual average net calorific value is used in the calculations which determine the CO_2 emissions for the combine cycle plant.

The power meters and fuel gas meters are calibrated on an annual basis.

UNE

The baseline information from the UNE oil-fired power plants indicate that their facilities generate 0.906 tonnes CO_2/GWh

The Approved Consolidated Methodology ACM0007 specified the following tables for Project and Baseline emission parameters.

Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
1. $FGT_{NG,y}$	*Consumption of natural gas to operate the gas turbine for the year (y)*	*Metered on site by Energas*	*Nm^3*	*M*	*Continuous*	*100%*	*Electronic*	*Gas input to each turbine is continuously monitored and recorded hourly. Data will be downloaded and consolidated for input to the monitoring data model annually or when periodic verification is required. Measure to be used with the GHG Coefficient to calculate project emissions from GTs.*
2. $FST_{NG,y}$	*Consumption of natural gas used for supplementary heat in the HRSG for the year (y).*	*Metered on site by Energas*	*Nm^3*	*M*	*Continuous*	*100%*	*Electronic*	*Gas input to each HRSG is continuously monitored and recorded hourly. Data will be downloaded and consolidated for input to the monitoring data model annually or when periodic verification is required. Measure to be used with the GHG Coefficient to calculate project emissions from STs.*
3. $NCV_{NG,y}$	*Net Calorific Value of natural gas.*	*Calculated by Energas*	*GJ/Nm^3*	*C*	*Monthly*	*100%*	*Electronic*	*Data to be used with emission factor and oxidation factor to calculate GHG Coefficient.*
4. $EF_{CO2,NG,y}$	*CO_2 Emission Factor of natural gas*	*Calculated by Energas*	*tCO_2/GJ*	*C*	*Monthly*	*100%*	*Electronic*	*Data to be used with net calorific value and oxidation factor to calculate GHG Coefficient.*
5. $OXID_{NG,y}$	*Oxidation factor of natural gas*	*IPCC*	*%*	*E*	*Monthly*		*Electronic*	*Data to be used with emission factor and net calorific value to calculate GHG Coefficient.*

Data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
6. PG_y	*Actual electricity generated by project in the year*	*Metered*	*MWh*	*M*	*Annual*		*Electronic*	*For calculation of electricity generated from waste heat.*

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Annex 5

References

1. Sherritt International; *Phase 3 History*.

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7. Sherritt International; *Affidavit on CDM*; August. 2006

8. Sherritt Power Corporation; *Initial Public and Secondary Offering* (Prospectus); February 1998.

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14. Sherritt International; *Varadero Phase 3 – Vendor Challenges*; Oct. 2005.

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