CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

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Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

CAPEX S.A. – *AGUA DEL CAJÓN* THERMAL POWER PLANT – OPEN TO COMBINED CYCLE CONVERSION
Version 02
9 May 2006

A.2. Description of the project activity:

- Purpose:

The conversion of *Agua del Cajón* is a conventional open-cycle thermal power plant into a combined cycle power plant, by adding one steam turbo generator to make use of the exhaust gases coming from the six (6) existing gas turbo generators. This results in the generation of extra energy and power without increasing the fossil fuel consumption. Therefore the plant is supplying clean energy without emitting additional CO_2.

- Project outline:

Capex S.A.'s main business is the generation and sale of electricity within Argentina. The company owns and operates a power plant located in the province of Neuquén, on the Agua del Cajón concession. The facilities extend over the fields named El Salitral, which supply the Agua del Cajón power plant with the natural gas it uses as fuel to generate electricity.

The project comprises the open to combined cycle conversion of six gas turbines (370 MW ISO). A combined cycle takes advantage of the exhaust gases from the gas turbines to produce steam in the recovery boilers placed in each of the turbines; the steam so generated drives a steam turbine with a 185 MW generating capacity; in turn, so as to streamline the project, the steam production is increased by adding extra heat in each recovery boiler. This is achieved through burners that provide supplementary fire by using the excess oxygen available at the turbine exhausts.

In order to recover part of the wasted heat from the stacks, a Rankine steam cycle is added to the existing Brayton cycle. This requires a heat recovery steam generator (HRSG) that captures the exhaust gases from the gas turbine and transmits their heat energy to the water generating steam in the HRSG heat exchanger. The steam then feeds a turbo generator able to generate 185 MW of additional electricity, without consuming extra fuel. The steam that exits the turbine passes through a condenser (cooling steam into water) and then through the pump feed water cycle, the heaters and the water treatment plant and back to the HRSG where, thanks to the supplementary fire, the output can be increased by 100 MW.

Prior to the implementation of the project activity there were five Westinghouse turbo generators, 46.1 MW gross power each, and one 130 MW gross power Westinghouse turbo generator. They came on line between December 1993 and May 1995, making up an open cycle, gas-fired, thermal power plant.

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Contribution to sustainable development:

The project provides clean energy and reduces the CO_2 emissions in Argentina.

The implementation of this project has generated extra GWh of clean energy without consuming fossil fuel, therefore saving natural gas on the Argentine reserves, and reducing the CO_2 emissions.

The combined cycle conversion project as a whole doubles Capex's income yielded by energy and power sales, with the ensuing municipal, provincial and national tax contributions. It also contributes to the safety of the overall electricity grid, by adding more power in a reliable way.

From the social point of view, the project has created, during its development stage, 200 direct and indirect jobs. Since the thermal power plant became commercially operational, 17 more permanent jobs were created. Besides, the development and construction stage had a strong impact on the area, at both local and municipal level.

During conversion of the power plant, the area within the plant boundaries was afforested, thus reducing the dust raised by local winds and the temperature in the area and increasing CO_2 absorption by trees.

The project has met environmental criteria established by the Municipality of Plottier in the Environmental Statement of Plottier (1983; updated in 2002).

Due to the economic crisis the country has undergone no investments in electricity generation were made since 2002. Argentina will need to increase the generation capacity in order to meet the demand in the upcoming years. The qualification of Capex project into the CDM will motivate other independent power producers to extend country's capacity with cleaner generation.

A.3. Project participants:

Name of Party involved ((host) indicates a host Party)	Private and/or pulbic entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Argentina (host)	CAPEX S.A. (private entity)	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

A.4.1.1. Host Party(ies):

Argentina

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

Neuquén

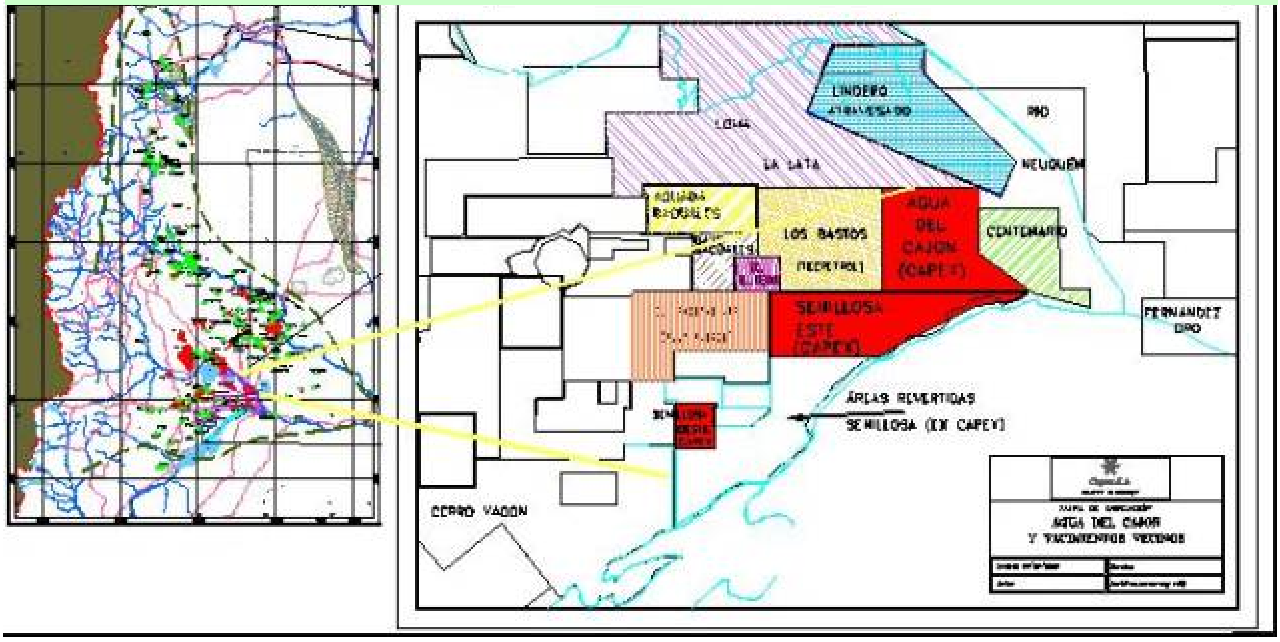
A.4.1.3. City/Town/Community etc:

Plottier

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

The project is located on the Route 22, at the km 1,244.5 landmark, on the way to China Muerta, in Plottier, province of Neuquén. The thermal power plant is in a strategic location, on the gas reservoir that supplies the fuel. The gas produced by this reservoir is solely used to supply the thermal power plant: there is no connection with any trunk distribution or transport pipeline.

Location of the project activity in Plottier, Province of Neuquén, Argentina



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

Sectoral Scope One: Energy Industries (renewable and non-renewable resources).

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

The project consisted in converting six gas turbines (370 MW ISO) from simple (open) cycle operation into combined cycle operation. The combined cycle takes advantage of the exhaust gases from the gas turbines to produce steam in the recovery boilers installed in each gas turbine. The steam produced by the six recovery boilers drives a steam turbine. Besides, the steam production is increased by adding extra heat in each of such boilers by means of burners that provide supplementary fire; the combustion takes advantage of the excess oxygen available at the turbine exhausts. A Rankine steam cycle is added to the existing Brayton cycle to recover part of the heat that leaves through the stacks. This includes a heat recovery steam generator (HRSG) that takes the exhaust gas from the gas turbines and transmits the heat energy to the water, generating steam in the HRSG heat exchanger. The steam then passes through a steam turbo generator, which yields 185 extra MW of electricity without additional combustion or additional fuel consumption. The steam that leaves the turbine passes through a condenser and then through the pump feed water cycle, the heaters and the water treatment plant and then it goes back to the HRSG where, with the help of supplementary fire, another 100 MW effective can be generated.

Prior to project implementation the plant had five 46.1 MW Westinghouse gas turbines and one 130 MW Westinghouse gas turbine. The lifetime of these equipment is greater than the 21-year crediting period and thus equipment was not likely to be replaced or retrofitted in the absence of the CDM project activity.

Technical data of existing equipment prior to project implementation:

Five W251B11 gas turbo generators
Installed capacity: 48 MW
Net power: 46.1 MW
Heat Rate: 2,676 kcal/kWh
Rated voltage: 11.5 kV
Rated frequency: 50 Hz

One MHI701D gas turbo generator
Installed capacity: 136 MW
Net power: 130 MW
Heat Rate: 2,562 kcal/kWh
Rated voltage: 15 kV
Rated frequency: 50 Hz

Technical data of equipment added for implementing the proposed project activity:

One Mitsubishi steam turbo generator
Total gross power: 301 MW
Total net power: 285 MW
Rated voltage: 16.5 kV
Rated frequency: 50 Hz
Net power without supplementary fire: 185 MW

Total heat rate of the combined cycle:	1,808 kcal/kWh
Total installed power for the combined cycle:	677 MW
Total net power of the combined cycle:	645.5 MW

The Plant is connected to the grid by means of the equipment described below:

- 132 kV transformers in every piece of equipment.
- One 132 kV double busbar transformer substation with bus coupler circuit breakers that belongs to the company.
- Two 132 kV transmission lines, 29.8 km long, that belong to the Company and connect the Plant with the Arroyito Substation (belonging to the Comahue trunk transport network, TRANSCOMAHUE); they have a 150 MVA output each.
- One 132 kV transmission line, 51.8 km long, that belongs to the Company and connects the Plant with the Chocón Oeste Substation (belonging to the high voltage power transmission company Transener SA.); it has a 150 MVA output.
- Two 132/500 kV step-up transformers that belong to the Company, with a 300 MVA output each, that connect the 132 kV Agua del Cajón substation with a 500 kV line, 52 km long, linking Agua del Cajón and the 500 kV Chocón Oeste Transformer station belonging to Transener S.A. Capex S.A. built the line linking Agua del Cajón and Chocón Oeste under a COM (Construction, Operation and Maintenance) contract signed with the high-voltage power transmission company. This line, unlike the three 132 kV lines, is for public access.

Execution

Capex gained significant experience from carrying out the construction associated to the Agua del Cajón Thermal Power Plant (Central Térmica Agua del Cajón) that took place while the plant was operating in an open cycle (phases[1] I-III):

Phase I (December 1993): Two Westinghouse B251B11A Gas Turbo generators (46.1 MW each one)

[1] The time evolution of the power plant is divided into phases in order to identify each stage in the development of the plant. But these phases were consequence of unscheduled capacity expansions carried out to take advantage of the gas extracted from the Agua del Cajón field exploited by Capex.

Phase II (October 1994): Three Westinghouse B251B11A Gas Turbo generators (46.1 MW each one)
Phase III (August 1995): One Mitsubishi 701D Gas Turbo generator (130 MW)

All three phases were developed as turnkey projects by Westinghouse Electric Co. (currently Siemens-Westinghouse), the company that supplied the turbo generators (in the case of the Mitsubishi 701D turbo generator, the turbine was supplied by Mitsubishi, the generator by the Brush company and the whole assembly was "packaged" by Westinghouse).

The ancillary works that were carried out also gave Capex experience as principal. Such ancillary works include:

- One 132 kV transformer substation
- Two 132 kV lines to the Arroyito transformer substation
- One 132 kV line to the Chocón Oeste transformer substation
- One 33 kV system to feed ancillary facilities
- One water demineralization plant
- Facilities for turbine gas feed and conditioning

Combined cycle conversion (the proposed project activity)

Capex hired the engineering firm Burns & Mc Donnell to define the technical specifications and to prepare the draft EPC (Engineering Procurement Construction) contract, as well as to assist the company in the technical assessment of proposals.

Capex finally awarded the firm Black & Veatch Intl. (BVI) the turnkey project to implement the combined cycle conversion. Capex's own staff (from the Electricity Department and the Plant) was in charge of the overseeing and startup, helped by the German firm Steag (which had been hired to operate the plant).

This new phase was for Capex a great learning experience in construction, startup and operation procedures.

Operation

From December 1993 to July 1999 the plant was operated by Westinghouse, the equipment supplier during phases I-III (simple cycle). In the meantime Capex's operators (most of whom still work for the company) acquired vast experience in operating the gas turbines working in simple cycle.

During the construction phase of the combined cycle conversion, the operators were intensely trained in the operation of the steam equipment by both the construction contractor (BVI) and the operation contractor (Steag).

The plant is operating commercially in combined cycle mode since 17 January 2000. The operation contract signed with Steag was terminated in March 2002 and since then, Capex is adequately operating the plant.

The path followed by Capex has allowed the company to acquire environmentally safe and sound technology and know-how transferred from Annex 1 countries, for closing the first combined cycle converted in Argentina from six already existing gas turbo turbines operating in open cycle, which use the natural gas of their own gas field.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

The implementation of this project will reduce CO_2 emissions by generating clean electricity, with no combustion of additional fossil fuel (a non-renewable resource).

Since this project is on line, it has substituted and will continue substituting generation units that would otherwise be dispatched to the SIN (Sistema Interconectado Nacional, National Electricity Grid) if this project would have been not implemented; the substituted generation units would be those that are using fossil fuels.

Indeed, the addition of this generation unit modifies the dispatch order of all the units that make up the national electricity grid, thus improving the variable cost per each MWh generated.

If this project had not been implemented other generation units that burn fossil fuel should have replaced it to meet the electricity demand.

In the no-project scenario (i.e. without the 185 additional MW produced by the steam turbo generator), the six existing gas turbo generators would have operated in an open cycle, burning the same amount of fossil fuel (gas) as the combined cycle does (in the project) and the combined cycle would have been replaced by marginal thermal power generation units. The CDM project comprises the 185 MW able to be delivered without additional combustion by the steam turbo generator, whose annual utilization rate is above 90%.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

Year	**Annual estimation of emission reductions in tonnes of CO_2 e**
2000	403,883
2001	427,896
2002	334,519
2003	272,761
2004	347,080
2005	484,537
2006	378,446
Total estimated reductions (tonnes of CO_2 e)	**2,649,122**
Total number of crediting years	7 (first crediting period)
Annual average over the crediting period of estimated reductions (tonnes of CO_2 e)	**378,446**

The total crediting period chosen for this project activity is 21 years, in which 7,947,366 tonnes of CO_2 e emission reductions are expected.

A.4.5. Public funding of the project activity:

The project activity does not rely on public funding.

SECTION B. Application of a baseline methodology

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

Baseline methodology for conversion from single cycle to combined cycle power generation (ACM0007, Version 01, Sectoral Scope 01, 28 November 2005).

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

This methodology is applicable when:

- The project developer (Capex S.A.) utilizes previously-unused waste heat from a power plant, with a single-cycle capacity, and utilizes the heat to produce steam for another turbine —thus making the system combined-cycle;
- Waste heat generated on site is not utilizable for any other purpose on-site;
- The project activity does not increase the lifetime of the existing gas turbines during the crediting period (i.e. this methodology is applicable up to the end of the lifetime of existing gas turbines, if shorter than crediting period);
- Capex has 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 (national electricity grid without including the Patagonia system).

All these conditions are met by the proposed project activity.

B.2. Description of how the methodology is applied in the context of the project activity:

The methodology is applied following all steps and procedures proposed in ACM0007, considering the combined margin approach for determining baseline emissions as proposed in the consolidated methodology ACM0002. Throughout this PDD the application of the methodology is referred, maintaining all the characteristics of the approved methodology, among them:

Parameters, data sources and assumptions

Parameters and data sources:

- Total electricity generated by CDM project (measured by Capex).
- Electricity emissions factor (calculated from best available official statistics, which in this case are the National GHG Emission Inventories of Argentina) including data such as:
    - Fuel emission factors (from National Inventory sources) for each fuel used in other power plants serving the grid.
    - Heat rates of plants that make up the build and operating margins (taken from the wholesale electricity manager (CAMMESA).

Assumptions:

- Total Electricity generated by the project can be accurately measured and recorded.
- It is assumed that Capex has access to accurate data to calculate the combined margin/carbon emissions factor (CAMMESA).
- All fuel consumed in the power plant is used for the conventional units.

The criteria used in developing the proposed baseline methodology are the following:

- That waste heat from single-cycle operations are not being used and not likely to be in the future.
- That little or no additional fuel input is required to provide the additional electricity; if additional fuel is required, that is accounted for as project emissions.
- That the combined margin for determining the carbon intensity of the baseline scenario is appropriate because utilizing the waste heat adds MWh to the grid without additional emissions (similar to renewables) and because the combined margin approach has been approved by the CDM Executive Board.

How the methodology determines the baseline scenario

The baseline scenario is that in the absence of the proposed project activity the electricity, to meet the demand in the grid system, would be generated:

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

This methodology is only applicable where it can be demonstrated that the baseline scenario is as described above.

The baseline for the proposed project activity corresponds to the scenario in which the existing open cycle would continue operating without any modification (or with the addition of another gas turbine, equivalent to the use of supplementary fire) in open cycle mode, which can be considered as the continuation of the existing open cycle (and the addition of a new generation source;. actually the additional generation will be mostly cancelled in the calculation of emission reductions, i.e., it is almost the same in the baseline and in the project scenarios).

To demonstrate it, the following steps are considered:

1) Identification of plausible alternatives to the project activity that deliver similar outputs and services in a comparable service area, of which one of the scenario is the baseline scenario described above.
2) Evaluation of the identified alternative baseline scenarios for their compliance with applicable regulations, including:

- Regulations for utilization of waste heat on the premises where it is generated;
- Regulation on energy efficiency norms for power projects; and
- Emission norms for power projects.

Alternatives that are not in compliance with existing regulations are removed from further assessment.

3) Conduction of a barrier test analysis considering the following types of barriers:

- Investment barriers,
- Technological barriers,
- Barriers due to prevailing practice, and

- Other barriers.

4) The scenario with the least barriers is the baseline scenario, corresponding to the continuation of the current practice.

The continuation of the current practice in this case could correspond, not only to the continuation of the operation of the pre-existing open cycle (continuation of the current situation), but also to the expansion of the power plant, operating in open cycle, as new reserves arise and are available (continuation of the current practice in terms of resources).

The key information and data used to determine the baseline scenario is provided in the following table.

Data	Sources
Merit order of power plants	CAMMESA
Combined cycles in Argentina	Secretariat of Energy – CAMMESA
Sectoral information	Secretariat of Energy – CAMMESA
Electricity prices forecast	Mercados Energéticos S.A.
Agua del Cajón natural gas reserves	Netherland, Sewell & Associates, Inc. – Capex S.A.
Financial analysis	Capex S.A.
Legislation	Ministry of Economy – Secretariat of Energy – ENRE – Equilibrium S.A.

B.3. 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:

Additionality

Additionality is demonstrated by using the latest version of the "Tool for the demonstration and assessment of additionality" approved by the CDM Executive Board, available on the UNFCCC CDM web site. Currently this Tool is given by the version of 22 October 2004.

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

Project participants wish to have the crediting period starting prior to the registration of the project activity. Therefore:

a) ***Evidence that the project activity started in January 17, 2000, thus falling between 1 January 2000 and 18 November 2004 (date of the registration of the first CDM project activity)***

The real action (commercial operation) of the project activity is publicly documented as registered by CAMMESA (Wholesale Electricity Manager, the regulatory body which oversees the Argentine Electricity Market) and the Secretariat of Energy. Copy of this documentation will be provided to the DOE during validation of the project (it is public).

b) ***Evidence that the incentive from the CDM has been considered in the decision to proceed with the project activity***

Capex S.A. designed the project activity with the aim to contribute to GHG emission reductions, alleviating the huge investment and additional costs involved through the sell of carbon credits. The project was conceived in an early stage of CDM with the expectation that carbon credits (whatever they were) compensated such an additional effort, bringing Capex the possibility to be an early and pioneer

player in the emerging carbon market. There is documented evidence that this was the case as shown, e.g., in the Statements of the company (from 1999 to 2005) audited by Price Waterhouse & Co. SRL, in the communications to the Stock Exchange of Buenos Aires in 1999 and 2000, and in public presentations recorded in the proceedings of the annual compilation of environmental activities performed by the Consejo Empresario Argentino para el Desarrollo Sostenible (Argentine branch of the World Business Council for the Sustainable Development, 1998 – 2004, www.ceads.org.ar). This documentation will be provided to the DOE during validation of the project and it can be made public if required.

As detailed below (Step 2), the economic analysis of the project took into consideration the future income that the carbon trading might yield, within the framework of the Kyoto Protocol.

Path followed by the project implementation before other organizations:

A survey process was conducted by Capex with the United States Initiative on Joint Implementation (USIJI), in order to consider the presentation of the project under the pilot phase of the Activities Implemented Jointly (AIJ), supposed to be a scheme able to be plugged into an emerging carbon market. Advised by International Utility Efficiency Partnerships, Inc. (IUEP),[2] Capex began analyzing the possibility of development of an AIJ project, which could serve as a pioneer mechanism for the recognition of carbon credits in the framework of the by then recently created CDM. In consequence, the project was submitted as AIJ —until CDM entered into effect— to the Argentine Secretariats of Environment and Energy in 1998. Capex was the first company in Argentina that has adopted a header position with respect to GHG emission reductions, paving the way for other companies to follow this initiative. The Argentine Office of Joint Implementation (under the Secretariat of Environment with participation of several State Secretariats, such as the Secretariat of Energy and the Ministry of Foreign Affairs) approved the proposed project in October 1998, and the United States Initiative on Joint Implementation granted its approval in March 1999. Since January 2000 Capex has recorded and verified the emission reductions achieved by the project through an international and independent auditing firm (Environmental Resources Trust Inc.), which verified the emission reductions. This auditing firm projected that the total CO_2 emission reductions throughout the project lifetime might amount to 19 million of metric tonnes of CO_2 e, as long as the plant and the Argentine electricity market situation prevailing in June 2001 remains constant throughout the project lifetime (i.e. until 2025).

Every action related to the project qualification that was undertaken by Capex S.A. before the startup in 2000 is fully documented, whether it is referred to the decision making process, the design or the construction stages. This documentation will be provided to the DOE during validation of the project and it can be made public if required.

Several notes on the project exchanged between Capex S.A. and national and international bodies concerning the qualification process and the intends of trading carbon credits are shown below.

Date of Notification	From:	To:	Reference
April 20, 1998	María Julia Alsogaray – Secretary of Natural	Guido Di Tella – Minister of Foreign Affairs	Request to consider Capex S.A. project, recognizing it as a sustainable

[2] The documentation is available for the DOE, which can be made public if required. The discussion of the sale of carbon offsets was also held at high-level governmental spheres between United States and Argentina officials, as an opportunity for the sustainable development of the country. In a letter from the President of Capex to the Secretary of Energy of the US Department of Energy, it is confirmed that the project is only viable through the sale of carbon offsets: "… The possibility of certifying the project under the USIJI, thus allowing us to market the CO_2 credits to third parties was one of the important factors in our decision to proceed forward with the project." IUEP confirmed Capex the possibility of selling credits at US$ 5 per tonne of CO_2 e to a US electric utility.

	Resources and Sustainable Development – Argentine Government	– Argentine Government	development project to be submitted under the Treaty signed by the Argentine Gov. with USA.
August 31, 1998	María Julia Alsogaray – Secretary of Natural Resources and Sustainable Development – Argentine Government	Madelaine Albright – Secretary of State of the US Department of State	Request to consider Capex S.A. project, recognizing it as a sustainable development project to be submitted under the Treaty signed by the Argentine Gov. with USA.
October 23, 1998	María Julia Alsogaray– Secretary of Natural Resources and Sustainable Development – Argentine Government	Madelaine Albright – Secretary of State of the US Department of State	Project description. Support by the International Utility Efficiency Partnerships, Inc. Argentine Government's acknowledgment of the project (Argentine Joint Implementation Office).
March 17, 1999	US Initiative on Joint Implementation (USIJI)	Informative publication	Project description.
March 9, 1999	Jack Fitzgerald – Director of the US Initiative on Joint Implementation (USIJI)	Ron Shiflett – Director of Edison Electric Institute, a company hired by Capex S.A.	Letter of Acceptance of CAPSA's (Capex S.A.) project under the USIJI program.
November 8, 2004	Hugo Cabral and Norma López – Capex S.A.	Nazareno Castillo – Coordinator of the CDM Argentine Office – Argentina DNA	National Approval Letter request.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a. Alternatives to the project activity

The alternative scenarios available to the project participants were:

- The continuation of the current situation (no expansion of the plant operating as open cycle);
- The capacity expansion of the plant continuing operating in open cycle. Two options were possible:
  - Expansion for generating an output comparable to the one reached by the proposed CDM project activity (around 185 MW),
  - Continuation of the current practice in terms of resources: Restricted expansion in order to take advantage of the exploitable natural gas of the own field (around 105 MW);
- The proposed project activity not undertaken as a CDM project activity (combined cycle conversion for about 185 MW of clean energy plus additional generation for about 100 MW to take advantage of the remaining available natural gas).

No other alternatives provide outputs comparable or compatible with the proposed CDM project activity.

Sub-step 1b. Enforcement of applicable laws and regulations

Argentina has not any regulation for utilization of waste heat on the premises where it is generated.

All the above-mentioned alternatives are in compliance with the electricity sector regulation. The Argentine legal framework for electric power generators is regulated by Law N° 24,065, which establishes the guidelines for the competition among the generators that make up the national electricity grid. This law is regulated by the so-called "Dispatch Scheduling and Price Calculation Procedures" (The

Procedures) that are enforced by CAMMESA (*Compañía Administradora del Mercado Mayorista Eléctrico S.A.*).

The electricity industry in Argentina

Below is a summary of certain issues on the Argentine electricity industry, including regulations and legal provisions that are applicable to the electricity sector.

Historic background

Argentina's first electricity supply, which was used for street lighting, began in 1887. The creation in 1946 of the General Directorate of Government-run Power Plants, body that would build, operate, and conduct research on power plants, marks the start of government's involvement in the electricity sector. One year later a new State-owned company opened its doors, the Water and Electricity Company (Agua y Energía Eléctrica, "AyEE") in order to develop the hydroelectric generation, transmission and distribution system in Argentina. "SEGBA" was created in 1958 by Law N° 14,772 and Decree 1,247/62 awarded it under concession; the goal of this new company was to generate and distribute electricity in Buenos Aires. In October 1967, Hidronor was founded and vested with concession rights to build and operate hydropower plants.

By 1990 practically the whole Argentine electricity industry was managed by the State. The central government, through the Secretariat of Energy and Transportation (or simply the "Secretariat of Energy") assumed the responsibility for regulating this sector at the national level and controlling the state-owned power generation companies, AyEE, SEGBA and Hidronor. Also, through the Ministry of Foreign Affairs the central Government represented the country's interests during the process of analysis, development or operation of power plants, jointly with Uruguay, Paraguay and Brazil. Many provinces within Argentina operated their own electricity companies as well. The State management and investment policies for the sector proved inefficient, and caused to a large extent the serious situation in which the electricity sector found itself at the time, with obsolete equipment and poor quality service, plus increased financial losses.

Therefore, the Argentine government decided in 1991 that it was time for a major change. The Presidential Executive Order N° 634 enacted in March and Law Nº 24,065, passed in January 1992 (the "Regulatory Framework Law") provided for the restructuring and privatization of the electricity sector, in accordance with Law Nº 23,696. The new regulatory framework divided the range of activities into three independent categories: generation, transmission and distribution of electricity and provided independent regulations for each. The ultimate goal was to foster competition and better serve the population, improving both rates and service quality. The privatization process started in February 1992 by selling a number of important thermal power plants that were operated by SEGBA, and next by selling transmission and distribution installations as well as more thermal and hydropower plants. The Government also intends to sell the nuclear and hydroelectric generation assets that still remain under its control.

The resulting structure of the Argentine electricity sector is described below.

The new structure of the Argentine Electricity Market

The Secretariat of Energy established a new regulatory framework for the electricity industry, as defined by the Regulatory Framework Law and Resolution N° 38/91 dated July 19th, 1991, among others. This new legal framework divided the range of activities into three integrated categories, generation, transmission and distribution, providing independent regulations for each. The ultimate goal is to constantly match the generation and the consumption of electricity in the most efficient and competitive way. Electricity generation is considered to be a competitive activity, so the new legal framework implicitly paves the way for a free market where power generators can sell their power to the distribution companies, to large consumers and to the wholesale electricity market. Transmission companies, which benefit from an obvious monopoly and are compelled to allow access to third parties to any transmission capacity available, are not allowed to sell or buy electricity; they are only allowed to charge a rate for transmission services. Regarding the distribution companies, which also operate in monopolistic conditions, they have to comply with regulated rates and service quality standards. These companies have to meet market demand and, as long as there is available distribution capacity, they are

compelled to allow the large users who have bought electric power from another source to carry such energy through their network for a fee. The companies and the large users agree upon such fee and, whenever they cannot reach an agreement, CAMMESA sets the fee according to the situation in the market.

Regulations and Operation of the Wholesale Electricity Market

The national Government controls the electricity sector through ENRE, the national regulatory authority that in turn reports to the Secretariat of Energy and is responsible for verifying that all the players in the electricity sector comply with the industry regulations and with their corresponding concession terms. ENRE has also implemented a system of public hearings where the sector players can make their voices heard on a broad range of topics, such as compliance by the licensees with the concession agreements.

The management of the electricity sector is in the hands of CAMMESA, whose share capital is distributed among the organizations that represent the generation, transmission and distribution companies, the large users and the Secretariat of Energy, which represents the retail consumers. CAMMESA is in charge of scheduling and dispatching the different generation units in order to meet demand (this is done according to a ranking made by the marginal cost and availability offered by the different generators; the lower the marginal cost offered, the higher the generation unit is ranked in the list).

The regulatory framework of the WEM (Wholesale Electricity Market) came into force in August 1991, when the Secretariat of Energy passed Resolution N° 38/91, and it was specified in great detail by Resolution N° 61/92. Thus the WEM has become a market where generation and distribution companies can buy and sell electricity at prices set by supply and demand, and they are allowed to enter into forward agreements.

The WEM is then made up of:

(a) The forward market ("Forward Market") that comprises agreements in which quantity, price and specifications are established directly between buyers and sellers;
(b) The spot market ("Spot Market"), with hourly prices defined according to production costs; such costs are the marginal short-term production costs as calculated in Ezeiza, province of Buenos Aires, where the system load hub is located;
(c) A system to stabilize spot prices every three months, applicable to buys made by distribution companies.

Regulatory System

There follows a description of the main regulatory authorities of the electricity industry in Argentina that oversee thermal power generators. There are other regulatory bodies that control hydroelectric and nuclear power plants, as well as provincial authorities.

ENRE

ENRE is an agency reporting to the Secretariat of Energy with ample jurisdictional and regulatory powers. Among its duties, it has to (i) enforce the Regulatory Framework Law and the relevant regulations; (ii) control the electricity supply and the compliance with concession contracts; (iii) adopt standards applicable to generation, transport and distribution companies, electricity users and other parties involved in safety, technical guidelines and procedures, consumption measurement and billing, service interruption and reconnection, third-party access to the different installations, and service quality; (iv) prevent non-competitive, monopolistic and discriminatory practices among the different players in the electricity industry; (v) impose sanctions in case of breach of concession contracts or any other relevant regulations; and (vi) arbitrate in case of conflict among the different players in the electricity industry.

ENRE is managed by a Board of five members appointed by the Argentine Executive, two of who are nominated by the Consejo Federal de Energía Eléctrica (Federal Electricity Council).

CAMMESA

Executive Order Nº 1,192, passed on July 10, 1992, approved CAMMESA incorporation and by-laws. The Argentine government has 20% of the shares and the rest is equally distributed among the organizations that represent the generation, transport and distribution companies and the large users —20% each.

CAMMESA is in charge of:

(a) Managing the SIN (Sistema Interconectado Nacional, the national electricity grid) in accordance with the Regulatory Framework Law and related regulations. In this regard, this agency is specifically in charge of (i) scheduling, based on technical and economic considerations, the electricity dispatch to the SIN, maximizing the system safety and the service quality while minimizing the wholesale prices in the Spot Market; (ii) planning the energy capacity needs and streamlining its use, in compliance with the provisions periodically set by the Secretariat of Energy; and (iii) monitoring the Forward Market, managing the technical aspects of electricity dispatch according to the contracts traded in that market;
(b) Acting as a representative of the different players in the WEM and/or carrying out the electricity-industry related activities that correspond to this representative;
(c) Buying and/or selling imported or exported energy from/to other countries, conducting the necessary import/export formalities; and
(d) Rendering consulting or other kind of services concerning the above mentioned activities. CAMMESA operating costs are paid with mandatory contributions made by the companies that compose the WEM. There are regulations that establish that CAMMESA annual budget cannot exceed 0.85% of all the transactions carried out in the WEM.

Dispatch

CAMMESA dispatches the electricity according to a ranking of marginal production costs, starting with the lowest; this is subject to the exceptions that will be further detailed. The generators report their figures every six months, enabling CAMMESA to estimate the marginal production costs and to schedule the seasonal and weekly dispatches in the way outlined below.

Cost Reporting by Generators

Thermal power plants. Each generation company reports the variable production costs of each of its thermal power plants according to the type of generation unit and the type of fuel that can be consumed by each unit.

Hydroelectric power plants. Every WEM hydropower plant with seasonal dams (i.e. hydroelectric plants with a dam that is big enough to store water from one season to the next, allowing to adjust the use of water) has to submit to CAMMESA the water price, the water availability forecasts, and the scheduled discharge and maintenance operations that might affect generation. The companies define these indicators according to the water level in the dams, the forecasted hydrologic patterns, and the data and prices submitted in the preliminary schedule explained above. The goal pursued by the generation companies is to report a price that might yield the highest revenue possible.

Dispatch Schedule

CAMMESA issues weekly and seasonal dispatch schedules, thus allowing each generator to define its own short-term and seasonal schedules. Based on the information that each company sends to CAMMESA at the end of each calendar week, this agency schedules the weekly dispatch trying to minimize the total production cost and the risk of system failure. CAMMESA may adjust this weekly dispatch schedule on a daily basis.

CAMMESA also schedules seasonal dispatches trying to minimize the total cost of electricity in the Spot Market; the calculations are based on production costs plus the cost of the unmet demand or the cost of system failure. The seasonal schedule is carried out with the help of optimization and programming models approved by the Secretariat of Energy, such as the Margo simulation model and the Oscar optimization model, which are the main tools used nowadays for demand and supply forecast in Argentina.

Pricing

The generation companies sell the electricity to the WEM at the Spot Price, whereas distribution companies pay for it at the Seasonal Price (as defined below). The difference between both prices accrues in the Stabilization Fund (as defined below).

Seasonal Electricity Price

The year is divided into two seasons (from November 1st to April 30th and from May 1st to October 31st), each with its own hydrologic and demand characteristics. Every six months (subject to quarterly review) CAMMESA establishes the seasonal price to be paid by the distribution companies to the WEM ("Seasonal Price"). This agency also establishes the prices that distribution companies, large users and self-generators will have to pay for their capacity demand in the WEM.

The Seasonal Price defined by CAMMESA is mainly based on the average cost of supplying one additional MW of electricity (marginal cost) and the cost derived from the system failure, plus other factors. To determine this price CAMMESA uses a seasonal database and optimization models.

Besides, to define the Seasonal Price, CAMMESA has to take into account the amount of electricity supplied by each generator, based on their expected availability, electricity import commitments and their reported availability. To establish the demand, CAMMESA has to include the requirements of distribution companies, large users and self-generators that buy their energy from the WEM, as well as the electricity committed for export.

CAMMESA job is to simulate the situation for one season, testing several supply and demand scenarios. For each alternative analyzed, CAMMESA has to define the best dispatch of the available supply while considering the restraints imposed by the transmission network, in order to meet demand and at the same time minimize the production costs plus the cost of reducing the risk of system failure, which varies from season to season.

The final factor considered to establish the Seasonal Price is the Stabilization Fund ("Fondo de Estabilización"). This concept is explained below under that same heading.

Remuneration in the Spot Market

In the Spot Market generation companies are paid for their electricity according to the marginal cost of the next MW available for dispatch after meeting the electricity demand. Also, generators are paid for (i) the capacity that they make available to the Spot Market, including the stand-by capacity; (ii) the additional stand-by capacity, to be used in case of a system capacity shortage; and (iii) certain ancillary services. Therefore, generation companies that operate in the WEM receive the following payments:

- Energy payments for the actual amount of electricity delivered, at the price prevailing in the Spot Market;
- Capacity payments for the hours of regular demand, when the generation company is accepted by CAMMESA to dispatch during working days;
- Cold reserve capacity payments during a period in which a generation company is scheduled in stand-by (this is valid for thermal power plants only); and
- Ancillary service payments, i.e. payments for additional services like frequency regulation and voltage control that a generation company must render if it is to participate in the WEM.

The calculations of these payments are detailed below:

Forward Market

Generators can participate in the Forward Market to supply electricity and capacity to distribution companies and large users.

Payment for Transmission

The high-voltage transmission of electricity among the different areas that make up the WEM is a public service rendered by Transener S.A., under a concession agreement. The rates established for this concession are in line with the WEM regulations and remunerate Transener for connection, transmission capacity supplied and actual power transmission.

The remuneration for the connection to the system comprises the Operation and Maintenance of the connection equipment used and it is based on the service quality required for the connection to the transmission system.

The remuneration for the transmission capacity supplied to the system refers to the cost of Operation and Maintenance of the transmission equipment used and it is based on the service quality required by the high-voltage transmission system.

The remuneration for the actual power transmission is based on: (i) any difference between the amount of electricity received by the recipient node and the amount of electricity supplied by the delivery node, when the price difference between both nodes equals the marginal value of transmission losses and (ii) any extra cost imposed on the consumers, when that cost is linked to a recipient node and it is due to short and long-term outages in the transmission system; this cost is calculated from an annual service interruption rate and from the cost of the unmet demand.

Current National Legislation

Law 13,273 as amended. Law on Forests. It declares that the defense, improvement and extension of forests is of public interests.

Law 19,587 on Occupational Safety and Health (enacted April 21, 1972).

Law 20,284 on Air Preservation. Public Health. Passed and enacted on April 16, 1976.

Law 22,421 on the Wildlife Protection and Conservation. March 12, 1981.

Law 22,428 on Soil Conservation. March 20, 1981.

Law 23,922, which ascribes to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, executed in Basel, Switzerland, on March 22, 1989 (April 24, 1991).

Law 23,028 on Labor-related Accidents and Occupational Diseases, enacted in December 1991.

Law 24,040 on chemical compounds. Controlled substances included in Annex A to the Montreal Protocol on Substances that Deplete the Ozone Layer. Rules. January 8, 1992.

Law 24,051 on the generation, transportation and treatment of hazardous wastes. Rules. Passed December 17, 1991 and enacted on January 8, 1992.

Law 24,295. UN Framework Convention on Climate Change. January 11, 1994.

Decree 531 **–** It regulates *Law 19,587*. June 1979.

Decree 681 **–** Soil Preservation. It regulates *Law 22,428*. April 3, 1981.

Decree 691 **–** Wildlife Protection and Conservation. It regulates *Law 22,421*. April 7, 1981.

Resolution 369 (MTySS). Rules on the use, handling and safe disposal of polychlorinated biphenyls and their wastes. Official Gazette, April 23, 1991.

Resolution 1,069 (MTySS). Construction. Rules on Occupational Safety and Health. Approval. January 9, 1992.

Resolution 577 (MTySS). Asbestos. June 21, 1991.

Resolution 1,656/95 (DNV). Environmental Assessment and Management Handbook for Roadworks.

All the alternatives considered in Sub-step 1a are in compliance with current National Legislation.

Current Provincial Legislation

Law 1,914 on environmental preservation, conservation, defense and improvement. Amendment. Enacted on July 4, 1991.

Law 1,875 – Environmental Protection Law on environmental preservation, conservation, defense and improvement. Enacted on December 21, 1990. Its purpose is regulating the territory, providing for the rational use of resources, the defense of protected areas and the prevention and control of all activities likely to degrade the environment, human life or living bodies:

- It forbids the dumping of pollutants into watercourses if they affect their quality of use.
- It provides for the use of soil in line with its potential, and forbids soil contamination or alteration if this modifies its suitability or has a negative undesirable impact on flora, fauna, human health or property.
- It forbids atmospheric contamination that affects its quality for human welfare or for the preservation of flora and fauna.
- It forbids all kinds of activities that may jeopardize the existence of individuals or animal species.
- It provides that companies responsible for such alteration, whichever its nature, shall bear the cost of implementing any pertinent environmental remediation measures to restore the environment to the conditions present before such disturbance.

Law 1,875 was amended by *Law 1,914* in 1991 (sections related to the enforcement authority. The Provincial Environmental Council was created as the enforcement authority for environmental matters).

Law 899 – Water Code (1975). Article V relates to Industrial Uses. It is the legal body of rules applicable to the control of liquid discharges. The law was regulated by *Decree 2,756* passed in 1983. This Decree regulates the rate regime for irrigation water, but does not include any specific provision on the discharge of industrial effluents into sewerage systems.

Title VIII, Annex II of such Decree sets forth (§ 749) that no waters containing matter that may be detrimental to public health or agricultural may be discharged into sewerage systems. Any waste waters resulting from industrial activities must be cleaned before being discharged into the general sewerage system.

Currently, the Provincial Water Agency also frames its activities within the scope of the wording of a Draft Regulation on Industrial Effluents.

Decree 2,756. It regulates the use of public waters in the Province of Neuquén. November 7, 1983.

Resolution 207/98, which amends *Resolution 170/96*. It currently regulates the discharge of wastewaters in the Province of Neuquén.

As production commences and effluents are discharged, the owner shall file an analysis of the industrial effluents generated by the facility. The sample shall be taken at a time of peak pollutant concentration, including the parameters listed in Annex 1 to *Resolution 204/98* for each industry type.

All the alternatives considered in Sub-step 1a are in compliance with current Provincial Legislation.

Regulations regarding Thermal Power Plants and the Electricity Market

Law 24,065 on the Privatization of Electric Power – Natural Resources. Electric Power. Power Generation, transportation and distribution. Provisions common to carriers and distributors. Import and Export. Dispatching. Rates. National Electric Power Fund. Infringements and Penalties. Miscellaneous provisions. Amendment to *Law 15,336*. Passed December 19. Enacted January 3, 1992.

Executive Order 1,398/92. It provides for the protection of the environment against the negative effects of power development. In this connection, it provides as follows:

Section 16: "Power generators, carriers, distributors and users must operate and keep their facilities and equipment in a condition that entails no danger for public health, and are also bound to comply with such regulations and resolutions as the Board may provide to that end."

"Such facilities and equipment shall be subject to such regular testing and inspection as the Board may provide. The Board shall be further empowered to instruct the interruption of services, and the repair or replacement of facilities or equipment, or the adoption of any other measure intended to protect public safety."

Section 17: "The physical infrastructure, facilities and operation of equipment associated to power generation, transport and distribution shall comply with regulations intended to protect water basins and the ecosystems involved."

Moreover, they shall comply with pollutant emission standards currently in force or to be adopted in future at a national level by the Secretariat of Energy.

Based on the provisions transcribed above, the *Manual de Gestión Ambiental de Centrales Térmicas Convencionales* (Environmental Management Handbook for Conventional Thermal Power Plants) approved by *Resolution 149/90* of the former Energy Under-Secretariat, as amended by *Resolution 154/93*, shall be adopted.

The enforcement authority for the regulations listed above is the ENRE, pursuant to the provisions of Sections 56, subsections (k) and (s), and 63, subsection (g) of *Law 24,065*, as regulated by *Executive Order 1,398/92*.

Resolution 149/90, as amended by *Resolution 154/93*, provides for the duty to take specific environmental control measures regarding the type of facility managed by the operator. In this connection, operators must inform the ENRE about the results of tests and environmental assessments carried out by submitting the following documents:

- Environmental System Diagnosis
- Environmental Impact Assessment
- Environmental Management Plan

It is worth noting that by *Resolution 32/94* the ENRE approved the *Guía de Contenidos Mínimos del Plan de Gestión Ambiental* (Guide of Basic Contents for an Environmental Management Plan) that each

operator registered with the Wholesale Electricity Market "must develop and apply while operating its facilities," as provided by Section 10 of the above-mentioned Resolution.

The following are the basic contents to be included in the Environmental Management Plan, as indicated by Item III of the Annex to ENRE *Resolution 32/94*:

- Management Program for Solid and Semi-solid Wastes and Liquid and Gaseous Effluents
- Contingency Prevention Program
- Environmental Monitoring Program
- Approvals and permits

All this makes up an action intended to standardize environmental legislation, and its enforcement:

- by having legislation enforceable in national jurisdictions whenever such jurisdictions generate the wastes or suffer their impact or when such impact is suffered by a jurisdiction that did not generated the wastes;
- by the enactment of similar laws in the provinces, in line with the provisions of Section 67;
- because whenever the enforcement authority does not act due to its own jurisdiction (either by virtue of the generating location or of the inter-jurisdictional nature of its effects), it shall act as coordinator before competent provincial or municipal authorities.

Section 2 of the aforementioned law, and *Executive Order 831/93*, Annex I, define hazardous wastes as any material that may directly or indirectly cause damage to living creatures or contaminate the soil, water, the atmosphere or the environment in general.

Executive Order 177/92 provided that the former Secretariat for Natural Resources and Sustainable Development (currently, Secretariat of Environment and sustainable Development) would be the enforcement authority of such legal framework. This agency, which reports to the Argentine Executive, was created by *Executive Order 2,419/91* "to have jurisdiction over anything related to natural resources and the environment", as defined by the 4th preamble of *Executive Order 177/92*. In this connection, the Secretariat is the enforcement authority for *Laws 24,051*, *24,040*, *22,421*, *22,428* and *23,922*.

Pursuant to *Law 24,051/92* §14, a generator is defined as any natural or artificial person that, as a result of its business activity, generates wastes rated as hazardous.

Under the Law and its regulations, *Thermal Power Plants are deemed "generators" of hazardous wastes.* This classification is based, firstly, on the fact that they generate wastes identified in Annex 1 to *Law 24,051/92* as included in the categories subject to supervision (such as mixes and waste oil and water emulsions and hydrocarbon and water emulsions. A second explanation is found in the probability of using oils for transformers that may contain PCBs.

Resolution 149 (SSE) – Manual de Gestión Ambiental de Centrales Térmicas Convencionales (Environmental Management Handbook for Conventional Thermal Power Plants). Approval. March 1990.

Resolution 154 (SE) **–** Enforcement of the provisions contained in the *Manual de Gestión Ambiental de Centrales Térmicas Convencionales*. June 4, 1993.

Resolution 182/95 (SE). It amends *Resolution 154/93* and substitutes Annex I: Conditions and Requirements. It provides for the obligation to operate thermal power plants without affecting the environment, maintaining equipment in proper condition so that it will not contaminate the environment.

Companies are also obliged to keep a record of their emissions, discharges and wastes during plant operation. Also, the law provides for admissible limits for NO_x, Particulate Matter and Sulfur Dioxide.

Resolution ENRE 52/95. It provides that PGAs will be approved by the Board of Directors of ENRE and sets the timeframes for their submission, as well as applicable procedures in case of non-compliance.

Resolution ENRE 51/95. It is a construction of §§17 and 56, subsection "K" of *Law 24,065* and provides that generators registered with the WEM will abide by federal environmental legislation and by those rules passed at a jurisdictional level, as per the plant's location. This resolution clarifies the procedure to be applied by ENRE if any non-compliance with current environmental rules (not passed by the Energy Secretariat) is detected.

Resolution ENRE 13/97. It approves the *Guía Práctica para la Evaluación del Impacto Ambiental Atmosférico* (Practical Guide for Atmospheric Environmental Impact Assessment). The methodology used by this guide shall obligatorily be applied in Environmental Impact Assessments carried out in case of extension or expansion of thermal power plants if the same may modify expected gaseous emissions which may in turn result in changes to air quality near the Power Plant.

All the alternatives considered in Sub-step 1a are in compliance with Regulations regarding Thermal Power Plants and the Electricity Market.

Petroleum and Gas related framework

Since Capex was organized in 1988 to engage in oil and gas exploration activities in Argentina, it is worth to mention that Capex is also in compliance with regulations affecting the gas exploitation activity indirectly related to the proposed CDM project.

In January 1991, Capex acquired 100% of the rights over the Agua del Cajón area, licensed by the Energy Secretariat. Capex was granted the concession for 25 years, with the option to extend this term for another 10 years (this extension must be ratified by the Argentine Executive Power). Most reserves identified in this area are located in two fields in Agua del Cajón (El Salitral and Agua del Cajón).

Capex has significantly increased oil and gas production levels in the Agua del Cajón area since these areas were acquired, especially due to well work-over and drilling and the optimization of production systems. In turn, exploration and development efforts have helped identify major additional natural gas and oil reserves.

After the addition of new gas reserves, Capex started analyzing alternative industrial uses of natural gas, in view of the insufficient electric power generation capacity and the still incipient deregulation process of the Argentine power sector in the early '90s. This scenario offered a good opportunity to give natural gas a value added and to create an additional market for it. After completing feasibility studies and analyzing alternative projects (especially the construction of additional gas pipelines and treatment facilities) that would allow Capex to develop and sell its natural gas reserves, the Company decided to build the gas-fed power plant. Expansion of the plant to the generating capacity prior to the implementation of the proposed project activity was developed in three stages, as mentioned in Section A.4.3.

All the alternatives are in compliance with *Resolution 143/98* of the Secretariat of Energy that regulates the venting of gas in reservoirs. The fields exploited by Capex do not exceed the limits imposed by regulation, thus allowing the Company to undertake any of the different alternatives considered in Sub-step 1a. The possibility of using this gas in any expansion of the power plant allowed Capex to perform

an investment analysis for the decision-making process that concluded with the implementation of the proposed project activity.

Step 2. Investment analysis

Sub-step 2a. Determination of appropriate analysis method

The method selected is Option II (investment comparison analysis) due to the circumstances of the project proponent, Capex S.A., and the characteristic of the proposed CDM project activity. The analysis is carried out from the project sponsor perspective in order to take into account its decision-making process. Sectoral circumstances are considered as part of the general environment under which the project is developed. The main aim of the project was not to attend the increasing demand in the Argentine power system, although the project has contributed to add capacity to the national grid to renew the power generation matrix of the country. In the absence of the project, other independent power producers could have met the demand maybe constructing a power plant of similar capacity, but it is included in the methodology itself through operating and build margin considerations. New additions to the system would not likely be covered by zero-emitting resources, as shown at the end of this Section, where the applicability of the baseline methodology is considered in order to determine the baseline scenario.

Sub-step 2b. – Option II. Investment comparison analysis

The internal rate of return (IRR) is the financial indicator most suitable for this project activity and decision-making context. Nevertheless, net present value (NPV) and payback period are also discussed. Moreover, total investment and the strategic use of available natural gas became key elements for decision making too. This set of parameters and strategic considerations are used in the investment comparison analysis.

Sub-step 2c. Calculation and comparison of financial indicators

The 185 MW power increase, attained without additional fuel consumption, already represented more profits for Capex S.A. due to the higher sales volume. However, if these profits are compared with the capital investment needed and the sale price of the end product, which is "energy," this was not a vital decision to sustain the plant competitiveness and long-term survival. As shown in Steps 3 and 4, there were not reasons to expand the capacity of the power plant in open cycle mode since it was competitive in the wholesale electricity market. Previous expansions of the *Agua del Cajón* power plant always obeyed reasons related to the use of the own natural gas reserves in order to give the existing resources a value added.

The decision to undertake the combined cycle conversion took into account the environmental benefits derived from it, in terms of the GHG (CO_2) emission cuts. Besides, while the conversion was being carried out, the area within the plant boundaries was afforested, thus reducing the dust raised by local winds and the temperature in the area; this increases the plant operating efficiency and also the CO_2 absorption, at least in small amounts.

Project assessment – Strategic development

Capex S.A. calculated the economic and financial projections to perform an economic assessment of the alternatives and assign the priorities in order to decide what kind of action (e.g. expansion, if any) would have been undertaken in the generation plant.

Analysis of the economic feasibility of Agua del Cajón Thermal Power Plant expansion

In order to analyze the project feasibility, the Board of Directors of Capex S.A. had previously defined the acceptance parameters applicable to the different alternatives.

1) Operating Guidelines

Given the scenario in which the project is implemented, any project should be assessed according to its operative synergies or its capability of achieving the company's strategic goals. Such goals comprise not only operational sustainability but also compliance with the company's values regarding environmental or community impact.

2) Economic Guidelines

These refer to size and intended profitability (IRR, NPV, payback period, investment and business strategy).

As regards size, the magnitude of the investment required by the project should be such that it could be paid with third parties or company own resources, or with a combination of both. In the medium term, it should provide the company with the technical ratios sufficient to enable it to sustain the project with the resources yielded by the project itself. Regarding profitability, eligible projects should have an IRR above 14% for a planning horizon no less than 20 years, depending on each project relative characteristics.

The intended rate considered the return on the project cash flow, which would enable the project to be sustainable in the long term, so as not to affect existing projects, yield enough resources for the project to be self-financed and to allow the company undertaking future projects keeping a healthy capital and financial structure.

Such an internal rate of return is associated to the cost of indebtedness for this kind of projects, which demand a payback period of seven years or more (the minimum requirement is 12-14%, in line with international financing costs for such terms and for countries whose country risk ranges between 400 and 700 basic points). Also the calculations consider a return on own capital in line with the expected values in the Argentine industry as well as in the Mercosur (2-4% above the debt to equity ratio).

A project with a lower rate of return might render different effects: since Capex is dealing with long-term projects, any lower rate of return would compromise the project survival if the business scenario changed, if there were delays or changes in product price formation, or if costs or the tax scheme changed. In fact, after making the decision, the income tax rate increased and new taxes on interests, financial transactions and minimum presumed income were imposed.

This rate also considered not only the return on own capital but also third party funding (banks or new shareholders), who would be willing to fund the project as long as it yielded enough for its own payback without withdrawing funding from their normal business activities.

Analysis of the alternative expansion projects for the Agua del Cajón Thermal Power Plant

The operating features of the areas exploited by Capex offered the company a series of alternatives to expand its thermal power plant.

As regards the investment in new open cycle units, these had the advantage of a familiar and efficient operation, the gas reserves were enough and could be extracted at the production cost and the investment per installed MW was fairly low due to the market situation for this kind of technology. The profitability of this alternative was above the acceptance criteria.

On the other hand, taking into account the operating parameters, this alternative had some room for improvement: the emission of high-temperature exhaust gases and the increased consumption of non-renewable fossil fuels.

Until the moment the project was implemented, combined cycle generation was not frequently found in the Argentine market, because of the abundance of relatively inexpensive natural gas and the high investment per installed MW required by a combined cycle expansion project. A more detailed analysis of this issue is contained in Step 4 below.

Therefore, according to the operating requirements, the company analyzed different alternatives to expand the power plant while reaching the economic as well as the operative goals laid out.

The first alternative was to continue with the original open cycle without any retrofit. The expansion of the power plant was not needed by Capex. Capex was expanding its capacity at the rate new reserves of natural gas were found. A new expansion of the plant was not originally conceived, as it is already shown in the stock exchange declarations of Capex, due to the uncertainty in reserves availability. The three original phases followed a business path according to the most convenient way to take advantage of the existing reserves from the economical point of view, since the field was simultaneously under exploitation. The communications to the Stock Exchange of Buenos Aires made by Capex during 1994-1996 period clearly reflect that Capex strategy was based on giving a value to the available natural gas.

When the proposed project activity was conceived, Capex had the possibility of consuming an additional portion of natural gas from its own field (around 650,000 m^3/day), with a 25-year lifetime. The continuation of the current situation would have represented, maybe, a less attractive course of action because an available non-renewable resource would be probably misusing.

The second alternative analyzed was to expand the power plant considering the strategic advantages the company had (it owned the fuel it needed), which resulted in a very high competitiveness without any dispatch problems.

Two possibilities had arisen. The first one was to expand the power plant until a capacity equivalent to that of the combined cycle (if the capacity expansion were the company's objective, which was not the case) by installing new gas turbines operating in an open cycle mode. The second one was to expand the power plant until reaching the consumption of the available natural gas in a long-term horizon, by installing a new gas turbine but only up to the capacity compatible with the gas to be consumed. These two options were the best from the point of view of capital cost, which in this case was sensibly lower than for the combined cycle alternative, and it offered Capex S.A. the best internal rate of return (IRR) among all the alternatives under analysis. However, the first possibility did not improve the plant efficiency, and it was not the best in terms of non-renewable fuel consumption —in fact, it would demand a higher fuel consumption.

The first option was analyzed assuming the project would require a piece of equipment with the following features:

Equipment data

Turbo generator:	Siemens V94.2A
Power (ISO):	190 MW
Efficiency (ISO):	36.4%
Ex works price:	36.1 MMUS$

Open cycle plant expansion in *Agua del Cajón*

Net power:	183.2 MW
Net efficiency:	35.1%
Heat rate:	2,450 kcal/kWh
Specific net flow rate:	291.67 m^3/MWh (8,400 / 9,300 kcal/kWh gas)
Investment:	330 U$/kW
O&M cost:	1.5 – 1.7 US$/MWh

Below there is an assessment summary of the expansion project that could be implemented in the *Agua del Cajón* thermal power plant, by adding a new open cycle gas turbine.[3]

CASE: **OPEN CYCLE**

INVT. IN TURBINE U$S X KW	330	GAS CONSUMPTION/DAY M m3	1,184
TOTAL INVESTMENT U$S X KW	362	AVERAGE AVAILABILITY/DISPACTH	89.0%
TOTAL INV., INCLUDING INSTALLATION MM	68.8	GROSS POWER CONSIDERED	190
OPERATING COST U$S X MWh	1.50	NET POWER CONSIDERED	169
COSTO OF GAS U$S X dam 3	16.40		

In thousand u$s	1998 per 1	1999 per 2	2000 per 3	2001 per 4	2002 per 5	2003 per 6	2004 per 7	2005 per 8	2006 per 9
GENERATION GWh	0	0	1,318	1,318	1,318	1,318	1,318	1,318	1,318
PRICE X MWh	0.00	0.00	18.99	19.66	20.63	22.06	22.06	22.06	22.06
INCOME ON GENERATION	0	0	25,036	25,919	27,198	29,083	29,083	29,083	29,083
CERs	0	0	0	0	0	0	0	0	0
TOTAL INVESTMENT	-23,109	-45,736	0	0	0	0	0	0	0
TOTAL COSTS (1)	-400	-700	-12,786	-11,476	-11,402	-11,322	-11,225	-11,203	-11,203
CERs AND INTERST	0	0	0	0	0	0	0	0	0
INC. TAX/VAT/TURNOVER T	-4,937	-9,620	3,752	1,186	731	-2,585	-5,017	-5,049	-5,057
TOTAL EXPENSE	-28,446	-56,055	-9,034	-10,290	-10,671	-13,908	-16,243	-16,252	-16,260
NET CASHFLOW	-28,446	-56,055	16,002	15,629	16,527	15,176	12,841	12,831	12,823
EST. NET INCOME	132	231	9,403	9,567	10,406	11,652	11,620	11,613	11,613

RETURNS

	25 years	20 years	15 years
IRR →	15.69%	15.10%	13.80%

Values included till break-even year (2006)

In order to better assess this option some strategic considerations are necessary. Considered alone the expansion looks like a very attractive course of action for Capex. However, it rests on the hypothesis that Capex had the possibility to provide the power plant with its own natural gas extracted from its reserves without additional costs. If it were the case, it would be right to assume that the average dispatch factor would be the same the power plant currently had (around 89%) and that the fuel cost is negligible. In this way the extension would be competitive anyway in the wholesale electricity market.

But the situation was different. Available gas wells in *Agua del Cajón* allowed Capex to extract additional 650,000 m^3 of natural gas per day. Going beyond this amount would have required Capex to invest in exploration, opening new wells and extracting more natural gas from its limited reserves. This possibility is limited due to the characteristics of the reservoir in Agua del Cajón field, since in order to increase the flow a highly expensive re-pressurization, if physically possible, would have been needed. On the contrary, Capex would have had to buy natural gas from other companies at market prices, also investing in the connection to the gas pipeline. Whatever the case would have been, Capex would have increased the operating costs of the power plant. Moreover, the use of the own gas would have represented for Capex a more aggressive business strategy, since in this case an early depletion of the field reserves would have occurred, limiting the productive capacity of the gas field due to premature depressurization of the reservoir. Thus Capex would probably have lost its own gas availability before the payback period in terms of the estimated reserves, representing a financially unattractive course of action. As a matter of

[3] Only a relevant portion of the spreadsheet is shown due to the great number of columns involved in the cash-flow analysis.

horizons, the use of the limited extractable gas would have permitted Capex to manage the natural gas production without incurring in so ventured strategies.

Below is a summary of the financial analysis corresponding to the case in which Capex would have bought the remaining part of natural gas that goes beyond the above-mentioned 650,000 m^3/day. What would have happened in that case is that the power plant would have been less competitive than usual, impacting in its average dispatch factor. It is assumed a conservative 4-point decrease in the average utilization factor (85%) of the thermal plant (the cost of gas varies from 16.40 US$/$dam^3$ to 19.84 US$/$dam^3$, considering that a local provider would have supplied the extra natural gas at a very conservative low price; the real situation would have been worst, moreover taking into account that investment in pipeline connection is not included in the analysis).

CASE: **OPEN CYCLE (limited availability of gas)**

INVT IN TURBINE U$S X KW	330	GAS CONSUMPTION/DAY M m3	1,130.8
TOTAL INVESTMENT U$S X KW	362	AVERAGE AVAILABILITY/DISPATCH	85.0%
TOTAL INV., INCLUDING INSTALLATION MM	68.8	GROSS POWER CONSIDERED	190
OPERATING COST U$S X MWh	1.70	NET POWER CONSIDERED	162
COST OF GAS U$S X dam 3	19.84		

	1998	1999	2000	2001	2002	2003	2004	2005	2006
in thousand u$s	per 1	per 2	per 3	per 4	per 5	per 6	per 7	per 8	per 9
GENERATION GWh	0	0	1,203	1,203	1,203	1,203	1,203	1,203	1,203
PRICE X MWh	0.00	0.00	18.99	19.66	20.63	22.06	22.06	22.06	22.06
INCOME ON GENERATION	0	0	22,836	23,642	24,808	26,528	26,528	26,528	26,528
CERs	0	0	0	0	0	0	0	0	0
TOTAL INVESTMENT	-23,109	-45,736	0	0	0	0	0	0	0
TOTAL COST (1)	-400	-700	-13,585	-12,277	-12,209	-12,136	-12,048	-12,027	-12,027
CERs AND INTEREST	0	0	0	0	0	0	0	0	0
INC. TAX/VAT/TURNOVER T	-4,937	-9,620	3,293	1,690	1,238	31	-3,880	-3,909	-3,916
TOTAL EXPENSE	-28,446	-56,055	-10,292	-10,587	-10,972	-12,105	-15,928	-15,936	-15,943
NET CASHFLOW	-28,446	-56,055	12,544	13,055	13,837	14,423	10,600	10,591	10,585
EST. NET INCOME	132	231	7,195	7,307	8,072	9,209	9,180	9,173	9,173

RETURNS

	25 years	20 years	15 years
IRR →	12.84%	12.02%	10.41%

Values included till break-even year (2006)

The summary above shows that the open cycle expansion became unfeasible when a more realistic approach is taken into consideration.

The second option was to consider a new generation gas turbine, by acquiring an efficient equipment with a heat rate of 2,450 kcal/kWh, as the one proposed in the first option. The additional gross power compatible with the 650,000 m^3/day of gas would be 105 MW.

The advantage of this option is that the power plant would use the natural gas it had (beyond the one that was being consumed in the existing open cycle prior to project implementation), without additional investment in either gas exploitation or natural gas supply from other companies. Thus this option keeps operating costs as they were for the existing open cycle.

Below is an assessment summary of the second option.

CASE	OPEN CYCLE		
INVT IN TURBINE U$S X KW	330	GAS CONSUMPTION/DAY M m3	650.0
TOTAL INVESTMENT U$S X KW	362	AVERAGE AVAILABILITY/DISPATCH	89.0%
TOTAL INV., INCLUDING INSTALLATION MM	38.0	GROSS POWER CONSIDERED	105
OPERATING COST U$S X MWh	1.50	NET POWER CONSIDERED	93
COST OF GAS U$S X dam 3	16.40		

in thousand u$s	1998 per 1	1999 per 2	2000 per 3	2001 per 4	2002 per 5	2003 per 6	2004 per 7	2005 per 8	2006 per 9
GENERATION GWh	0	0	729	729	729	729	729	729	729
PRICE X MWh	0.00	0.00	18.99	19.66	20.63	22.06	22.06	22.06	22.06
INCOME ON GENERATION	0	0	13,836	14,324	15,030	16,072	16,072	16,072	16,072
CERs	0	0	0	0	0	0	0	0	0
TOTAL INVESTMENT	-12,771	-25,275	0	0	0	0	0	0	0
TOTAL COST (1)	-400	-700	-7,868	-6,566	-6,525	-6,481	-6,427	-6,415	-6,415
CERs AND INTEREST	0	0	0	0	0	0	0	0	0
INC. TAX/VAT/TURNOVER T	-2,766	-5,323	2,004	869	426	-975	-2,699	-2,717	-2,721
TOTAL EXPENSE	-15,936	-31,298	-5,864	-5,697	-6,099	-7,456	-9,126	-9,132	-9,136
NET CASHFLOW	-15,936	-31,298	7,971	8,626	8,932	8,616	6,946	6,941	6,937
EST. NET INCOME	132	231	5,213	5,112	5,576	6,265	6,247	6,243	6,243

RETURNS	25 years	20 years	15 years
IRR →	15.06%	14.43%	13.07%

Values included till break-even year (2006)

<u>The third alternative</u> was to close the electricity generation cycle, turning the existing open cycle units into one combined cycle unit that would not increase fuel consumption and would have a better global efficiency, but at a noticeably higher capital cost.

To take advantage of the available natural gas this option would generate additional energy through the possibility of adding extra heat in each of the existing boilers by means of burners that provide supplementary fire, generating more electricity, at a heat rate of around 2,100 kcal/kWh, lower than those of the existing gas turbines, around 2,600 kcal/kWh in average.

Below follows an assessment summary of the expansion project carried out in the *Agua del Cajón* thermal power plant, by implementing the combined cycle conversion, but without taking into account the income from trading the CERs obtained as a consequence of the CDM project activity.

CASE	COMBINED CYCLE	WITHOUT CERs

TURBINE INVESTMENT U$S X KW	433	GAS CONSUMPTION/DAY M m3	650.0
TOTAL INVESTMENT U$S X KW	553	AVERAGE AVAILABILITY/DISPATCH	89.0%
TOTAL INVESTMENT W/INSTALLATION MM u$s	166.0	GROSS POWER CONSIDERED	300
OPERATING COST U$S X MWh	1.14	NET POWER CONSIDERED	270
COST OF GAS U$S X dam 3	16.40		

In thousand u$s	1998 per 1	1999 per 2	2000 per 3	2001 per 4	2002 per 5	2003 per 6	2004 per 7	2005 per 8	2006 per 9
GENERATION GWh	0	0	2,082	2,104	2,104	2,104	2,104	2,104	2,104
PRICE X MWh	0.00	0.00	18.99	19.66	20.63	22.06	22.06	22.06	22.06
GENERATION INCOME	0	0	39,530	41,360	43,401	46,409	46,409	46,409	46,409
CERs	0	0	0	0	0	0	0	0	0
TOTAL INVESTMENTS	-55,413	-110,607	0	0	0	0	0	0	0
TOTAL COSTS (1)	-400	-700	-14,175	-10,951	-10,833	-11,706	-10,551	-10,515	-10,515
CERs AND INTERESTS	0	0	0	0	0	0	0	0	0
IN. TAX/VAT/TURNOVER	-11,721	-23,243	5,690	1,060	-176	-474	-2,831	-9,560	-9,572
TOTAL EXPENSES	-67,533	-134,550	-8,485	-9,891	-11,009	-12,180	-13,381	-20,076	-20,087
NET CASHFLOW	-67,533	-134,550	31,046	31,470	32,392	34,230	33,028	26,334	26,322
NET ESTIMATED INCOME	132	231	18,179	18,350	19,689	22,007	21,626	21,614	21,614

RETURNS	25 years	20 years	15 years
IRR →	13.31%	12.65%	11.16%

Values stated until break even year (2006)

This alternative, less profitable than the previous ones, would not have been developed if Capex S.A. had not had strong environmental concerns. In fact, as it will become clear, the project profitability was not good enough for any investor in the macroeconomic scenario described below.

The definite possibility of attaining other benefits than those related strictly to power generation that might enhance the feasibility of this alternative project led Capex to conclude that both the combined cycle expansion of the *Agua del Cajón* thermal power plant and the possibility of taking part in CER trading markets achieved all the goals set by Capex.

The economic profitability goal would be achieved, the industry and the community would get efficient energy, the project size would be within the defined constraints and the environment would also be benefited by the more rational consumption of pollutants and non-renewable resources.

This alternative —the combined cycle conversion— offered a major improvement that rendered the project feasible: the incorporation into the cash flow of the trading of carbon credits.

The trading of about 800,000 tonnes of CO_2 per year was included,[4] which improved the project IRR. Based on market analyses valid when the decision was made,[5] the price scenarios considered for the CERs trading, net of expenses, were the following:

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[4] This value was 20% below the amount estimated when the project was decided. Capex contracted a consultant company (Mercados Energéticos S.A.) to develop a scenario analysis with projection of electricity prices in order to run a simulation model for developing the baseline study. The methodology applied in that occasion was different to the one used here. The results obtained by Capex were close to one million tonnes of CO_2 emission reductions per year. The reports elaborated by Mercados Energéticos S.A. and an update with a sensitivity analysis are available at DOE request, together with Capex original baseline study.

Low estimate
- For the first 4 years: 2 US$/ton of CO_2 e
- For the following 4 years: 5 US$/ton of CO_2 e
- From then on: 10 US$/ton of CO_2 e

Medium estimate
- For the first 4 years: 3 US$/ton of CO_2 e
- For the following 4 years: 8 US$/ton of CO_2 e
- From then on: 15 US$/ton of CO_2 e

High estimate
- For the first 4 years: 5 US$/ton of CO_2 e
- For the following 4 years: 10 US$/ton of CO_2 e
- From then on: 15 US$/ton of CO_2 e

The results obtained for the medium estimate were the following:

[5] Capex also contacted International Utility Efficiency Partnerships, Inc. (IUEP) to advise regarding the carbon market and the opportunity to develop the project. This company suggested CER price scenarios.

CASE	COMBINED CYCLE	WITH CERs

TURBINE INVESTMENT U$S X KW	433	GAS CONSUMPTION/DAY M m3	650.0
TOTAL INVESTMENT U$S X KW	553	AVERAGE AVAILABILITY/DISPATCH	89.0%
OTAL INVESTMENT INC. INSTALLATION MM	166.0	GROSS POWER CONSIDERED	300
OPERATING COST U$S X MWh	1.14	NET POWER CONSIDERED	270
COST OF GAS U$S X dam 3	16.40		

In thousand u$s	1998 per 1	1999 per 2	2000 per 3	2001 per 4	2002 per 5	2003 per 6	2004 per 7	2005 per 8	2006 per 9
GENERATION GWh	0	0	2,082	2,104	2,104	2,104	2,104	2,104	2,104
PRICE X MWh	0.00	0.00	18.99	19.66	20.63	22.06	22.06	22.06	22.06
INCOME ON GENERATION	0	0	39,530	41,360	43,401	46,409	46,409	46,409	46,409
CERs	0	0	2,400	2,400	2,400	2,400	6,400	6,400	6,400
TOTAL INVESTMENTS	-55,413	-110,607	0	0	0	0	0	0	0
TOTAL COSTS (1)	-400	-700	-14,175	-10,951	-10,833	-11,706	-10,551	-10,515	-10,515
CERs AND INTEREST	0	0	0	0	0	0	0	0	0
VAT/INCOME T/TURNOV.	-11,721	-23,243	5,690	268	-968	-1,266	-3,623	-11,672	-11,684
TOTAL	-67,533	-134,550	-8,485	-10,683	-11,801	-12,972	-14,173	-22,188	-22,199
NET CASHFLOW	-67,533	-134,550	33,446	33,078	34,000	35,838	38,636	30,622	30,610
NET ESTIMATED INCOME	132	231	17,387	17,558	18,897	21,215	19,514	19,502	19,502

RETURNS	25 years	20 years	15 years
TIR →	15.55%	15.04%	13.70%

Values included until break-even year (2006).

A summary of the analysis of scenarios gives the following results (discount rate = 10%):

Scenario	Plant factor %	Total investment 10^6 US$	Cost of gas US$/dam^3	Natural gas consumption 10^6 m^3/d	IRR (25 years) %	NPV (25 years) 10^3 US$	Payback period years
Open cycle expansion (185 MW, unlimited availability of own gas)	89	68.8	16.40	1,184.0	15.69	30,492	14
Open cycle expansion (185 MW, limited availability of own gas)	85	68.8	19.84	1,130.8	12.84	13,403	23
Open cycle expansion (105 MW)	89	38.0	16.40	650.0	15.06	15,027	16
Combined cycle (without CER)	89	166.0	16.40	650.0	13.31	40,045	20
Combined cycle (low CER price scenario)	89	166.0	16.40	650.0	14.81	64,632	16
Combined cycle (medium CER price scenario)	89	166.0	16.40	650.0	15.55	77,427	15
Combined cycle (high CER price scenario)	89	166.0	16.40	650.0	15.94	82,365	14

The trading of the CERs obtained by reducing the CO_2 emissions allowed the development of an environment-friendly project while protecting non-renewable natural resources, in spite of the associated higher capital investment.

In the medium scenario, the combined cycle alternative, indeed, matches almost perfectly the conditions of the project that Capex considered the best from the economic-financial standpoint, which was to expand the generation plant with another open cycle. And an additional expectancy remains for having higher benefits due to the CDM incomes. On the other hand, there was a risk associated to the CDM approval or low CER prices as the market evolved; fact that has been disregarded by Capex that highlighted the environmental benefits the project could generate, gaining also in public recognition.

The IRR improvement due to the extra income yielded by trading the CERs and the strong environmental values supported by the Capex Board of Directors were highly influential in the decision-making process, which resulted in the installation of a combined cycle plant.

The proposed project activity not undertaken as a CDM project activity is not the most financially attractive scenario. There are other alternatives with a better financial indicator set. NPV was reported for a 25-year period, but in a 15-year period the combined cycle gives negative NPV values slightly increasing the discount rate, while in the other options (with the exemption of the case in which natural gas is not available at all) the NPVs remain positive.

The economic analysis has shown that the combined cycle was not an attractive alternative by itself. The barrier analysis (Step 3) reinforces this conclusion.

Sub-step 2d. Sensitivity analysis

The investment analysis was performed through a series of spreadsheets, which can be made publicly available as required. They will be presented to the DOE during validation of the project.

The parameters selected for performing the sensitivity analysis are those related to the critical assumptions of the investment analysis. They are:

- Average dispatch factor
- Discount rate
- Electricity prices
- Emission reduction volume and CER prices

Other parameters are fixed and not affecting any option in a differentiate way.

Average dispatch factor: In the case of the open cycle expansion without limitations in own gas availability, the average dispatch factor supports variations until 5 points below keeping the IRR of the open cycle expansion above 14%, with a payback period below 20 years and a positive NPV. The same happens with the combined cycle, when CER prices are those of the medium price scenario. In the case of the addition of a 105 MW gas turbine to the existing open cycle, this variations reach until 3 points below in order to have acceptable results. The same happens with the combined cycle, when CER prices are those of the low price scenario. The combined cycle without CER benefits becomes economically attractive when the average dispatch factor is increased 3 points, and 6 points with respect to the power plant operating in open cycle to be the most attractive alternative.

Discount rate: The discount rate was assumed to be 10%. At 13% the NPV at 15 years becomes negative and the payback period grows up until 24 years for the open cycle expansion. The same happens with the existing open cycle with additional 105 MW and with the combined cycle with CER at the medium price

scenario. There are no values of the discount rate that allow increasing the IRR of the combined cycle not undertaken as a CDM project activity above the 14% threshold.

Electricity prices: The open cycle expansion supports a 7% decrease of electricity prices keeping the IRR of the project above 14%, increasing the payback period to 18 years with a positive NPV. The 105 MW gas turbine option supports a 5% decrease of electricity prices, increasing the payback period to 19 years with a positive NPV. The same variation is supported the combined cycle in the low CER price scenario, with a payback period of 18 years with a positive NPV. The combined cycle in the medium CER price scenario supports a decrease of 10% while keeping the IRR above 14%, increasing the payback period to 19 years with a positive NPV. The combined cycle not undertaken as a CDM project activity becomes economically attractive with a 5% increase of the electricity prices. However, under this circumstance, the other alternatives result more attractive than the combined cycle.

Emission reduction volume and CER prices: The IRR of the combined cycle conversion project at 25 years would still remain above 15%/14% (with a payback period of 16/18 years and NPV of 10^3 US$ 68,082/51,727) if the volume of emission reductions went down from 800,000 tCO_2/year to 600,000/250,000 tCO_2/year (close to the current estimations) in the medium CER price scenario, respectively.

Therefore, it is concluded that the proposed CDM project activity is unlikely to be the most financially attractive course of action, unless the combined cycle expansion would allow Capex increasing considerably the average dispatch factor with respect to the operation as an open cycle (whatever the expansion is, e.g. with a new 185 MW gas turbine or with a new 105 MW gas turbine). The following analysis shows that it is not the case for *Agua del Cajón* power plant.

Dispatch of the power plant

CAMMESA, the regulatory body that oversees the Argentine Electricity Market, defines the order in which the different generation units are dispatched, according to the Variable Production Cost they have declared: the lower the declared cost, the sooner the unit is dispatched. From the moment *Agua del Cajón* power plant became commercially operational as an open cycle, it has been among the first power plants to be dispatched in the Argentine electricity system. Before undertaking the combined cycle conversion, the average dispatch had been above 90%.[6]

Because Capex owns its gas reserves it is self-reliant and does not depend on distributors' pipelines; this ensures a steady gas supply at costs which are very competitive when compared to the rest of the power plants that get their supply from gas pipelines.

[6] In the investment analysis 89% was conservatively used.

There follows a summary of the prices reported to CAMMESA prior to the combined cycle conversion, showing the extremely high competitiveness of this power plant when it operated in an open cycle.

VARIABLE PRODUCTION COST REPORT
Winter 1999
Baseline – Main Power Plants

#	Power Plant	Type	Fuel cost ($/dam³)	Heat rate (kcal/kWh)	Generation cost ($/MWh)
1	YPF Plaza Huincul	GT	8.00	2,385	2.3
2	Embalse	Nu			3.9
3	YPF Puesto Hernández	GT	15.40	2,385	4.4
4	Pluspetrol	CC	21.20	1,757	4.4
5	Filo Morado	GT	12.70	3,200	4.8
6	Güemes	ST	19.00	2,224	5.0
7	Agua del Cajón 500 – GT6	GT	17.10	2,562	5.2
8	Agua del Cajón 500 – GT1 to 5	GT	17.10	2,676	5.4
9	San Miguel de Tucumán	GT	19.50	2,655	6.2
10	Atucha	Nu			6.5
11	Luján de Cuyo – CT Mendoza	CC	46.39	1,560	8.6
12	Ave Fénix	GT	37.92	2,264	10.2
13	CT Buenos Aires	CC	55.00	1,603	10.5
14	Costanera	CC	60.00	1,503	10.7
15	Luján de Cuyo – CT Mendoza	CC	44.07	2,173	11.4
16	Genelba	CC	62.90	1,524	11.4
17	Loma de la Lata	GT	38.75	2,550	11.8
18	Luján de Cuyo – CT Mendoza	ST	40.26	2,639	12.6
19	Alto Valle	CC	50.40	2,150	12.9
20	Arcor	CC	52.86	2,250	14.2
21	Bahía Blanca	ST	52.40	2,300	14.3
22	Termo Roca	GT	48.00	2,527	14.4
23	Costanera	ST	65.00	2,200	17.0
24	San Nicolás	ST	62.00	2,400	17.7
25	Central Puerto	ST	66.00	2,300	18.1
26	Dock Sud	GT	54.00	3,000	19.3

Continued

(*) Extracted from CAMMESA public data ($ stands for Argentina $, exchange rate: US$ 1 ≅ AR$ 3)
GT, ST, CC and Nu stand for gas turbine, steam turbine, combined cycle and nuclear, respectively.

Therefore, it should be noticed that the open to combined cycle conversion of the power plant was not and is not essential from the point of view of dispatch. In fact, the declared dispatch costs would remain competitive even if the plant global efficiency did not improve due to the combined cycle conversion, which reduces the unit cost per MWh delivered.

The variable production costs shown above, corresponding to the plant operating in open cycle, adjusted according to the specific consumption after the combined cycle conversion, did not modify the plant position in the Argentine grid dispatch ranking, as illustrated by the following table that lists the dispatch ranking after plant's conversion.

VARIABLE PRODUCTION COST REPORT
Winter 2000
Baseline – Main Power Plants

#	Power Plant	Type	Fuel cost ($/dam^3)	Heat rate (kcal/kWh)	Generation cost ($/MWh)
1	Argener	Co	0.00	2,483	0.00
2	CMS Ensenada	Co	0.00	1,309	0.00
3	YPF Puesto Hernández	GT	0.00	2,385	0.00
4	YPF Plaza Huincul	GT	0.00	2,385	0.00
5	Güemes	ST	9.99	2,224	2.64
6	Embalse	Nu			3.97
7	Agua del Cajón	CC	18.58	1,808	4.00
8	Filo Morado	GT	12.70	3,200	4,84
9	Agua del Cajón 500 – GT6	GT	16.29	2,562	4.97
10	Agua del Cajón 500 – GT1 to 5	GT	16.29	2,676	5,19
11	San Miguel de Tucumán	GT	16.50	2,655	5.22
12	Atucha	Nu			5.41
13	Luján de Cuyo – CT Mendoza	CC	41.00	1,560	7.61
14	Ave Fénix	GT	30.00	2,264	8.09
15	Central Puerto	CC	50.31	1,487	8.91
16	Genelba	CC	57.40	1,524	10.41
17	CT Buenos Aires	CC	55.00	1,603	10.50
18	Costanera	CC	58.70	1,503	10.52
19	Dock Sud	CC	63.00	1,528	11.46
20	Loma de la Lata	GT	40.19	2,550	12.20
21	Luján de Cuyo – CT Mendoza	ST	39.00	2,639	12.25
22	Alto Valle	CC	50.36	2,150	12.89
23	Termo Roca	GT	45.00	2,527	13.54
24	Arcor	CC	52.44	2,250	14.05
25	Costanera	ST	60.00	2,200	15.71
26	Bahía Blanca	ST	62.07	2,300	17.00
27	Sorrento	ST	64.60	2,450	18.84

Continued

(*) Extracted from CAMMESA public data ($ stands for Argentina $, exchange rate: US$ 1 ≅ AR$ 3)

GT, ST, CC and Nu stand for gas turbine, steam turbine, combined cycle and nuclear, respectively.

Historical public data show that the open cycle power plant would have still been dispatched with the same load factor than the plant operating in a combined cycle.

Fiscal year	Annual mean availability and service (%)
1995	82.71
1996	97.21
1997	78.52
1998	85.85
1999	97.15
2000	84.20
2001	77.95
Average	**86.23**

Source: CAMMESA

Capex's combined cycle conversion project yields 50% more electricity while consuming the same amount of fossil fuel, which would be consumed anyway if the plant still operated in open cycle mode.

That is to say, if Capex's emission reduction project is considered as an independent project, as if it were the sole focus of this analysis, CO_2 emissions would still be reduced due to the improved efficiency per each MWh delivered.

Step 3. Barrier analysis

Sub-step 3a. Identify barriers that would prevent the implementation of type of the proposed project activity

Barrier due to prevailing practice: The project activity was the first of its kind. No project activity of this kind has never been currently operational in Argentina and probably in the world.

Agua del Cajón power plant is not connected to the natural gas pipeline as it happens for most of the combined cycles installed in Argentina. Typical combined cycles (a complete list of all of them and their characteristics is shown in Table 1 below), connected to the natural gas pipeline, consists of a package including two gas turbines and one steam turbine. This corresponds to the most efficient way to construct a combined cycle close to the existing pipeline. However, the proposed project corresponds to the closing of an open cycle consisting of six gas turbines with one steam turbine. The heat rate for this combined cycle is lower than for typical combined cycles, due to heat loses along the additional extension of pipelines needed to interconnect the whole power plant (with significant investment in new infrastructure; Figures 1 and 2 show the power plant prior to and following project implementation).

Figure 1: Original open cycle

Figure 2: Current combined cycle

Typical combined cycles have needed to increase their efficiency in order to be competitive in the market, but it was not the case of *Agua del Cajón* power plant as explained above.

Thus, no combined cycle exists in Argentina with the technology used in *Agua del Cajón* power plant (six gas turbines and one steam turbine in a combined cycle) and where the gas belongs to the own field.

Table 1: Combined cycles installed in Argentina

Power plant	Equipment	Mode	Gas availabilty	Installation date
Agua del Cajón	6 GT + 1 ST	close	own	17/01/2000
AES Paraná	2 GT + 1 ST	new	pipeline	01/01/2001
Alto Valle	2 GT + 1 ST	close	pipeline	01/01/2001
Buenos Aires	2 GT + 1 ST	new	pipeline	01/02/1997
Puerto	2 GT + 1 ST	new	pipeline	01/01/1999
Costanera	2 GT + 1 ST	new	pipeline	01/10/1998
Dock Sud	2 GT + 1 ST	new	pipeline	01/01/2000
Genelba	2 GT + 1 ST	new	pipeline	01/01/1997
Luján de Cuyo	2 GT + 1 ST	close	pipeline	25/02/1998
Modesto Maranzana	2 GT + 1 ST	new	pipeline	17/10/1996
San Miguel de Tucumán	2 GT + 1 ST	new	pipeline	01/05/2001
Tucumán	2 GT + 1 ST	new	own	01/10/1999

Notes: GT stands for gas turbine and ST for steam turbine. Some power plants have more than one combined cycle. Close refers to converting an open cycle to a combined cycle, and new refers to the installation of a complete combined cycle package.

Technological barrier: The proposed project activity represented an untested use of a new technology for Capex with the associated risk related to the lack of skill, affecting efficiency and performance of the new equipment and package, leading sometimes to equipment disrepair and malfunctioning. Training of personnel was necessary to operate and maintain the technology, advised and trained by the operator of the new equipment (Steag). It took more than two years to close the contractual agreement with the operator after having completely tested the performance of equipment. The own wholesale electricity market administrator (CAMMESA) did not give Capex the official habilitation to operate in the national power system due to uncertainty of the combined cycle power plant performance.

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

The above-mentioned barriers do not affect neither the continuation of the operation with the existing open cycle nor the expansion with additional gas turbines. Thus the identified barriers would not have prevented the implementation of the other alternatives. However, some of these alternatives were prevented due to strategic reasons, as shown below in the baseline determination analysis, where results clear that there is only one alternative different from the proposed project itself that was not prevented by any barrier or reason, representing the baseline.

Step 4. Common practice analysis

Sub-step 4a. Analyze other activities similar to the proposed project activity

In the period 1997-2000 several natural gas-based combined cycles were installed in Argentina, as a consequence of the deregulation of the wholesale electricity market, where dispatch was based on least generation costs, favoring the installation of efficient equipment.

However new combined cycles were completely developed as combined cycle packages instead of conversions from open cycles like *Agua del Cajón* power plant. Moreover none of them included six gas turbines together with a steam turbine for operating in combined cycle mode. The main reason for the installation of these combined cycles was related to competitiveness in the market.[7] As explained above it was never a problem for Capex, who owns its natural gas reserves and was not worried about efficiency, dispatch ability and competitiveness.

The first combined cycle was installed in 1996 (operating in 1997) and by 2000 conventional natural gas-based combined cycles dominated the thermal generation (distribution was as follows: 55% combined cycles, 28% steam turbines and 17% gas turbines, excluding nuclear). Existing gas turbines and steam turbines entered combined cycles or were replaced and completely new combined cycle equipment was installed, hence the decrease in generation related to open cycle modes.

Overall trends shows that gas turbines and steam turbines units run at an efficiency about 30% (30.5% and 32%, respectively) while combined cycles have an overall efficiency of 50%.[8] Of course there are

[7] It is important to notice that an interconnected system cannot survive only incorporating capacity additions through the most efficient technology (natural gas-based combined cycles in this case) since the variable costs of these power plants would become equal to the marginal price —which determines the electricity price paid to generators— and thus leaving independent power producers without enough revenue with respect to their variable costs as to compensate investment.

[8] Many inefficient gas turbines units were not used at all or very seldom, while most available steam turbines units were used frequently. Only gas turbines units working at efficiencies comparable to that of steam turbines were used, hence the small differences in overall efficiency.

significant differences in efficiency among individual units, mainly depending on age and capacity (larger units are generally more efficient).

The utilization of plants varies greatly. In general, combined cycles are used much more than other plants. Most have utilization factors between 50-75%. In 2000, exceptions were some units installed during the year showing low utilization (the utilization factors in this study are calculated on an annual basis), as well as the combined cycle at Agua del Cajón that declared very low costs and had, accordingly, a utilization factor of about 90%.

However, a closer look on the efficiency of thermal plants shows that there are several plants that declare low costs. Hence, they are dispatched even more than combined cycles. Some plants even declare zero variable costs: gas turbines in Argener, gas turbines in Ensenada, gas turbines in Luján de Cuyo, the gas turbines in Plaza Huincul and gas turbines in Puesto de Hernández.[9] The units in Plaza Huincul and Puesto de Hernández are used in self-production (industries producing their own electric energy), the units in Ensenada and Argener are co-generators (industries using excessive heat to generate electric energy), while the units in Luján de Cuyo are "ordinary" generators.

Other plants declare a very low cost compared to plants at the approximate same fuel consumption (for example the gas turbine in Ave Fénix, gas turbines in Filo Morado and the gas turbines and the combined cycle in Tucumán). This is due to gas on site. All these plants have very high utilization factors (at 75-85%), but efficiencies are not corresponding to that (not even in the case of the combined cycle in Agua del Cajón running at 47% efficiency[10]). Excluding units at Agua del Cajón, thermal power plants —excluding nuclear— generated in 2000 about 1.5 TWh (about 2% of total generation) at an overall efficiency of 31%.[11]

Combined cycles reach the highest efficiency when they are acquired as a standard package (e.g. two gas turbines plus a steam turbine). The performance of the power plant selected for the project is lower and the associated costs are higher than in the case of package acquisition. It is worth to mention that *Agua del Cajón* power plant is not connected to the gas network but to their own wells. This makes Capex project a unique project in the Argentine electricity market.

Therefore, there are no other activities similar to the proposed project activity, which simultaneously combine the closing of an open cycle, the combination of six gas turbines with a steam turbine, having the own gas on site and not connected to the natural gas pipeline (see Table 1 above).

Sub-step 4b. Discuss any similar options that are occurring

The analysis made in Sub-step 4a has shown that no other similar options either were or are occurring.

Step 5. Impact of CDM registration

Likelihood of implementing the combined cycle conversion project without taking into account the CDM registration

Capex's combined cycle conversion project would not have been implemented if it had not been for the possibility of qualifying this project for the CDM, with the ensuing impact of the additional revenue from the trading of emission reductions on the company's cash flow.

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[9] CAMMESA, Annual Report 2000.

[10] Other combined cycles, most of them also more efficient, declare significantly higher costs.

[11] Based on "Informe del Sector Eléctrico 2000," Secretariat of Energy.

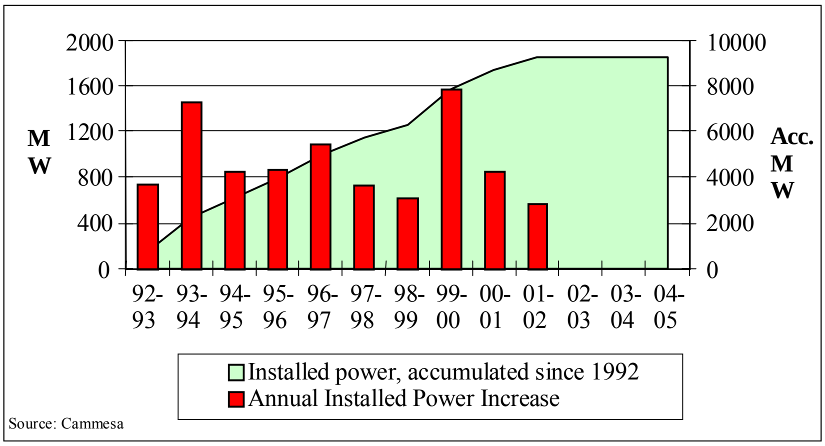
In the last years and before the asymmetrical devaluation that took place in 2002, companies made high investments in generation equipment in order to:

1) Keep their plants competitive, whenever the existing generation equipment reduced the likelihood of being dispatched, together with an excess cash flow caused by energy supply contracts extremely expensive on the buyer —transferred by the Argentine government when the power plants were privatized, to make the transaction more appealing.
2) Invest in new electricity export opportunities stemming from the new interconnection with neighbor countries (mainly Brazil). Investment made by gas producers in order to take advantage of their reserves.

This tendency towards investment, as the reality of the Argentine electricity industry has shown, had slowed down practically to a halt before the devaluation in 2002.

Exhaustion of investment

The following graph clearly shows how the investment went down after devaluation of Argentine currency.



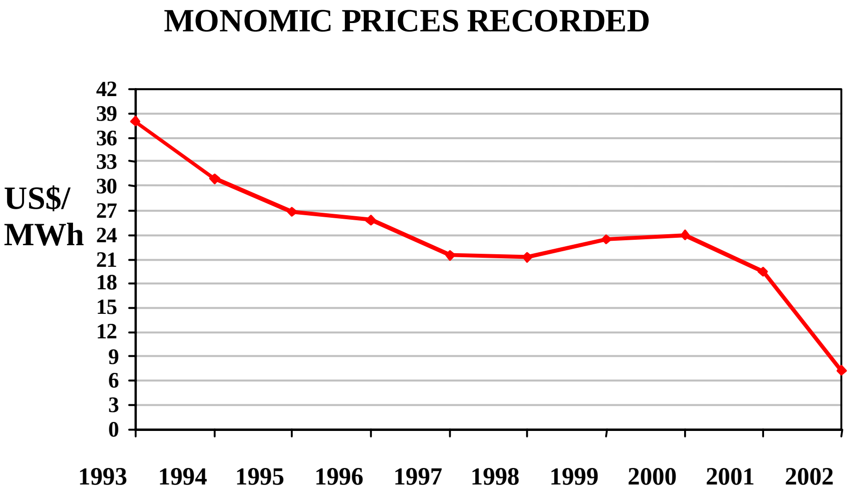
As previously noted, this kind of project has a very dubious payback without considering the additional revenues yielded by the trading of CO_2 emission reductions.

From the point of view of a shareholder who has to make a decision about the implementation of a given project, considering that the shareholder, (i) on the one hand, has an open cycle power plant which adds value to its gas reserves with a very low variable production cost that guarantees the plant dispatch, so that it is certain that its product is going to be sold, and, on the other hand, (ii) has a project for that same power plant that will increase the power output but will require a very high capital investment and will not significantly improve the plant's dispatch chances, and has a dubious payback due to the market prices; then:

"Only a shareholder with extremely strong environmental values, interested in worldwide clean development mechanisms, who is aware of the extra revenue it might get from the CO_2 emissions trading that might contribute to the project's funding, would embark on such a project."

The payback price for a state-of-the-art combined cycle is estimated to be about 29.00 US$/MWh. During the last years this price has never reached such a level.

Needless to say, after the devaluation of the Argentine currency that occurred in 2002, the situation detailed here is even more valid, given that the electricity market does not show a logical price trend as a result of a series of regulations that kept prices low in the Argentine electricity market.



Even though investment had come to a halt before the devaluation, because the electricity price was very low, the devaluation magnified this phenomenon even more.

The approval and registration of the proposed project activity as a CDM activity, and the attendant benefits and incentives derived from the project activity, would alleviate the economic and financial hurdles (Step 2) and the other identified barriers (Step 3) and thus enable the project activity to be undertaken. These benefits and incentives are related to anthropogenic greenhouse gas emission reductions, contribution to sustainable development, technology upgrade, business leadership and public recognition, participation in a new emergent carbon market, and the financial benefit of the revenue obtained by selling CERs.

This analysis shows that the proposed project activity is additional.

Baseline determination

Following the procedural steps established in ACM0007, the identification of alternatives has been elaborated above through the application of the additionality tool. The baseline methodology requires applying the additionality tool to assess the likelihood of each alternative coming to pass. The baseline scenario will be the alternative with the least barriers that appears the most likely to occur in the absence of the project.

The company history is part of the explanation of why the project activity and the project itself are additional to the industry baseline in the Argentine electricity market.

As it has been already mentioned, the installation of the six gas turbines operating in an open cycle on the *Agua del Cajón* reservoir, carried out by Capex during Phases I, II, and III, profited from a unique advantage in the Argentine electricity system: the power plant was self-reliant when it came to getting the fuel needed for generation; that is why the plant, as noted above, had one of the lowest variable production costs of the system, which made it one of the first to be dispatched.

Therefore it is remarkable that, in spite of circumstantial technological changes, the open cycle thermal power plant —if the steam turbine would not have been installed at all— would still be dispatched beyond the cut in variable production costs caused by the new combined cycle technologies, aero-derivative gas turbines, etc.

That is to say, being left outside the dispatch to the electricity grid by the incorporation of new equipment was never a concern for Capex —even if the emission reduction project would not have been fulfilled.

The application of the additionality tool has demonstrated that the project is additional, so that it could not have been developed without CDM registration. However it remains to be determined what would have occurred in the absence of the proposed project activity. It is determined by considering the alternatives described in Step 1 of the additionality tool.

A consideration of up to what extent the additional capacity provided by the project would have been covered in the short term by zero-emitting resources or whether electricity imports from another country or grid (those dominated by hydropower) would have occurred is also taken into account among the alternatives. In order to respond to this consideration a previous analysis of the electricity sector in Argentina is necessary.

The Argentine Electricity Sector[12]

The demand of electric energy in Argentina has increased with an annual average of 6.7% since 1991, and 4.9% since 1970.[13] There were some disruptions in the growth due to the economic difficulties Argentina has been facing. In 1999 the net generation reached 80 TWh. Exports has been absent until the end of the 90s. In 1999 exports accounted for 1 TWh, and growth is expected. Imports grown in those years (5.5 TWh in 1997, 8 TWh in 1998 and 6.4 TWh in 1999, while about 1-3 TWh during the 80s), mainly due to the entering into operation of large hydropower plants in Brazil. Final consumption grown more or less at the same rate as the generation, and reached 71 TWh in 1999. Figure 3 displays the evolution of the sector.

[12] T.Svensson et al., "Emissions related to Electric Energy Generation in Argentina," Integrated Energy Strategies (2002).

[13] Based on Secretariat of Energy, Balance Energético Nacional 1970-1999.

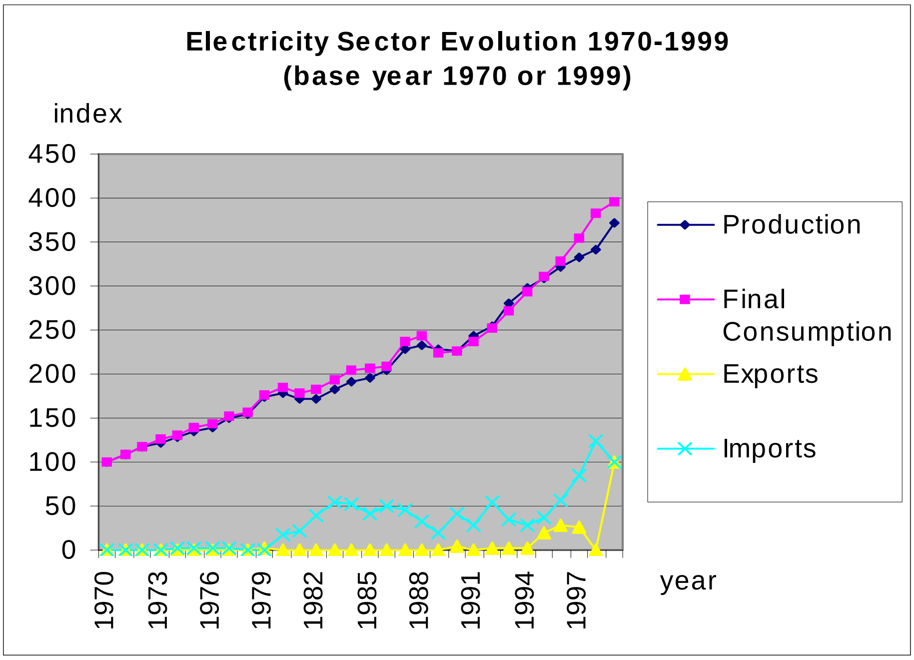


Figure 3: Evolution of the argentine electricity sector[14]

Generation of Electric Energy

Over half of the electric energy generated in Argentina comes from thermal power plants, mainly burning natural gas. In 2000 electricity production totaled 81 TWh, 56.5% coming from conventional thermal plants, 35.5% from hydroelectric dams, and 7.6% from nuclear plants (remaining 0.4% came from mainly diesel engines, but also from wind energy and solar energy).[15] The generation in conventional thermal plants, which mainly run on natural gas, increased significantly in those years, while nuclear generation kept the same level for a long time. Generation in hydro plants increased, but not in the same rate as in the case of thermal generation.

Conventional thermal generation went through significant changes in those years. In 2000 combined cycles dominated the conventional thermal generation. Figure 4 presents the participation of the major sources (in GWh). It is obvious that the major part of increase in demand was covered by conventional thermal generation.

[14] Secretariat of Energy, Balance Energético Nacional 1970-1999.

[15] Secretariat of Energy, Informe del Sector Eléctrico 2000. These numbers do not include self-production.

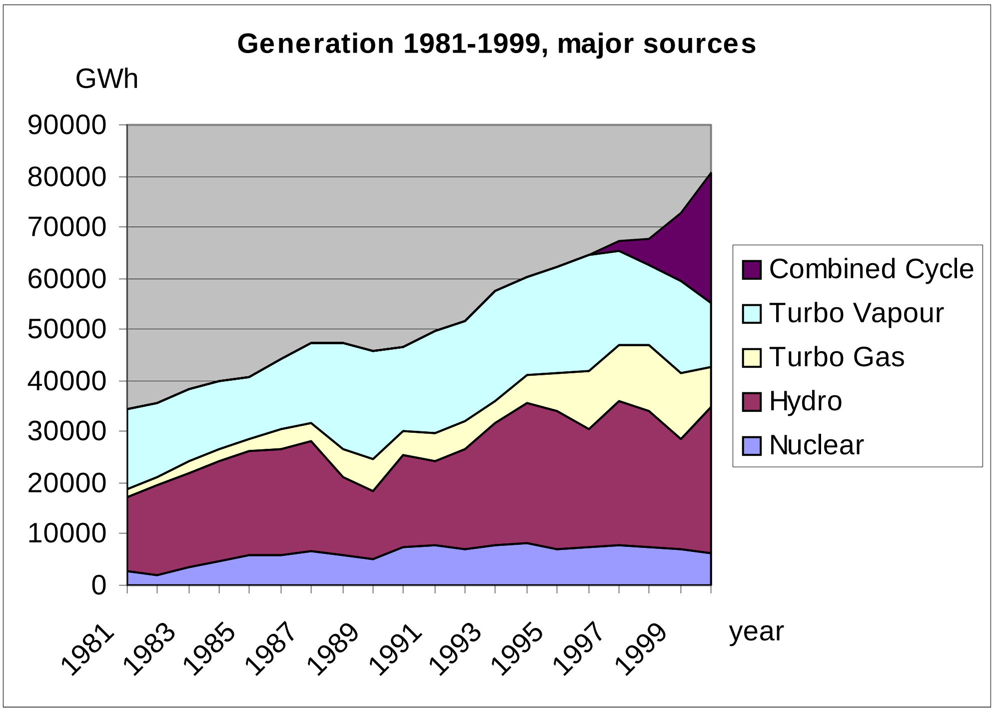


Figure 4: Generation of electric energy in Argentina[16]

The most important fuel in the thermal generation is natural gas, in those years accounting for about 90% of energy consumption. In the early 80s, natural gas was less dominant, and accounted for roughly 50% of consumed energy in thermal generation, while fuel-oil accounted for most of the rest. In general the relative importance of natural gas increased, while use of fuel-oil and diesel decreased correspondingly. The use of coal did not show an obvious pattern, usually varying between 1-5% of the energy consumption. From an environmental perspective, Argentina's dependence on natural gas is far more appealing than use of oil or carbon. Compared to use of natural gas, use of oil and carbon would lead to higher emissions of CO_2, SO_x and particulate matter.

The changes in fuel consumption pattern (e.g. greater penetration of natural gas) and generation technique were accompanied by an increase in efficiency and a consequent decrease in CO_2-intensity. Figure 5 presents the evolution of efficiency and CO_2-intensity in Argentine thermal generation. The quick development in 1998-2000 is due to the installation and use of combined cycles, significantly increasing the efficiency (and hence decreasing the carbon intensity).

[16] Secretariat of Energy, Informe del Sector Eléctrico 1981-2000.

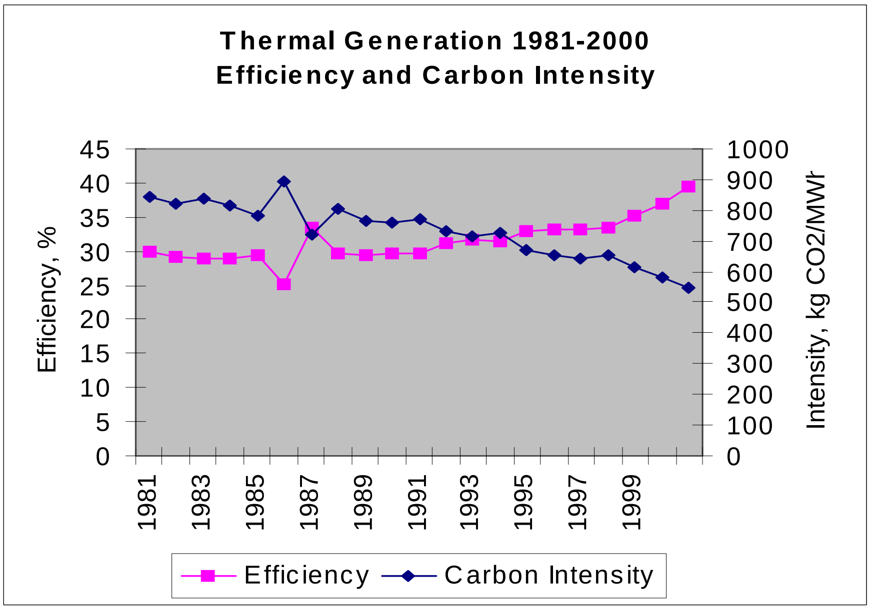


Figure 5: Characteristics of thermal generation in Argentina[17]

In 2000, installed capacity was more than 24,200 MW —adding about 1,000 MW to the 1999 capacity. The same year, the peak load was 13,754 MW.[18] In the previous five years almost all added capacity was thermal capacity. No major hydro plants were opened. No nuclear capacity was added since 1983, but one plant is under construction (although halted since several years).

The typical generation pattern —according to the least-cost dispatch— is as follows: nuclear plants and hydro plants run as much as possible (they are only limited by repairs, water access, etc.) followed by the cheapest thermal plants. This fact justifies that marginal power plants are typically thermal units.

Consumption of Electric Energy

The growth of electric energy consumption was far greater than the growth of overall energy consumption (see Figure 6). While total final energy consumption doubled since 1970, final consumption of electricity increased by a factor 4. In 1999 final consumption reached 71 TWh, of which industry used 46%, residential sector 29%, and commercial and public sector 23% (remaining parts was used in agriculture and transportation). The average per capita consumption was about 1,950 kWh (1998).[19]

[17] Based on Secretariat of Energy, Informe del Sector Eléctrico 1981-2000. Here energy content is taken as the average of the low and high heating values. CO_2 emission factors are taken from IPCC.

[18] CAMMESA, Annual Report 2000.

[19] Secretariat of Energy, Balance Energético Nacional 1986-1999.

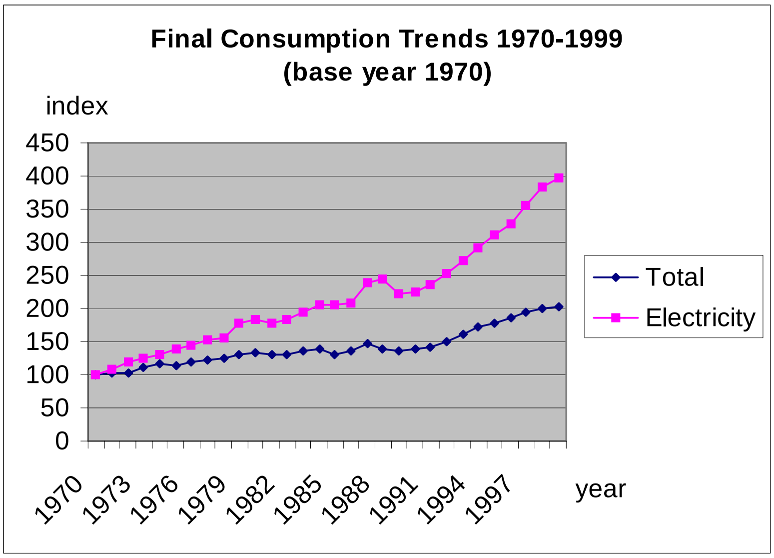


Figure 6: Final consumption trends[20]

After turbulence in the 80s, the annual increase in consumption was about 4-7% (see Figure 7[21]). All sectors (except the transportation sector in which increases were very small), approximately followed this development.

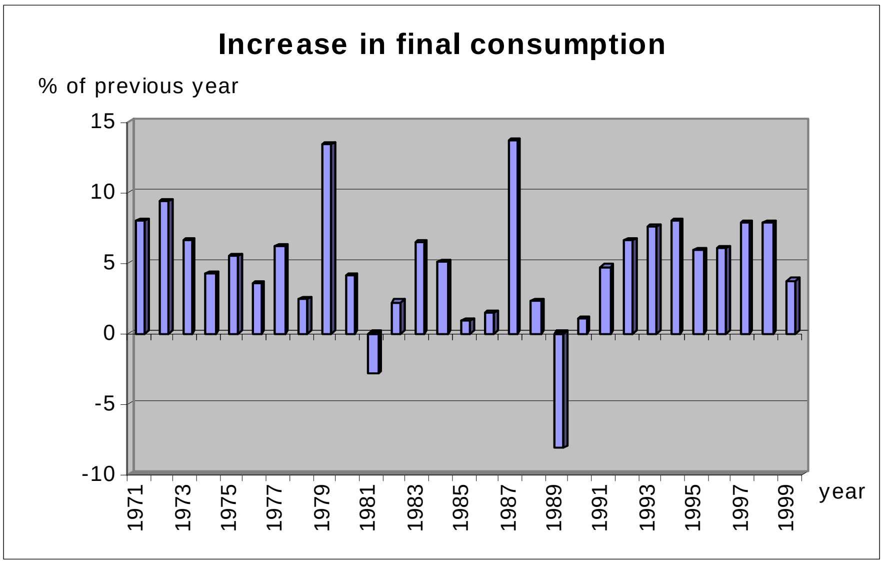


Figure 7: Annual changes in final consumption of electric energy[22]

System Characteristics

A single interconnected grid distributes electricity to most of the users, although some are isolated (in 2000 isolated systems generated roughly 1.8 TWh). The interconnected grid is considered as two separate systems due to a very weak connection (a bottleneck) —only a 132 kV transmission line. The major part,

[20] Secretariat of Energy, Balance Energético Nacional 1971-1999.

[21] Based on Secretariat of Energy, Balance Energético Nacional 1971-1999.

[22] Based on Secretariat of Energy, Balance Energético Nacional 1970-1999.

Wholesale Electricity Market (WEM), comprises almost all generation and all consumption, while Wholesale Electricity Market of the Patagonia System (WEMPS) only supplies the weakly populated southern area (in 2000 WEMPS faced 5% of total national demand). Due to the very weak connection between the systems, economical presuppositions differ. For example, prices are higher in WEMPS —in 2000 the average price in WEMPS was 27.92 US$/MWh, while being 20.08 US$/MWh in WEM (in 1999 difference was even bigger).[23]

The analysis shows that the evolution trend in capacity additions was mainly dominated by conventional thermal power plants. Therefore the proposed project activity is displacing thermal generation in the operating margin as well as the in build margin. The combined margin approach permits to accurately account for both effects, giving a transparent and reliable estimation of baseline emissions and emission reductions achieved due to the implementation of the project activity. Moreover eventual zero-emitting generation and/or imports are included in the calculation performed through the use of the combined margin approach and the analysis above, together with project additionality considerations, clearly shows that the project is not deferring, delaying, displacing or eliminating the construction of any particular zero-emitting power plant —their partial contributions are already included in the combined margin calculation of emission factors.

On the other hand, the additionality tool has shown that the situation in which the project is undertaken without the involvement of CDM could not have been the case for Capex S.A. Moreover it is not an option for baseline candidate.

As regards the possibility of meeting increasing demand through supply-side energy efficiency, the analysis above have shown that this was partially the case in Argentina. However it does not mean that this scenario should be either excluded or included. It depends on the common practice analysis explained in Step 4 of the additionality tool. In spite of the fact that combined cycles were frequent in Argentina, from the project proponent perspective there was not any motivation to increase efficiency, as largely demonstrated above. Moreover the combined margin approach was selected by the CDM Executive Board to account for all the effects related to deferral or displacement of other power supplied by new electricity sources.

<u>Technology baseline: Economic aspects that influenced the selection of baseline equipment</u>

The electricity system is based on the marginal-cost theory, in which generation units go on line through a centralized dispatch system, according to their variable production costs (which in turn are linked to the heat rate). The price in the Wholesale Electricity Market (WEM) is set by the last generation unit that goes on line each hour, therefore, as stated above “marginal power plants cannot guarantee that they will cover their cost” so, if they remain “marginal” for a long period of time, it would be impossible for that plant to survive in the medium term.

Under these circumstances, all the power plants that are dispatched make an earning determined as the difference between their variable cost and the marginal price set.

Therefore, prospective generation units will have to enjoy a good return above their variable costs to justify the investment. That is why the medium-term supply, beyond the investment situation between 1997 and 2001 that have already been discussed, relied on those generation units installed by private investors, who expected a reasonable return on investment.

The technology installed in the WEM during the last investment wave was the combined cycle technology but, for a new generation of equipment to be installed in order to meet the expected demand

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[23] CAMMESA, Annual Report 2000.

growth, the marginal price cannot be defined by the very same technology. If that were the case, this new generation would not make any earnings.

A mechanism that ensures there is a “not so efficient” technology that will set the prices in the WEM for a large number of hours a year should be in place in the system. This can be achieved by keeping equipment like steam turbo generators, in some cases with many hours of use, or else by using other technologies that are not as efficient but with lower capital costs (gas turbo generators operating in open cycle mode).

In summary, the price necessary to justify the connection of new equipment to the system cannot be constantly set by combined cycle-like technologies; on the contrary, there has to be such a combination of generation units that the resulting price in the wholesale market warrants an additional investment. If the prices are too low, the private sector will not invest in getting new equipment on line.

The alternative capital costs of installing new generation technologies like hydroelectric or wind generation units are much higher than thermal equipment generation costs.

Besides, in this post-devaluation era —even though this issue was a problem before this event— the restraints on “gas” as fuel have increased with time, so, in order to meet demand more liquid fuel has to be consumed to replace gas, with the ensuing higher CO_2 emissions.

Even though the gas price determines the electricity price, the latter has its own break-even point, given by a mix of the different generation technologies and the different fuels consumed; this as a whole will set an average long-term price that will entice new investments in generation.

<u>Technical aspects that influence the selection of baseline equipment</u>

Also the technical aspects have to show a certain balance between the installed equipment and the extent of dispatch of the different types of technology and generation units.

An electricity market with a load factor like the one in Argentina will not be able to “operate” with a very high participation of combined cycles in the supply without new investments in state-of-the-art generation equipment. Such equipment is less efficient in environmental terms and it is necessary to meet the daily demand peaks.

Those combined cycles already installed and the ones that will be installed in the future are considered baseline generation units, since they have very little operational flexibility. To clarify this aspect, it could be said that combined cycles, nuclear power plants and most hydropower plants are built to operate at full capacity at all hours, with scarce capability of adjusting power.

So, for the technical and economic reasons explained before, even though the technology to be installed has to be the most efficient one, it cannot be the only one. The alternative is to either keep the old equipment running or install more flexible, not so efficient equipment, like open cycle gas turbo generators.

The scenario analysis proposed here only considers the options available for the project developer in the corresponding sectoral context, in order to take into account the feasibility of the scenarios considered.

Coming back to the alternative scenarios analyzed while using the additionality tool, the baseline scenario selection can be summarized as follows:

<table>
<tr><th colspan="3">Scenario</th><th>Economic</th><th>Barriers</th><th>Conclusion</th></tr>
<tr><td colspan="3">Alternative 1 (continuation of existing open cycle)</td><td>Indifferent</td><td>No</td><td>Probable</td></tr>
<tr><td rowspan="3">Alternative 2 (open cycle expansion)</td><td rowspan="2">Option 1 (new 185 MW gas turbine)</td><td>Case 1 (unlimited availability of own gas)</td><td>Very attractive</td><td>Technically implausible</td><td>Implausible</td></tr>
<tr><td>Case 2 (limited availability of own gas)</td><td>Unfeasible</td><td>No</td><td>Unfeasible</td></tr>
<tr><td colspan="2">Option 2 (new 105 MW gas turbine)</td><td>Feasible</td><td>No</td><td>More probable</td></tr>
</table>

Actually, two options are candidates to be the most likely scenario: the continuation of the current situation and the continuation of the current practice in terms of available resources. Even if the second option seems to be more attractive than the first one, it is not an option that surpasses by far the financial indicator standards fixed by the Board of Directors and should be analyzed within a complex decision making process. It is highly probable that it would have been the baseline scenario, but there are no financial indicators to compare this scenario with the continuation of the current situation, since the latter does not involve any investment. Thus, it is difficult to decide which of the two options would have been the baseline. In order to resolve this issue a conservative approach is selected. The baseline scenario corresponds to the scenario that represents less emissions among the potencial candidates to be the baseline.

Therefore, the continuation of the current operation of the pre-existing open cycle without any retrofit and expansion results the baseline scenario.[24]

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

As proposed in the approved methodology, the project boundary encompasses all anthropogenic emissions by sources of greenhouse gases (GHG) under the control of the project participants that are significant and reasonably attributable to the CDM project activity. In this case, the project boundary encompasses the site of the *Agua del Cajón* power plant that is being converted from single-cycle to combined-cycle.

The spatial extent of the project boundary includes the project site and all power plants connected physically to the electricity system that the CDM project power plant is connected to, i.e. the national interconnected grid including only the Wholesale Electricity Market (WEM).[25]

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

Date of completion of the baseline study: 10/09/2005

Name of person/entity determining the baseline:

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[24] The comparison between the two baseline candidates in terms of CO_2 emissions is showed in Section D.

[25] The Wholesale Electricity Market of the Patagonia System (WEMPS) is excluded due to the weak interconnection to the grid of the WEM.

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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:

17/01/2000

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

25 years (at least)

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

C.2.1. Renewable crediting period

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

17/01/2000

C.2.1.2. Length of the first crediting period:

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. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

Monitoring methodology for conversion from single cycle to combined cycle power generation (ACM0007, Version 01, Sectoral Scope 01, 28 November 2005).

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

The methodology is applicable in the context of the proposed project activity because the latter meets the conditions under which the approved methodology is applicable. Specifically they are:

- The project developer (Capex S.A.) utilizes previously-unused waste heat from a power plant, with a single-cycle capacity, and utilizes the heat to produce steam for another turbine —thus making the system combined-cycle;
- Waste heat generated on site is not utilizable for any other purpose on-site;
- The project activity does not increase the lifetime of the existing gas turbines during the crediting period (i.e. this methodology is applicable up to the end of the lifetime of existing gas turbines, if shorter than crediting period);
- Capex has 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 (national electricity grid without including the Patagonia system).

All these conditions are met by the proposed project activity.

This methodology requires a great amount of information in order to do a detailed combined margin approach. CAMMESA (the wholesale electricity market manager) will provide the necessary data.

A methodology applicable to the activity carried out under the scope of the project was chosen. Indeed, it follows the dispatch principles applicable to generation units in the Argentine electricity market established by Law N° 24,065 and its regulations.

In line with the methodology used, a computational method —currently operational— was developed, which calculates the number of metric tons of CO_2 not emitted by analyzing publicly available dispatch information on the electricity market, namely generation units dispatched.

D.2.1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

The monitoring methodology requires monitoring of the following:

- Electricity generation from the proposed project activity;
- Heat rates to estimate fuel consumption from the proposed 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 conversion from single cycle to combined cycle power generation”;
- Data needed to recalculate the operating margin (OM) emission factor, based on dispatch data analysis to determine the OM, consistent with “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” (ACM0002); and
- Data needed to recalculate the build margin (BM) emission factor, consistent with “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” (ACM0002).

ACM0007 proposes the set of equations that shall be taken into account to quantify CO_2 emissions.

D.2.1.1. 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
2-1	*Consumption of natural gas for operating the gas turbines* ($FGT_{NG,y}$)	*Measured at site by Capex*	m^3	*m*	*Hourly measurement, monthly recording*	*100%*	*electronic*	The on-site natural gas consumption is metered through volume meters. Data will be archived for two years following the end of the crediting period.
2-2	*Supplementary natural gas used in steam turbine* ($FST_{NG,y}$)	*Measured at site by Capex*	m^3	*m*	*hourly measurement, monthly recording*	*100%*	*electronic*	The on-site supplementary natural gas consumption is metered through volume meters. Data will be archived for two years following the end of the crediting period.
2-3	CO_2 *emission factor of natural gas* ($EF_{CO2,NG}$)	*Argentina Second National Comm. to the UNFCCC*	tCO_2/m^3 *of natural gas*	*m*	*yearly*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period.
2-4	*Oxidation factor of natural gas* ($OXID_{NG}$)	*IPCC*	*%*	*e*	*yearly*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period.

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Project emissions include emissions from use of natural gas to operate the gas turbines and supplementary natural gas used in order to operate the steam turbine. Thus, project emissions are given by

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

where $FGT_{NG,y}$ is the amount of natural gas (in m^3) consumed to operate the gas turines by the project in year y and $FST_{NG,y}$ is the supplementary amount of natural gas (in m3) consumed in the heat recovery steam generator to operate the steam turbine by the project in year y. $COEF_{NG}$ is the CO_2 coefficient for natural gas used in the project, expressed in tCO_2 per m^3 as

$$COEF_{NG} = EF_{CO2,NG} \times OXID_{NG}$$

$EF_{CO2,NG}$ is the CO_2 emission factor per unit of volume of natural gas (tCO_2/m^3), and $OXID_{NG}$ is the oxidation factor of natural gas (0.995, IPCC). Therefore, project emissions can be rewritten as

$$PE_y = (FGT_{NG,y} + FST_{NG,y}) \times EF_{CO2,NG} \times OXID_{NG}$$

D.2.1.3. Relevant 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
3-1	*Electricity produced from use of waste heat in hour h (CG_h)*	*Metered at site by Capex*	*MWh*	*m*	*hourly measurement, yearly recording*	*100%*	*electronic*	Summing these values over 8,760 hours per year, CG_y is obtained. Data will be archived for two years following the end of the crediting period and cross-checked with CAMMESA's values.

3-2	*Carbon Emission Factor for the entire grid* ($EF_{grid,y}$)	*CAMMESA – Secretariat of Energy – Argentina Second National Comm. to the UNFCCC*	tCO_2/MWh	*c*	*yearly*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period.
3-3	*Carbon Emissions from Operating Margin* ($EF_{OM,y}$)	*CAMMESA – Secretariat of Energy – Argentina Second National Comm. to the UNFCCC*	tCO_2/MWh	*c*	*yearly*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period.
3-3.a	*Hourly generation-weighted average emissions per electricity unit* ($EF_{DD,h}$)	*CAMMESA – Argentina Second National Comm. to the UNFCCC*	tCO_2/MWh	*c*	*yearly*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period.
3-4	*Carbon Emission Factor from build margin* ($EF_{BM,y}$)	*CAMMESA – Secretariat of Energy – Argentina Second National Comm. to the UNFCCC*	tCO_2/MWh	*c*	*yearly*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period.

3-5	*Total CO_2 emissions from grid ($E_{OM,y}$)*	*CAMMESA – Secretariat of Energy – Argentina Second National Comm. to the UNFCCC*	*tCO_2/year*	*c*	*yearly*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period.
3-6	*Total electricity to grid (GEN_y)*	*CAMMESA*	*MWh/year*	*m*	*yearly*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period.
3-7	*Amount of fossil fuel i consumed by equipment j during hour h ($F_{i,j,h}$)*	*CAMMESA*	*Physical unit (l, t, m^3)*	*c*	*yearly*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period and cross-checked with aggregated information reported by the Sec. of Energy.
3-7.a	*Heat rate for fuel i of equipment n ($HR_{i,n}$)*	*CAMMESA*	*kcal/kWh*	*m*	*yearly*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period.
3-7.b	*Net calorific value of fuel i (NCV_i)*	*Argentina Second National Comm. to the UNFCCC*	*kJ/unit of fuel*	*m*	*yearly*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period.
3-8	*CO_2 coefficient of each fuel i ($COEF_i$)*	*Argentina Second National Comm. to the UNFCCC – IPCC*	*tCO_2/unit of fuel*	*m*	*yearly*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period.

3-8.a	*CO_2 emission factor of fuel i ($EF_{CO2,i}$)*	*Argentina Second National Comm. to the UNFCCC*	*tCO_2/unit of fuel*	*m*	*yearly*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period.
3-8.b	*Oxidation factor of fuel i ($OXID_i$)*	*IPCC*	*%*	*m*	*yearly*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period.
3-9	*Electricity generation of equipment j during hour h ($GEN_{j,h}$)*	*CAMMESA*	*MWh*	*m*	*yearly*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period.
3-10	*Plant identification for OM*	*CAMMESA*	*Name*	*e*	*yearly*	*100% of set of plants*	*electronic*	Data will be archived for two years following the end of the crediting period.
3-11	*Plant identification for BM*	*CAMMESA*	*Name*	*e*	*yearly*	*100% of set of plants*	*electronic*	Data will be archived for two years following the end of the crediting period.
3-12	*Total electricity generation of imported power*	*CAMMESA – Secretariat of Energy*	*MWh*	*m*	*yearly*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period.
3-13	*Merit order in which power plants are dispatched*	*CAMMESA*	*Text*	*m*	*hourly measurement, yearly recording*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period.

3-14	*Historical net quantity of electricity generated by the open cycle operation of power plant (HG_{OC})*	*Capex*	*MWh*	*m*	*yearly*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period and cross-checked with CAMMESA's values.
3-15	*Net quantity of electricity generated by the project power plant (PG_y)*	*Capex*	*MWh*	*m*	*yearly*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period and cross-checked with CAMMESA's values.
3-16	*Net generation capacity of the project power plant (PC)*	*Capex*	*MW*	*m*	*hourly measurement, yearly recording*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period and cross-checked with CAMMESA's values.
3-17	*Historic fuel consumption of the project in open cycle generation (FC_{hist})*	*Capex*	*m^3*	*m*	*once in the credting period*	*100%*	*electronic*	Data will be archived for two years following the end of the crediting period and cross-checked with CAMMESA's values.

It is considered that, following ACM0002, for the purpose of determining the Operating Margin (OM) emission factor, the CO_2 emission factor for net electricity imports ($COEF_{i,j,imports}$) from the connected Patagonia electricity system (WEMPS) is 0 tCO_2/MWh, because the connection is too weak —a 132 kV transmission line, where almost negligible electricity is exported to the national grid (WEM). For imports from connected electricity system located in another country, the conservative emission factor is 0 tons CO_2 per MWh. Electricity exports are not subtracted from electricity generation data used for calculating and monitoring the baseline emission rate.

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Baseline emissions in year *y* are estimated according to the following equation:

$$BE_y = OG_y \times EF_{OC} + CG_y \times EF_{grid,y}$$

where OG_y is the electricity generated by the open cycle in year *y* in the baseline (in MWh), EF_{OC} is the emission factor for plant operational in open cycle mode (in tCO_2/MWh), CG_y is the electricity generated from use of waste heat in year *y* (in MWh), and $EF_{grid,y}$ is the CO_2 emission factor for the electricity displaced due to the project activity during the year *y* (in tCO_2/MWh). Agua del Cajón power plant is only using one fuel, natural gas.

In the case of the current project activity, CG_y is the electricity generated through the use of the 185 MW steam turbine plus supplemental fire, which can be expressed as

$$CG_y = PG_y - OG_y$$

where PG_y is the electricity generated by the project, i.e. entire combined cycle in year *y* (in MWh).

OG_y is estimated as

$$OG_y = PLF \times OC \times T$$

where *PLF* is the plant load factor, expressed as fraction, *OC* is the net capacity (gross capacity less auxiliary consumption of the plant) of the open cycle gas turbines in MW, and *T* represents operation hours during year *y* (=8,760 hours in a full year).

The methodology proposes two alternatives to calculate *PLF*. The first option is the one compatible with the historical estimation of the open cycle emission factor (take into account that the plant load factor would remain almost unaltered following project implementation, due to the reasons explained in Section B.3, depending only on specific sectoral circumstances).[26] Thus,

[26] Typically the plant load factor is increased as a consequence of lowering the generation cost per MWh when delivering electricity under the combined cycle mode operation. But it is not the case for the Agua del Cajón power plant, since the generation cost did not depend on any improvement in power plant efficiency.

$$PLF = \frac{HG_{OC,x}}{OC_x \times T}$$

where $HG_{OC,x}$ is the average net annual generation from the operation of the power plant in open cycle mode based on 'x=3' years[27] of generation records previous to start of the project (in MWh) and OC_x is the net historic installed capacity (MW) of the open cycle gas turbines.

On the other hand, EF_{OC} is given by historical performance of the plant when operated in open cycle using data for a minimum of one full year previous to the start of project, according to:

$$EF_{OC} = \frac{FC_{NG,hist}}{HG_{OC,x}} \times COEF_{NG}$$

where $FC_{NG,hist}$ is the annual average fuel consumption of the gas turbines (in m^3) estimated using data for 3 years previous to start of the project and $COEF_{NG}$ is the CO_2 coefficient for natural gas used in the project for operating the open cycle gas turbines, expressed in tCO_2 per m^3, based on data for 3 years previous to the start of the project, given by

$COEF_{NG} = EF_{CO2,NG} \times OXID_{NG}$

Therefore, baseline emissions are given by

$BE_y = OG_y \times (FC_{NG,hist} / HG_{OC,x}) \times EF_{CO2,NG} \times OXID_{NG} + (PG_y - OG_y) \times EF_{grid,y}$

The baseline CO_2 emission factor for the grid electricity displaced due to the project activity during the year y ($EF_{grid,y}$) is calculated as a combined margin (*CM*), consisting of the combination of operating margin (*OM*) and build margin (*BM*) factors according to ACM0002. The exact steps to determine the combined margin are included in that methodology. The recommended approach is the Dispatch Data Analysis OM (option c in ACM0002). Moreover, Argentine grid is sometimes more than 50% hydropower, then the simple operating margin cannot be used.

The Dispatch Data OM emission factor ($EF_{OM,Dispatch\ Data,y}$) is summarized as follows:

[27] Full data for the last phase of the plant's open cycle gas turbines is available for three years previous to start of the project.

$$EF_{OM,Dispatch\,Data,y} = E_{OM,y} / EG_{WH,y}$$

where $EG_{WH,y}$ is the generation of the project (in MWh) in year y, and $E_{OM,y}$ are the emissions (tCO_2) associated with the operating margin calculated as

$$EF_{OM,y} = \sum_h EG_{WH,h} \times EF_{DD,h}$$

where $EG_{WH,h}$ is the generation of the project (in MWh) in each hour h and $EF_{DD,h}$ is the hourly generation weighted average emissions per electricity unit (tCO_2/MWh) of the set of power plants (n) in the top 10% of grid system dispatch order during hour h:

$$EF_{DD,h} = \frac{\sum_{i,n} F_{i,n,h} \times COEF_{i,n}}{\sum_n GEN_{n,h}}$$

where $F_{i,n,h}$ is the amount of fuel i (in mass or volume unit) consumed by relevant power sources n in hour h, $COEF_{i,n}$ is the CO_2 emission coefficient of fuel i (tCO_2/mass or volume unit of the fuel), taking into account the carbon content of the fuels used by relevant power sources n and the percent oxidation of the fuel in hour h, and $GEN_{n,h}$ is the electricity (MWh) delivered to the grid by source n during hour h, for the set of plants (n) falling within the top 10% of the system dispatch.

To determine the set of plants (n), CAMMESA is providing: a) the grid system dispatch order of operation for each power plant of the system; and b) the amount of power (MWh) that is dispatched from all plants in the system during each hour that the project activity is operating (GEN_h). At each hour h, it is stacked each plant's generation (GEN_h) using the merit order. The set of plants (n) consists of those plants at the top of the stack (i.e., having the least merit), whose combined generation ($\Sigma\ GEN_h$) comprises the greater of either the 10% of total generation from all plants during that hour or the project generation during hour h expressed as a percentage of the total grid generation for that hour (including imports to the extent they are dispatched).

The CO_2 emission coefficient $COEF_i$ is obtained as

$COEF_i = EF_{CO2,i} \times OXID_i$

where:

$OXID_i$ is the oxidation factor of the fuel (default values taken from page 1.29 in the 1996 Revised IPCC Guidelines);

$EF_{CO2,i}$ is the CO_2 emission factor per mass or volume unit of the fuel *i*.

Local values of $EF_{CO2,i}$ are used, extracted from the Second National Communication of Republic of Argentina to the UNFCCC.

Fuel consumption $F_{i,n,h}$ is obtained from given heat rates for fuel *i* of equipment *n*, $HR_{i,n}$, as provided by CAMMESA every year, instead of data on hourly fuel consumption. $F_{i,n,h}$ is calculated as[28]

$F_{i,n,h} = (HR_{i,n}/NCV_{i,n}) \times GEN_{n,h}$

where NCV_i is the net calorific value (energy content per mass or volume unit of the fuel *i*). These values are taken from the National GHG Inventories of the Republic of Argentina.

The Build margin (*BM*) emission factor is calculated as the generation-weighted average emission factor (tCO_2/MWh) of a sample of power plants *m*, as follows:

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

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

For the first crediting period, the Build Margin emission factor $EF_{BM,y}$ is updated annually *ex-post* for the year in which actual project generation and associated emissions reductions occur. For subsequent crediting periods, $EF_{BM,y}$ will be calculated *ex-ante*, taking into account the most recent information available on plants already built for sample group *m* at the time of PDD submission.

The sample group *m* consists of either the five power plants that have been built most recently, or the power plants capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently (it is considering several years after project was already implemented). Capex will use from these two options the sample group that comprises the larger annual generation every year.

Power plant capacity additions registered as CDM project activities are excluded from the sample group *m*.

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[28] If different energy units are used a conversion factor is added, e.g. from kcal to kJ, kWh to MWh, etc.

The requirements for weighting the OM and BM are the same for ACM0002, unless a new procedure is adopted by the CDM Executive Board for determining the weighting of the OM and BM in the case of large projects. When approved by this Board the same method would apply to this project as well and will be modified for further verifications. For this proposed project activity, a 50-50 default value is used. Capex is prepared to recalculate their results based on any forthcoming guidance on this topic. Thus

$$EF_{grid,y} = \tfrac{1}{2}\left(EF_{OM,y} + EF_{BM,y}\right)$$

Note: If the baseline would have been represented by the addition of a new gas turbine (around 105 MW) in open cycle mode, baseline emissions would have been greater than continuing operating the existing open cycle without any capacity expansion. It can be show in the following way. If an additional gas turbine would have been installed, its energy generation would have been comparable to that of the supplemental fire. However supplemental fire has an efficiency greater than the one considered for a modern gas turbine (around 2,100 kcal/kWh *vs* 2,450 kcal/kWh, respectively; this explains the slightly different capacity). Conservatively one can assume that both contributions are equal and cancel them since the project would have included a contribution that would have also occurred in the baseline. Thus the two baseline candidates give rise to the following comparative equations:

$$BE_y(addition\ of\ GT7) = \left(G_{GT1-6,y} + G_{GT7,y}\right)\times EF_{OC} + G_{ST7,y} \times EF_{grid,y}$$

$$BE_y(cont.\ existing\ OC) = G_{GT1-6,y} \times EF_{OC} + \left(G_{ST7,y} + G_{SF,y}\right)\times EF_{grid,y}$$

The identification of the variables has been changed in order to compare the two equations. $G_{GT1-6,y}$ represents the generation in the year y of the existing gas turbines of the open cycle, $G_{GT7,y}$ is the electricity that would have been generated in the year y by the new gas turbine of 105 MW and 2,450 kcal/kWh of efficiency (named 7), and $G_{ST7,y}$ is the generation of the new steam turbine of the project in year y. The second equation is the equation used in this methodology, by identifying $G_{GT1-6,y}$ with OG_y and ($G_{ST7,y}$ + $G_{SF,y}$) with CG_y, where $G_{SF,y}$ is the electricity generated through the use of supplemental fire in the year y.

In the two cases project emissions are given by

$$PE_y = \left(F_{GT1-6,y} + F_{SF,y}\right)\times COEF_{NG}$$

where $F_{GT1-6,y}$ is the natural gas consumed by the existing gas turbines in the year y and $F_{SF,y}$ is the consumption of supplemental fire in the same year.

$EF_{grid,y} < EF_{OC}$ since gas turbines emit more than the grid (on average) because the grid also includes contributions from hydroelectric power plants as well as other combined cycles and nuclear plants (see Section E.4). Then, BE_y (*addition of GT7*) > BE_y (*cont. existing OC*). Therefore, the continuation of the operation of the existing open cycle without any capacity expansion is the most conservative baseline scenario.

D.2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

This Section is left blank on purpose.

D.2.2.1. 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 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

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

D.2.3. Treatment of leakage in the monitoring plan

According to ACM0007, the main emissions giving rise to leakage are methane leakage in production, transportation and consumption of increased quantity of natural gas consumed by the project activity. Emissions arising due to power plant construction can be ignored when applying this methodology as well as methane emissions if project proponents demonstrate through estimation that these are a negligible fraction of baseline. The only potential leakage could be an accidental leak in the gas field, in the pipeline or in the power plant.

Production: If any problem arises in the field, wells are closed to avoid methane leaks, through safety pneumatic valves activated by pressure falls. This is controlled by an Environmental Management System of the Field, out of the project boundary. Moreover these leaks are not strictly a consequence of the project activity. Nevertheless they will be taken into account and associated to the project.

Transportation: If important leaks occur in the pipeline, the power plant is halted due to the shortage of fuel. Then, specific engineers start a series of measures to close the wells, by sectors in the field, according to the relevance of the problem.

Consumption: In the power plant there is an alleviating system connected to a flare for safety conditions in order to avoid methane leaks. A safety engineer is continuously controlling flanges in order to measuring (in ppm) any fugitive emissions of methane. This is one of the preventive actions, such as controlling corrosion, using cathodic protection as maintenance routine, etc.

Thus, if leakage occurs it is immediately detected and controlled. This would be estimated as:

$$L = V_{gas} \times \rho_{CH4} \times GWP_{CH4}$$

where V_{gas} is the volume of gas vented, ρ_{CH4} is the methane density, and GWP_{CH4} is the global warming potential of methane (21 according to the IPCC value accepted by the COP).

In order to estimate the maximum leakage, taking into consideration the worst situation that can occur, a one-minute venting breaking is considered (take into account that safety pneumatic valves are activated automatically in few seconds).

The maximum daily-average gas production registered in the field was around 3,600,000 m^3 gas/day in June 2000 (it can be used as an upper bound; currently the daily production is lower).[29] Then the gas vented in one minute is 2,500 m^3 gas/min. Assuming that all the gas is methane and a methane density of 7 g CH_4/m^3 (higher than the standard one), CO_2-equivalent leaks are 0.37 tCO_2e. They are much more lower that baseline emissions and can be neglected in calculation of emission reductions.

Capex S.A. will not claim any credit for the project on account of reducing these emissions below the level of the baseline scenario.

[29] These data are provided to the validatior.

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table 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

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

No significant leakage is envisaged in this project activity.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

The project activity mainly reduces carbon dioxide through substitution of grid electricity generation with fossil fuel fired power plants by the additional combined-cycle unit. The emission reduction ER_y by the project activity during a given year y is the difference between baseline emissions (BE_y) and project emissions (PE_y), as follows (leakage $L_y = 0$):

$$ER_y = BE_y - PE_y = OG_y \times (HR_{OC,NG} / NCV_{NG}) \times EF_{CO2,NG} \times OXID_{NG} + (PG_y - OG_y) \times ½ (EF_{OM,y} + EF_{BM,y}) - (FGT_{NG,y} + FST_{NG,y}) \times EF_{CO2,NG} \times OXID_{NG}$$

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
2-1, 2-2	*Low*	*These data are directly used for calculation of emission reductions. All fuel used is metered and accurately measured and compared to energy balance over the year.*
2-3	*Low*	*IPCC default data are used to check the local data.*
2-4	*Low*	*IPCC data ("IPCC 1996 Revised National GHG Inventory") will be checked every year to update information as per changes made by IPCC.*
3-1	*Low*	*These data are used for calculation of emission reductions. Sales record to the grid and other records are used to ensure the consistency. These data are directly metered by Capex and CAMMESA information is used as a cross-ckeck.*
3-2	*Low*	*These data are directly used for calculation of emission reductions. IPCC default data are used to check the local data.*
3-3, 3-3.a, 3-4, 3-5	*Low*	*These data are used for calculation of emission reductions. IPCC default data are used to check the local data.*
3-6	*Low*	*These data are directly used for calculation of emission reductions. Sales record to the grid and other records are used to ensure the consistency. IEA statistics are used to check the local data.*
3-7	*Low*	*These data are used for calculation of emission reductions.*
3-7.a	*Low*	*These data are used for calculation of emission reductions. Annual fuel consumption data taken from the Secretariat of Energy will be used to cross-check the calculations obtained through the use of heat rates.*
3-7.b, 3-8, 3-8.a	*Low*	*These data are used for calculation of emission reductions. IPCC default data are used to check the local data.*
3-8.b	*Low*	*These data are used for calculation of emission reductions.*
3-9	*Low*	*These data are used for calculation of emission reductions. Sales record to the grid and other records are used to ensure the consistency. IEA statistics are used to check the local data. These data are received on-line by Capex directly from CAMMESA.*
3-10, 3-11	*Low*	*These data are used for calculation of emission reductions. Secretariat of Energy data are used for cross-checking.*
3-12	*Low*	*These data are used for calculation of emission reductions. Sales record to the grid and other records are used to ensure the consistency. IEA statistics are used to check the local data.*
3-13	*Low*	*These data are used for calculation of emission reductions. These data are received on-line by Capex directly from CAMMESA.*
3-14, 3-15, 3-16	*Low*	*These data are directly measured by Capex and CAMMESA information is used as a cross-ckeck.*
3-17	*Low*	*These data are directly measured by Capex and Sec. of Energy information is used as a cross-ckeck.*

All variables used to calculate project and baseline emissions are directly measured or are publicly available official data (CAMMESA and Secretariat of Energy). To ensure the quality of the data, in particular those that are measured, the data are double-checked against commercial data. The quality control and quality assurance measures planned for the proposed project activity are outlined in the previous Table.

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

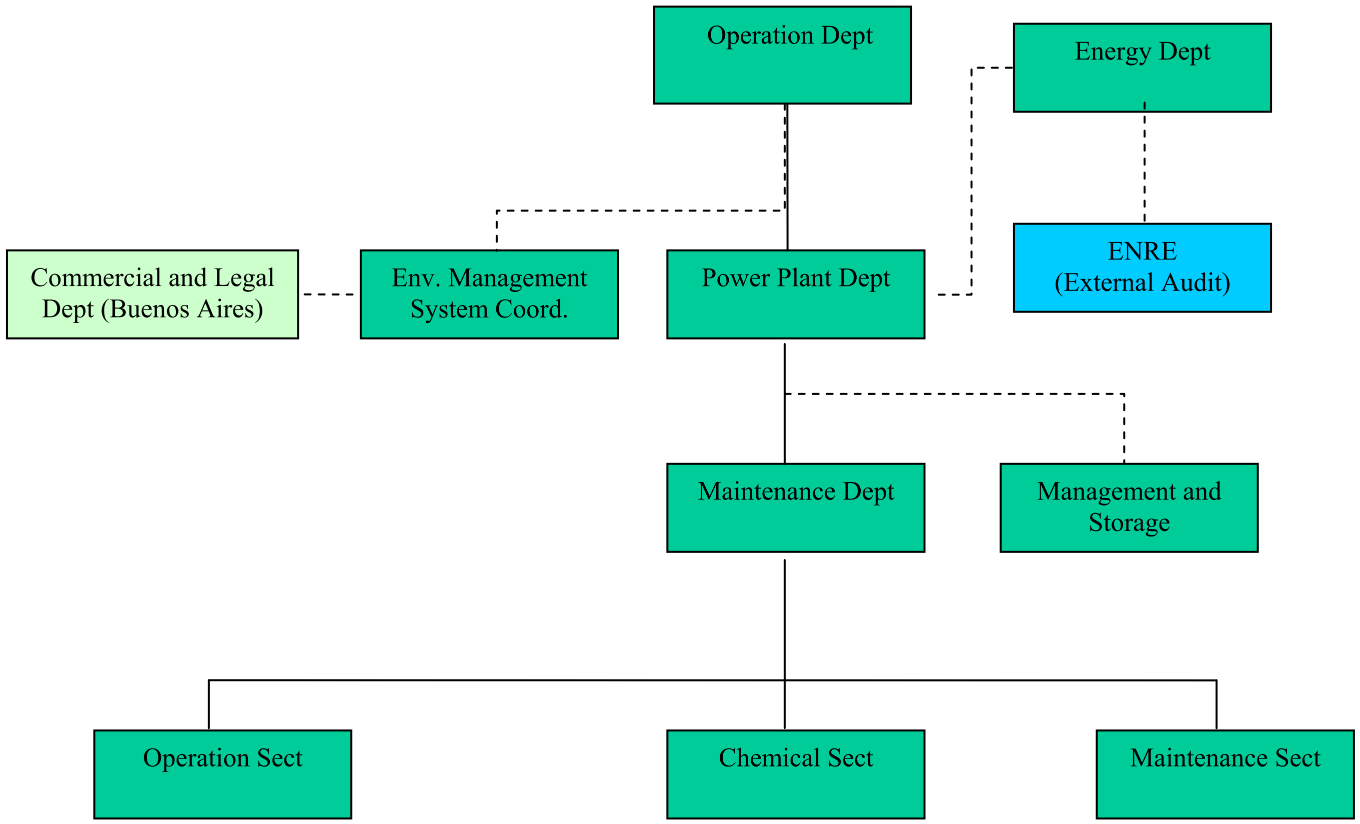
Capex S.A. has certified ISO 14001 standard, granted by Lloyd's Register Quality Assurance that is acting as internal auditor, and periodically (each six months) audited by ENRE, through the National Commission of Atomic Energy (CNEA). The operational and management structure is already in operation due to the project has already started. It is handled through the Environmental Management Handbook (under code PGA02). The responsible for it is the Coordinator of the Environmental Management System. The inclusion of the specific procedures, developed for monitoring the CDM project, into this handbook has been requested through a non-conformity registry (according to PGA15 below, RNC Nº 463) dated on 1 November 2005. It will be included into the Procedure for Measurements and Monitoring (PGA 12), through the Environmental Management Instruction IGA 12.01-05. The following list shows the documents included in the Environmental Management System.

Code	Procedure
PGA01	Environmental Policy
PGA02	Environmental Management Handbook
PGA03	Control of Documents
PGA04	Registries
PGA05	Legal matters
PGA06	Identification and assessment of environmental issues
PGA07	Environmental goals
PGA08	Environmental Management Program
PGA09	Capacity building and awareness
PGA10	Communications
PGA11	Preparation and response under emergency
PGA12	Environmental monitoring
PGA13	Calibration of equipment
PGA14	Environmental fulfillment assessment
PGA15	Non-conformity, preventive and corrective actions
PGA16	Auditing
PGA17	Revision by Management

PGA18	Terms and definitions
PGA19	Operating control
PG21	Waste
PG22	Soil contamination by oil
PG25	Projects
PCA01	Gas supply
PCA02	Water cycle
PCA03	Storage of chemical products
PCA04	Oil and fuels spillage
PCA05	Chemical products spillage
PCA06	Management
PCA07	High- and medium-voltage lines
PCA08	Maintenance of the Agua del Cajón Thermal Plant
PCA09	Operation of transformers and substation
PCA10	Operation of turbines (gas and steam)
PCA11	Maintenance of gas and steam turbines
PCA12	Storage of fuels and lubricants

PGA stands for Procedimiento de Gestión Ambiental (Environmental Management Procedure);
PCA stands for Procedimiento de Control Ambiental (Environmental Control Procedure).

Organization



Responsibilities

- **Energy Department**: Establishes the relation between the Env. Management System and the Application Authority (ENRE).
- **Operation Department**: Is in charge of the implementation of the Envrionmental Policy.
- **Power Plant and Maintenance Departments**: Advices in the formulation of Environmental Goals; supervises the operation and procedures of the Env. Management System.
- **Environmental Management System Coordination**: Supervises the fulfillment of the Env. Management System, according to ISO 14001 standard.
- **Operation, Management, and Maintenance Sectors**: In charge of identifying Environmental Concerns and supervises the fulfillment of the Env. Management System by personnel and contractors.
- **Commercial and Lega Department**: In charge of identifying legal requirements related to products and services of the Agua del Cajón power plant. In particular, this is the Department responsible for the implementation of the monitoring plan, through the Legal, Commercial and Computation Sectors.

The additional set of procedures, more specific for the CDM project activity, are detailed below.

ID #	Procedure	Code	Department	Registry	Cross-reference
1	*Surveillance and measurements of operating conditions (input and output)*	PGA 12	Geology Dept Energy Dept Operation Dept Operation Sect Plant Dept EMS Coord	RGA 12.00-10 (surveillance and measurements) RGA 12.01-10 (control parameters)	According to work instructive IGA 12. Env. Coord. of the Plant is in charge of supervising “No conformity and corrective and preventive actions,” including follow-up of the Env. Management Program, as a part of the Env. Management System within ISO 14001 standard. It includes monitoring of data necessary for the calculation of CO_2 emissions.
2	*Calibration of equipment*	PGA 13	Geology Dept Energy Dept Operation Dept Operation Sect Plant Dept EMS Coord	RGA13.00.10 (calibration registry) RGA13.00.20 (list of calibrated equipment) RGA13.00.30 (registry of failures)	According to work instructive IGA 13.01, using Calibration Handbook TESTO 350. Cross-check through third party controls.
3	*Maintenance of the Power Plant*	PCA 08	Maintenance Dept and Sect		O&M activities within the Env. Management Handbook procedures.
4	*Operation of transformers and substation*	PCA 09	Operation Dept Operation Sect		O&M activities within the Env. Management Handbook procedures.
5	*Operation of turbines (gas and steam)*	PCA 10	Operation Dept Operation Sect		O&M activities within the Env. Management Handbook procedures.
6	*Maintenance of gas and steam*	PCA 11	Maintenance		O&M activities within the Env. Management Handbook procedures.

	turbines		Dept and Sect		
7	*Technical procedure to meet CAMMESA's standards*	PT 15	Operation Dept		Adjustments of the power plant to guarrantee the integrity of electricity supply to the grid.
8	*Sending data to CAMMESA*	IOP-325-02	Operation Dept	Computer system registry	On-line communication to CAMMESA based on power plant electricity records.
9	*Burner fuel gas*	PO 571	Energy Dept Operation Dept		Operational procedure according to O&M Handbook John Zink.
10	*Duct burners and boiler control*	PO 572	Energy Dept Operation Dept		Operational procedure according to Mitsubishi and B&V I Handbook.
11	*Water injection*	PO 426	Operation Dept Plant Dept		Operational procedure according to Westinghouse Instructive Handbook I.B. 1810-C759.
12	*Control and measurement of noise*	IGA 12.01	Operation Dept Plant Dept	RGA 12.01-10	Noise meter according to standards IEC651, BS 5969, ANSI S1.4 TYPE 2. Noise gauge according to standards IEC942: 1988 CLASS 2L, ANSI S1.40-1984.
13	*Control and measurement of stack gases*	IGA 12.02	Operation Dept Plant Dept	RGA 12.02-10 (turbines) RGA 12.02-20 (burners)	Attachment of the Calibration certificate, as a part of the Env. Management System within ISO 14001 standard. Env. Coordinator of the Plant in charge of supervising "No conformity and corrective and preventive actions," according to procedure PGA 15
14	*Control and measurement of wastewater*	IGA 12.04	Plant Dept Plant Laboratory	ROP-00-007 ROP-00-008	According to procedure PO 566 "Chemical treatment of circulating water," based on "Operator Training Manual B & V Vol. 1 – Chap. 16.0 'Treatment of wastewater (WWC)'," together with calibration registry of flow meter ROP-00-011, as a part of the Env. Management System within ISO 14001 standard.
15	*Safety instructions*	IS 723-01 IS 724-01 IS 724-02 IS 724-03 IS 724-04 IS 724-05 IS 781-01	Personnel Dept Operation Dept		Medicines Fire Chemical products Meteorology phenomena Gas leaks Electric injuries Summary of safety standards
16	*Safety procedures*	PS 722 PS 723 PS 724 PS 731 PS 781 PS 782	Personnel Dept Operation Dept Plant Doctor Safety Advisor		Work injuries First aids Emergencies Outdoor works Contractors Visitors
17	*Internal audits*	PGA 16	Internal Auditor		According to the prescriptions of the Env. Management Plan.

			EMS Coord		
18	*Integrated monitoring management*		Commercial and Legal Dept		New procedure created for monitoring the CDM project and included within ISO 14001 standard.

All these procedures make part of a larger management system of the oil and gas field and the power plant, in order to make compatible the management of the two business units.

Eventual leakages produced from the gas wells and in the pipeline that connects the gas field with the power plant are controlled through the Field Procedure PY 29 (Control of relevant problems due to operation of production oil or gas wells) and the Field Instruction IY 31.01 (Control of pipeline quality and integrity). There is also a Contingency Plan (Field Instruction IY 11.22) that alerts in case of pressure problems in the field. The Environmental Management Registry (RGA 11.00.20), which reports any kind of risky problem occurred in the production wells and pipelines, has never registered any incident.

D.5 Name of person/entity determining the monitoring methodology:

Name of person/entity determining the monitoring methodology:

Contact person: Diego López Cúneo
Capex S.A.
Carlos F. Melo 630 – Vicente López
Province of Buenos Aires
Argentina

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

Project emissions are given by

$PE_y = (FGT_{NG,y} + FST_{NG,y}) \times EF_{CO2,NG} \times OXID_{NG}$

As shown in Annex 3, project emissions are:

Year	Estimation of project emissions (tonnes of CO_2 e)
2000	2,152,295
2001	1,897,925
2002	1,733,531
2003	2,047,689
2004	1,935,481
2005	1,385,411
2006	1,858,722
Total (tonnes of CO_2 e)	**13,011,054**

E.2. Estimated leakage:

No leakage is considered.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

Year	Estimation of project emissions (tonnes of CO_2 e)
2000	2,152,295
2001	1,897,925
2002	1,733,531
2003	2,047,689
2004	1,935,481
2005	1,385,411
2006	1,858,722
Total (tonnes of CO_2 e)	**13,011,054**

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

Baseline emissions are calculated applying the procedural steps set by the baseline methodology.

Baseline emissions are given by

$BE_y = OG_y \times (FC_{NG,hist} / HG_{OC,x}) \times EF_{CO2,NG} \times OXID_{NG} + (PG_y - OG_y) \times EF_{grid,y}$

where OG_y is given by the average net annual generation from the operation of the power plant in open cycle mode based on three years of generation records previous to start of the project activity, adjusted by the difference in the number of days in leap years (8784/8760):

OG_y = (2,479,586 + 2,710,973 + 3,067,854) MWh/y /3 = 2,752,804 MWh/y for normal years, and

OG_y = 2,760,346 for leap years

Fuel consumption by the open cycle in the last three years previous to the start of the project was: 823,913 dam^3 in 1997, 890,649 dam^3 in 1998, and 896,333 dam^3 in 1999. The average value is $FC_{NG,hist}$ = 870,298 dam^3.

Since the gas turbines only consumed natural gas, with a CO_2 emission factor 1.95 tCO_2/dam^3 and oxidation factor 0.995, $EF_{OC} = (FC_{NG,hist} / HG_{OC,x}) \times EF_{CO2,NG} \times OXID_{NG}$ = 0.61341 tCO_2/MWh.

The outputs of the dispatch data analysis are loaded in a spreadsheet that contains the date and hour of each dispatch report provided by CAMMESA, the electricity generated by the project in that date and hour, the hourly generation weighted average emissions per electricity unit of the set of power plants in the top[30] of grid system dispatch order in that date and hour, and the resulting CO_2 emissions obtained in that date and hour. The hourly results are added up in order to obtain the annual avoided CO_2 emissions according to the operating margin calculation. For the dates and hours in which dispatch reports are not found, it is conservatively assumed that no unit has been displaced, thus the avoided CO_2 emissions are zero. More details of the procedure are included in the monitoring plan (Annex 4). The OM grid emission factor is obtained as the rate between total CO_2 emissions in a year and total electricity generation by the project in that year.

The build margin emission factor is calculated from the set of power plants that represents the most recent capacity additions in the electricity system that comprise 20% of the system generation, because this is the sample group that comprises the larger annual generation (it was compared with annual electricity generation data, see Annex 3).

The Dispatch Data Analysis OM emission factor was calculated from 17 January 2000 to 31 December 2005. The average emission factor is (see Annex 3):

$$EF_{OM,DispatchData,y} = 0.33029 \text{ tCO}_2\text{/MWh}$$

The values of NCV_i and $EF_{CO2,i}$ were taken from national values and will be updated with data extracted from the Second National Communication of Republic of Argentina to the UNFCCC, which is currently in progress (see Annex 3 for detailed information).

[30] 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.

On the other hand, for the calculation of the BM emission factor the option 1 of the ACM0002 was applied. The power plants capacity additions in the WEM that comprise 20% of the system generation (in MWh) and that have been built most recently was used. The average result obtained for the first crediting period was:

$EF_{BM,y}$ = 0.36149 tCO_2/MWh

Then, the average Combined-Margin Baseline Emission Factor is given by[31]

$EF_{grid,y} = ½ (EF_{OM,y} + EF_{BM,y})$ = 0.34589 tCO_2/MWh

Baseline emissions are given by (see Annex 3)

Year	$EF_{OC} \times OG_y$ (tonnes of CO_2 e)	$EF_{grid,y} \times CG_y$ (tonnes of CO_2 e)	Baseline emissions (tonnes of CO_2 e)
2000	1,693,223	862,955	2,556,178
2001	1,688,596	637,224	2,325,820
2002	1,688,596	379,454	2,068,050
2003	1,688,596	631,854	2,320,450
2004	1,693,223	589,339	2,282,561
2005	1,688,596	181,352	1,869,948
2006	1,690,138	547,030	2,237,168
Total (tonnes of CO_2 e)	11,830,969	3,829,207	**15,660,176**

The average of the 2000-2005 period is used for estimating the value in year 2006.

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

Average emission reductions (for the period analyzed) are given by

$ER_y = BE_y – PE_y – L_y$ = 2,237,168 tCO_2/y – 1,858,722 tCO_2/y – 0 = **378,446 tCO_2/y**

E.6. Table providing values obtained when applying formulae above:

Calculated annual values are given by the following Table (see Annex 3).

Year	Estimation of project emissions (tonnes of CO_2 e)	Estimation of baseline emissions (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of emission reductions (tonnes of CO_2 e)
2000	2,152,295	2,556,178	0	403,883
2001	1,897,925	2,325,820	0	427,896
2002	1,733,531	2,068,050	0	334,519
2003	2,047,689	2,320,450	0	272,761
2004	1,935,481	2,282,561	0	347,080
2005	1,385,411	1,869,948	0	484,537

[31] A 50-50 weighting of the OM and BM is used until the CDM Executive Board approve a different approach to calculate the weighting in the combined margin calculation.

2006	1,858,722	2,237,168	0	378,446
Total (tonnes of CO_2 e)	**13,011,054**	**15,660,176**	0	**2,649,122**

SECTION F. Environmental impacts

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

The Environmental Impact Assessment (EIA) was performed by Equilibrium S.A. ("Environmental Impact Assessment Study- Detailed Design Stage, Conversion of *Agua del Cajón* Thermal Power Plant into Combined Cycle," Province of Neuquén, 1998).

The EIA analyzed the environmental impact caused by every aspect of the project, taking into account the water collection from the Limay river, the construction of the feed water pipeline, the effluent drainage from the cooling system and the power plant emissions into the atmosphere once the combined cycle conversion is completed. Moreover, the EIA also dealt with additional issues regarding the construction of a materials yard and its driveway, that were necessary in order to carry out the project.

The results of the Environmental Impact Assessment conducted for this project were summarized in a matrix form. The basis of the assessment method proposed assumes that whenever a new unit that produces goods or services is inserted in an environmental macro-system, there are responses that have a positive or negative impact on valuable features of any of the macro-system components.

In this field, the actions that take place as the human activity develops can be compared to a vector of endogenous and exogenous stimuli, where each component or action takes part in the specific modification of the environmental properties of any of the elements that make up the environmental system under study. These properties become the "valuable features" for the assessing entity, and such features are the ones that should be preserved from any damaging element.

The degree of influence or impact on the initial quality that was assumed for these features, before the stimuli, can be assessed by means of the matrix introduced above. In order to implement this the following items were taken into account:

- *Original quality*: it refers to the initial quality of the component's features (soil, water, air, etc.). The assumption is that such quality is only affected by human activity.
- *Kind of impact*: it measures the overall importance of the degree of influence; the scale goes from *Positive* to *Neutral* to *Negative*, where *Neutral* means that the environmental feature under analysis has not been modified, *Positive* means improvement and *Negative* means that man-made actions impair the original quality of the feature considered.
- *Magnitude*: magnitudes considered are low, moderate and high and apply to the level of environmental impact.
- *Extent*: it measures the physical reach; the scale goes from short range (small area affected) to long range.
- *Evolution*: it takes into account the speed with which the change unfolds.
- *Persistence*: it shows for how long the change remains stable.
- *Reversibility*: it describes how easily the original conditions of the feature under analysis can be restored, on its own or due to explicit human responses that will reverse or mitigate the impact's causes or effects.

- *Certainty*: it indicates how possible it is for the change to happen.

The environmental impact matrix is used to identify those elements within the biophysical and socio-economic environment that may be affected by the tasks to be undertaken, be it to modify an action whenever possible or to take the necessary remediation measures when such actions are unavoidable for the normal development of the tasks.

The impact matrix shown is the result of a significant effort of synthesis, aimed at including in the matrix only those elements deemed relevant for this analysis.

Therefore, the list of biophysical and socio-economic elements is short, in order to focus on those elements which should be a priority. The environmental impact matrix is shown below.

Attributes		Aspect	Degree of influence						
			Quality (1-10)	Magnitude (1-3)	Extent (1-3)	Evolution (1-3)	Persistence (1-3)	Reversibility (1-3)	Certainty (1-3)
Natural	Landform	Erosion due to removal (illegible)		0	0	0	0	0	0
	Soil	Sheet erosion		-1	1	1	3	3	2
		Gully erosion		0	0	0	0	0	0
		Hydrocarbons		0	0	0	0	0	0
		Pollution		0	0	0	0	0	0
	Surface water	Toxic substances		0	0	0	0	0	0
		Liquid hydrocarbons		0	0	0	0	0	0
		Turbidity		0	0	0	0	0	0
		Fecal coliforms		0	0	0	0	0	0
		Temperature		0	0	0	0	0	0
		pH		0	0	0	0	0	0
	Groundwater	Toxic substances		0	0	0	0	0	0
		Turbidity		0	0	0	0	0	0
		Fecal coliforms		0	0	0	0	0	0
		Temperature		0	0	0	0	0	0
		pH		0	0	0	0	0	0
	Air Quality	Hydrocarbons and gas		0	0	0	0	0	0
		Hydrogen sulphide		0	0	0	0	0	0
		Noise		0	0	0	0	0	0
Ecological	Species and Populations	Flora		-1	1	3	1	2	2
		Fauna		-1	1	3	1	1	2
		Habitat		-1	1	3	1	1	2
		Diversity		0	0	0	0	0	0
		Nesting areas		0	0	0	0	0	0
Aesthetic	Soil	Surface geology		0	0	0	0	0	0
		Landform and topography		0	0	0	0	0	0
	Air	Smell, visibility		0	0	0	0	0	0
		Noise		0	0	0	0	0	0
	Water	Rivers		0	0	0	0	0	0
		Lagoons		0	0	0	0	0	0
		Vegas or *mallines*		0	0	0	0	0	0
	Biota	Wild animals		0	0	0	0	0	0
		Domestic animals		0	0	0	0	0	0
		Diversity of species		0	0	0	0	0	0
Socio-Economic and Cultural	Conflicting uses	Mining		0	0	0	0	0	0
		Cattle raising		0	0	0	0	0	0
		Forestry		0	0	0	0	0	0
	Recreation	Hunting		0	0	0	0	0	0
		Fishing		0	0	0	0	0	0
		Tourism		0	0	0	0	0	0
	Sensitive	Admiration		0	0	0	0	0	0
		Integration		0	0	0	0	0	0
		Isolation		0	0	0	0	0	0
	Lifestyles	Country estates - Outposts		0	0	0	0	0	0

Note: A positive integer number means a positive impact, a negative integer number means a negative impact, and a zero means a neutral impact.

F.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:

Environmental Protection Plan

The preparation of the Environmental Protection Plan (EPP) has taken into consideration some measures to reduce the environmental impact during the construction and operation stages of the installations. Some of such measures are the following:[32]

Camp and construction site

1. Traffic will be only allowed in places and access roads identified in the construction site, according to the Working Area that will be determined before work begins.
2. It is mandatory to protect signs and billboards and comply with their instructions regarding health, safety and environment.
3. Sanitary installations will be built in compliance with Law No. 19,587 and its regulatory Executive Orders, and they will be kept perfectly clean and operational at all times. Depending on the construction size and the number of workers, the project will have to comply with Chapter 3 of the above-mentioned Law – Decree 351/79 and Executive Order 1,338/96.
4. Liquid effluents will be treated in a septic tank and a cesspit before their end disposal.
5. The septic tanks will be built in such a way that liquid effluents will not pollute underground water. As long as the camp is in place chlorine will be added to these installations, handling that substance with care.
6. The burn pits located in the field will be used for non-toxic wastes, whereas waste considered to be toxic will be transported to a safe end disposal site.
7. Fuel storage tanks will be located in safe areas away from the camp, surrounded by a wire fence. Each tank will have its own protective housing and will be built on impervious ground.
8. Soil affected by spills of oil or lubricants in general will be permanently removed and it will be disposed of under safe conditions, awaiting further treatment.
9. Equipment and materials will be stored outdoors, close to the camp.
10. Once the camp is dismantled the site will be restored to a condition as close as possible to the original, cleaning thoroughly the place, closing the pits dedicated to burning and disposition of non toxic wastes, adding chlorine to septic tanks and closing them adequately, scarifying roads and piping storage areas to encourage natural vegetation regeneration.

Right of way

The following protection measures are common guidelines implemented to clean the right of ways and related installations. Additional measures might be required in specific or sensitive areas or wherever the holders of surface rights or provincial authorities so demand.

1. Before construction, notify the holders of surface rights, occupants and relevant government representatives; document and take into account their concerns.
2. Identify the limits and location of the right of way, considering extra grading and waste storage.

Construction phase

1. During construction an Environmental Audit should be carried out in order to check the extent of compliance with the recommendations herein included; the auditors will be appointed by the operators or those responsible for the construction. The environmental auditor/s will work closely with the staff responsible for the technical aspects of the construction, checking all the items included in the Environmental Protection Plan.

[32] Extracted from the Environmental Impact Assessment performed by Equilibrium S.A.

2. A Head of Safety will be in the site at all times to carry out all the functions related to industrial safety and occupational health during the whole construction stage, in full compliance with Law No. 19,587 and Decree 351/79 and Executive Order 1,338/96.
3. Smoking, lighting fires, and using anything that might start a fire will be strictly forbidden in those areas where flammable and/or explosive products are stored, handled, loaded, unloaded, transported, manufactured or treated; the same restriction will apply wherever there are or may be flammable gases in the environment or wherever it may be regarded as risky – as indicated by warning signs to be put up to that end.
4. Personnel must not proceed to the working area carrying cigarettes, matches and/or lighters.
5. Personnel must not proceed to the working area carrying alcoholic beverages and/or medicines of any kind.
6. Personnel must not prepare meals employing fire, except in specifically authorized areas.
7. Personnel must not proceed to the working area carrying firearms or sharp objects that could be used as weapons, with the exception of the security personnel.
8. Personnel must not use volatile and/or flammable products –such as gasoline, naphtha, solvents and kerosene– to clean garments, equipment or tools.
9. Oxygen, acetylene and flammable fuel cylinders will be stored in places specially dedicated to this end; such places will be located within the working area.
10. Keeping animals, on a permanent or temporary basis, and/or feeding wild or domesticated animals even with leftovers, is strictly forbidden.

Construction of pipelines and installations

The construction of the pipelines can potentially cause a significant impact on the environment. Correctly planning the right of way, the scheduled time, and the construction and management techniques may help minimize the environmental disturbances and avoid claims. As general mitigation measures, we suggest the following:

1. Daily removing all the garbage and debris produced by the construction of the right of way and transporting it to an approved site.
2. Trenching should be performed with a backhoe or a revolving backhoe (trench cutter); a scarifier bulldozer may be needed to penetrate the soil in rocky parts.
3. Implementing edaphic selection, arranging topsoil and subsoil in adjacent mounds to avoid mixing them.
4. Crossings of routes and main roads should be performed with tunnel boring machines, to avoid dangerous settlements in heavy traffic areas. This is also advised for crossings with other pipelines.
5. Minimizing the length of open trenches, laying the pipes as soon as possible and backfilling the trenches immediately after placing the pipes, to reduce the interference with the land use, cattle and pedestrian fauna.
6. Backfilling with subsoil before replacing the topsoil. Keeping the backfill material free from pieces of wood, garbage, and other construction debris. Not using topsoil as cushioning material for the pipes.
7. Limiting backfilling to the right of way and compacting the subsoil backfill material whenever possible.
8. Starting with cleaning immediately after finishing backfilling.
9. Carrying out the restoration activities during the first stage of cleaning.
10. Placing warning signs for passers-by.
11. If the water table is too close to the surface, which is likely to happen, it is recommended to perform the trenching only when the piping is ready, in order to avoid water and mud flooding.

12. Reducing short-term impact by resorting to “bridges” over the trenches, fast laying of pipes and immediate backfilling.
13. Volcanic ashes or sulfates may be found during the excavation, which are highly corrosive and dispersible; therefore, workers should wear masks over their mouths and noses during construction.
14. During hydraulic testing on the piping, every reasonable precaution should be taken to protect both personnel and installations.
15. Crossroads, watercourses, other installations and control areas will be clearly identified with signs.
16. In case of unexpected archaeological, historical or paleontological findings, it is recommended to stop the activities under way until the construction plan has been reviewed for the most affected areas; the competent authorities must also be notified.
17. When the construction stage is over, wire fences, gates, cattle guards, lateral roads, exits, irrigation channels, fences or any other minor construction works necessary for agricultural or husbandry activities will be restored.

Water crossings

The general guidelines to be implemented in order to minimize the impact caused by the construction of water crossings are as follows:

1. A specific construction plan is needed for river and irrigation channel crossings.
2. According to the “Normas para la Ejecución de Obras en Canales de Riego, Desagües y Drenajes” issued by the “Dirección General de Recursos Hídricos” of the province of Neuquén, the contractor must get a consent from the relevant authority before starting the construction of a water crossing.
3. If spillways, dams and temporary detours are used when constructing the crossing in order to facilitate the excavation, the adequate flow should be ensured to allow downstream consumption of water.
4. Make sure that all the equipment and materials needed are on the site and ready to be used, before the construction of the water crossing begins.
5. Schedule the construction to be carried out during the low flow rate period and when the impact on the fish community will be lowest. Put it off if the weather forecast announces heavy rain or mudslide during the scheduled construction period.
6. Hand clean the slopes that become watercourses. Cut down trees far away from the watercourse to lessen the damage on the water habitat. Trees, debris, or soil inadvertently left in the high water mark must be removed quickly to minimize any disturbance on banks and beds.
7. Place the structures for the crossing of vehicles as part of the clearance, so that the construction equipment does not need to ford the watercourse – unless that is approved.
8. Remove the structures for crossing, restore and stabilize beds and stream banks as well as any other disturbed area, when the crossing of vehicles is no longer needed.
9. Check the hydraulic, fuel and lubrication systems of all the equipment used in the water crossing construction to ensure they work correctly and that they do not have any leaks. Avoid discharging substances that are toxic for fish or any other form of aquatic life supported by the watercourse. In order to prevent water pollution, the mobile construction equipment must not be fuelled less than 100 m away from the watercourse.
10. Do not wash equipment in the watercourse.
11. Since the branch of the Limay river is more than 10 m wide, place the stacks in the stream, far from the areas where water speed is high. Soil must not be stacked through the channel or block more than one third of the water stream.

12. Backfilling must be done using the material previously taken from the bed, restoring the original contour. In those water crossings where spawning takes place, backfill the trench's upper layer with the same or better backfill material than the original from the bed.
13. Immediately after backfilling, restore and stabilize the stream bank to its original contour and recreate vegetation with grass.
14. Bed material with high organic content must not be returned to the stream but replaced by granulate material, which has to be already on the site before trenching, to cover the pipes as soon as they are laid in the watercourse. The use of fine gravel as backfill material must be restricted to trenches in the riverbed to avoid artificial drainage from the trench on the ground towards the riverbed.
15. Regarding irrigation channel crossings, they should be buried at the adequate depth, which is 1 m below the bottom of the irrigation channel.
16. Bed material can be replaced by granulate matter, which has to be already on the site before trenching in order to cover the pipes as soon as they are laid in the watercourse. The use of fine gravel as backfill material must be restricted to the trenches.

The Environmental Protection Plan has also taken into consideration some measures to reduce the undesired effects during the construction of the materials yard. Some of such measures were the following:

<u>General measures</u>

1. Traffic will be only allowed through places and access roads identified in the construction site, according to the Working Area that will be determined before work begins.
2. It is mandatory to protect signs and billboards and comply with their instructions regarding hygiene, safety and environment.
3. Sanitary installations will be built according to Law No. 19,587 and its regulations, and they will be kept perfectly clean and operational at all times. According to the construction size and the number of workers, the project will have to comply with Chapter 3 of the above-mentioned Law – Decree 351/79 and Executive Order 1,338/96.
4. Liquid effluents will be treated before final disposal in a septic tank and a cesspit.
5. The septic tanks will be built in such a way that liquid effluents will not pollute underground water. As long as the camp is in place chlorine will be added to these installations, handling that substance with care.
6. Smoking, lighting fires, and using anything that might start a fire will be strictly forbidden in those areas where flammable products are stored, handled, loaded, unloaded, transported, manufactured or treated.
7. Personnel must not proceed to the working area carrying cigarettes, matches and/or lighters.
8. Personnel must not proceed to the working area carrying alcoholic beverages and/or medicines of any kind.
9. Personnel must not prepare meals employing fire, except in specifically authorized areas.
10. Personnel must not proceed to the working area or to the Field carrying firearms or sharp objects that could be used as weapons, with the exception of the security personnel.
11. Personnel must not use volatile and/or flammable products –such as gasoline, naphtha, solvents and kerosene– to clean garments, equipment or tools.
12. Keeping animals, on a permanent or temporary basis, and/or feeding wild or domesticated animals even with leftovers, is strictly forbidden.
13. The provincial authorities must be notified of any unexpected archaeological, historical or paleontological findings.
14. Crossroads, installations and control areas will be clearly identified with signs.

15. Rubble should be disposed of in an adequate site that will be backfilled in horizontal layers that will not exceed the elevation of the surrounding terrain, ensuring proper drainage and protecting it from erosion.
16. Coarse material will be covered with fine soil to form a relatively even surface.
17. When the construction works are completed all the rubble and large build-ups will be cleared in order to leave the place neat and ready to be used for other purposes.

Specific measures

1. During yard operation, non-toxic waste will be taken to burn pits, whereas waste considered to be toxic will be transported to a safe end disposal site in compliance with municipal and provincial regulations.
2. Felled shrubs must be adequately kept to minimize the risk of fire. Storing dry branches in the area should be avoided because they are highly flammable, posing a risk for installations and the environment. In this regards it was suggested:
   - As the machines clear the site, spread the felled vegetation in situ; this will foster its natural degradation and will supply nutrients and organic matter to the soil.
   - Burn the felled vegetation in Capex's burn pit (in windless days and under proper supervision)
3. During the construction of the materials yard personnel appointed by the operators or by whoever is accountable for the construction will conduct an Environmental Audit. The auditor/s will work closely with the staff in charge of the technical considerations of the construction works, checking every item contained in the Environmental Protection Plan.
4. A Chief of Safety will be in the site at all times to carry out all the functions related to industrial safety and occupational health during the whole construction stage, in compliance with Law No. 19,587 and Decree 351/79 and Executive Order 1,338/96.
5. If quarry areas should be established to obtain construction material (borrow pits of sand, gravel, stone, etc.), these will be chosen after analyzing different alternatives.
6. In that case, the topsoil (organic soil) removed from a borrow pit will be piled and protected with a plastic cover to be used in backfilling.
7. When the quality so allows, felled material will be used as backfill or as construction material, to minimize the need of resorting to other sources and to cut down financial and environmental costs.
8. Wasted felled material must not be stacked up. Such waste will be taken to sites previously defined in the project design and disposed of adequately to avoid landslides, diking or other environmental problems.
9. In case borrows or quarries are required, the excavation sites will be out of sight from the road.
10. All excavations will have proper drainage to avoid water collection, except when local authorities request otherwise.
11. Once the works are over, the borrow pits will be adapted to the surrounding topography by means of embankments 2:1 (H:V) with rounded upper edges so that the embankments pose no risks to people and animals and vegetation may root.
12. The bottom of the excavations will be given adequate slopes to ensure water runoff towards the natural drainage ways in the terrain.

Environmental Monitoring Plan

The main purpose of the Monitoring Plan was to verify that the proposed mitigation measures are enough and effective to control every potential impact identified in the EIA. In this regard, an Environmental Audit was conducted during the construction phase of the plant.

The Environmental Audit was conducted by those appointed by the operators accountable for the construction. The auditor worked closely with the staff in charge of the technical considerations of the construction works, checking every item contained in the EPP.

This audit allowed the necessary adjustments to the mitigation measures defined.

Capex S.A. continues monitoring emissions, discharges, waste and noise in the plant, according to the requirements established by Resolution 182/95 of the Secretariat of Energy and by Resolution 207/98 (August 1998) of the Ente Provincial de Agua y Saneamiento (Provincial Body for Water and Sanitation).

SECTION G. Stakeholders' comments

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

Stakeholder comments were collected during the second half of 2005, under the adage "Our commitment with the Environment."

A survey was performed, by sending a questionnaire to stakeholders representing the interests of the local community (represented by high school), municipal, provincial and national governmental authorities, sectoral associations, and local and national ONGs. The list of people consulted is given below.

1. Dr. Alberto Natale, National Congress.
2. Ricardo Martínez Leone, ENRE (Electricity Regulation National Entity).
3. Sabino Mastrángelo, CAMMESA.
4. Prof. Pilar Gómez, Plottier Municipality.
5. Adriana Kowalewski, AGEERA (Argentina Electricity Generators Association).
6. Walter Schmale, IAPG (Argentine Institute of Oil and Gas).
7. Arturo Acevedo, CEADS (Argentine Business Council for the Sustainable Development).
8. Javier Corcuera, FVSA (Argentine Wildlife Fund).
9. Patricio Sutton, Fundación Cruzada Patagónica.
10. Horacio de Beláustegui, Fundación Biósfera.
11. Students, EPET Nº 9, Plottier.

The survey addressed the following questions:

1. What is your opinion about climate change and the mechanism of the Kyoto Protocol to mitigate it?
2. In relation to your knowledge about environmental matters, please provide a brief opinion about the Capex S.A. – *Agua del Cajón* Thermal Power Plant – Open to Combined Cycle Conversion Project.
3. Would you recommend to private companies and government authorities to develop projects of this kind?
4. Do you think that the Capex S.A. – *Agua del Cajón* Thermal Power Plant – Open to Combined Cycle Conversion Project is contributing to sustainable development of the region and the country?
5. Provide additional comments, if necessary.

The results of the survey are shown in Section G.2.

As a complementary activity, Capex organized a drawing competition among pupils of 5th grade of elementary schools of Plottier. Capex invited the twelve elementary schools of Plottier (around 500 pupils) to participate in this competition and attend an award ceremony. Capex handed over workbooks on climate change issues for teachers, delivered training lectures at schools, invited pupils to visit the power plant, and organized the competition and ceremony.

These activities are contributing to create public awareness in an early stage of education.

G.2. Summary of the comments received:

The comments are summarized in table form below.

Person	Question 1	Question 2	Question 3	Question 4	Question 5
Alberto Natale	Concerned about climate change. Supporting flexibility mechanisms.	Supporting the proposed project activity.	Supporting the kind of activity.	The project contributes to sustainable development.	
Ricardo Martínez Leone		Capex S.A. is complying with the applicable regulations to pollutant emissions as verified by ENRE.	The project can incentive other actors of the WEM to follow a similar path.	The project highly contributes to sustainable development of the region and the country.	The recent creation of the Argentine Carbon Fund strengthen Capex presentation.
Sabino Mastrángelo	Concerned about climate change. Supporting flexibility mechanisms.	Supporting the proposed project activity.	Supporting the kind of activity.	The project contributes to sustainable development.	Supporting the proposed project activity.
Pilar Gómez	The support to the project has been given through the declaration of the outreach activity carried out by Capex as “Public Good” (Plottier, 3 November 2005).				
Adriana Kowalewski	Concerned about climate change. Supporting flexibility mechanisms.	Supporting the proposed project activity.	Supporting the kind of activity.	The project contributes to sustainable development. Employment concerns.	Argentina is one of the countries with the lowest CO_2 emissions per MWh in the world.
Walter Schmale	Concerned about climate change. Following closely flexibility	Supporting the proposed project activity.	Supporting the kind of activity.	The project contributes to sustainable development.	Argentina and Capex are showing their leadership on environmental matters.

	mechanisms.				
Arturo Acevedo	Concerned about climate change. Supporting flexibility mechanisms.	Supporting the proposed project activity.	Supporting the kind of activity.	The project contributes to sustainable development.	
Javier Corcuera	Concerned about climate change. Supporting flexibility mechanisms on a case-by-case basis.	Supporting the proposed project activity.	Supporting the kind of activity, if socio-economic aspects are safe warded.	The project contributes to sustainable development. It is in line with the International Campaign "Power Switch!" of the WWF.	Recognizing the environmental values of Capex, as showed by Capex's initiative on hydrogen production from wind energy.
Patricio Sutton	Concerned about climate change. Supporting flexibility mechanisms, although they are not enough.	Supporting the proposed project activity.	Supporting the kind of activity. Suggesting more involvement of the Government.	The project contributes to sustainable development. Recommending also renewable sources.	Expressing a regional concern if this kind of activities are not promoted.
Horacio de Beláustegui	CDM is an appropriate tool to mitigate climate change.	Supporting the proposed project activity.	Supporting the kind of activity.	The project contributes to sustainable development and to a cleaner energy generation and reduces fossil fuel consumption.	Highlighting the relevance of private sector involvement.
Students	Concerned about climate change.	Supporting the proposed project activity.	Supporting the kind of activity. Requesting more involvement of the private sector.	The project contributes to sustainable development.	Requesting access to public information. Proposing public awareness campaigns taking into account the Env. Statement of Plottier.

Note: Light yellow stands for issues to be attended; due account of them is commented in Section G.3.

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

All the comments received expressed the good predisposition of people with respect to the project.

As a consequence of the comments received by high school students to the above-mentioned survey, a motivation arose for developing an outreach activity in line with the environmental concerns of Capex S.A. Students showed a great concern about public consciousness campaigns.

The award ceremony and closure of this outreach activity will be held on November 24nd 2005 in the sport gymnasium of the Spanish Center Club of Plottier, with the expected participation of the mayor of Plottier (Pilar Gómez), the Director of Environment and Sustainable Development of the Province of Neuquén (José Sierra), a renowned artist (Iván Moricz Karl), and pupils and teachers of the attendant schools. These people are the proposed jury of the drawing competition and granted the awards to the selected works. The Municipality of Plottier has declared this outreach activity as a Public Good Event (Declaration Nº 028/05, Concejo Deliberante de Plottier, 3 November 2005).

In relation to employment concerns, the project has created, during its development stage, 200 direct and indirect jobs. Since the thermal power plant became commercially operational, 17 additional permanent jobs were created.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	CAPEX S.A.
Street/P.O.Box:	Av. Córdoba 948/950, 5th floor “C”
Building:	
City:	Buenos Aires
State/Region:	
Postfix/ZIP:	Zip code: C1054AAV
Country:	Argentina
Telephone:	(54 11) 4796 6000
FAX:	
E-Mail:	
URL:	http://www.capex.com.ar
Represented by:	
Title:	Commercial and Legal Director
Salutation:	Esq.
Last Name:	Cabral
Middle Name:	Aníbal
First Name:	Hugo
Department:	Commercial and Legal
Mobile:	
Direct FAX:	(54 11) 4796 6077
Direct tel:	(54 11) 4796 6071
Personal E-Mail:	hcabral@capex.com.ar

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding is involved in this project activity.

Annex 3

BASELINE INFORMATION

Fuel emission factors

Fuel	Emission factor
Natural gas	1.95 $kgCO_2/m^3$
Fuel oil	3.17 $kgCO_2/kg$
Gas oil	3.16 $kgCO_2/kg$
Coal	2.58 $kgCO_2/kg$

Thermal power plants in the WEM grid and their corresponding heat rates

Unit name	Type	Capacity (MW)	Heat rate (kcal/kWh)
ACAJTG01	GT	46.1	2,676
ACAJTG02	GT	46.1	2,676
ACAJTG03	GT	46.1	2,676
ACAJTG04	GT	46.1	2,676
ACAJTG05	GT	46.1	2,676
ACAJTG06	GT	130	2,562
ACAJTV07	ST	285	0
ACAJCC	CC	645.5	1,808
AESPTG01	GT	263	1,920
AESPTG02	GT	263	1,920
AESPTV01	ST	319.3	0
AESPCC01	CC	845	1,508
AFENTG01	GT	43.8	2,216
APARTVA	ST	150	2,800
ARGETG01	GT	171.7	1,381
ATUCNUCL	NU	357	2,840
AVALTG21	GT	16	3,600
AVALTG22	GT	25	3,200
AVALTG23	GT	25	3,200
AVALTV11	ST	15	0
AVALTV12	ST	15	0
AVALCC	CC	80	2,150
AZAPTVA	ST	40	4,126
BARRTG21	GT	9	5,000
BARRTG22	GT	13	4,500
BARRTG23	GT	13	4,600
BARRTG24	GT	12	4,500
BARRTG25	GT	13	4,500
BARRTV	ST	25	3,900
BBLATV29	ST	310	2,300
BBLATV30	ST	310	2,300
BSASTG01	GT	218.5	2,368

BSASTV01	ST	103.1	0
BSASCC	CC	322	1,603
CALCTV11	ST	30	2,950
CATATG21	GT	13	3,800
CDPITG21	GT	14	3,800
CEPUTG11	GT	258	2,409
CEPUTG12	GT	258	2,409
CEPUTV10	ST	282	0
CEPUCC01	CC	798	1,487
CORRTG21	GT	10	4,700
COSTTG08	GT	263.3	2,187
COSTTG09	GT	263.3	2,187
COSTTV01	ST	123	2,211
COSTTV02	ST	113.6	2,325
COSTTV03	ST	112	2,191
COSTTV04	ST	120	2,190
COSTTV06	ST	350	2,111
COSTTV07	ST	310	2,148
COSTTV10	ST	323.5	0
COSTCC01	CC	851	1,486
CVARTV	ST	1.4	9,999
CVISTV	ST	1.2	9,999
DFUNTG01	GT	16	3,660
DFUNTG02	GT	16	3,660
DFUNTV	ST	33	3,000
DIQUTG01	GT	16	3,600
DIQUTG02	GT	16	3,600
DIQUTG03	GT	15	3,600
DIQUTG04	GT	14	3,600
DSUDTG07	GT	36	3,000
DSUDTG08	GT	36	3,000
DSUDTG09	GT	249	2,020
DSUDTG10	GT	246.2	2,154
DSUDTV11	ST	287.6	0
DSUDCC01	CC	798	1,528
ELOMTG01	GT	15	1,631
EMBANUCL	NU	648	2,704
ENSETG01	GT	128	1,475
FILOTG01	GT	21.2	3,200
FILOTG02	GT	20.8	3,200
FILOTG03	GT	21.3	3,200
FORMTG21	GT	13	4,700
FRIATG21	GT	13	3,800
FRIATG22	GT	13	3,800
GEBATG01	GT	218.7	2,347
GEBATG02	GT	218.7	2,347

GEBATV01	ST	236.2	0
GEBACC	CC	674	1,524
GOYATG21	GT	13	4,100
GUEMTV11	ST	64.5	2,505
GUEMTV12	ST	64	2,464
GUEMTV13	ST	135.9	2,284
INDETG21	GT	10	4,400
INDETG22	GT	17	3,500
INDETV14	ST	25	3,050
INDETV15	ST	25	3,050
LBANTG21	GT	13	4,100
LDCUTG21	GT	27	3,585
LDCUTG22	GT	27	3,585
LDCUTG23	GT	24.8	2,990
LDCUTG24	GT	24.8	2,990
LDCUTG25	GT	197	3,962
LDCUTV11	ST	60	2,638
LDCUTV12	ST	60	2,667
LDCUTV14	ST	30	0
LDCUTV15	ST	92.3	0
LDCUCC01	CC	84	2,173
LDCUCC02	CC	290	1,560
LDLATG01	GT	125	2,550
LDLATG02	GT	125	2,550
LDLATG03	GT	125	2,550
LEDESMA	ST	36.2	2,800
LEVATG01	GT	23	3,574
LEVATG02	GT	23	3,603
LRIODI	DI	4	3,059
LRIOTG21	GT	13	4,000
LRIOTG22	GT	12	4,100
MDAJTG15	GT	15	3,900
MDAJTG17	GT	15	4,000
MDPATG12	GT	16	3,712
MDPATG13	GT	24	3,379
MDPATG19	GT	15	3,569
MDPATG20	GT	15	3,705
MDPATG21	GT	25	3,451
MDPATV07	ST	27	2,830
MDPATV08	ST	29	2,849
MMARTG01	GT	32	2,250
MMARTG02	GT	32	2,250
NECOTV01	ST	32	2,760
NECOTV02	ST	32	2,760
NECOTV03	ST	70	2,499
NECOTV04	ST	70	2,421

NIDETG	ST	7	3,619
NPUETV04	ST	30	3,895
NPUETV05	ST	110.7	2,396
NPUETV06	ST	253.8	2,181
PALPTG21	GT	17	3,800
PALPTG22	GT	13	4,500
PDMETG02	GT	17	3,500
PDMETV01	ST	33	4,300
PHDZTG01	GT	16.9	2,385
PHDZTG02	GT	19	2,385
PHUITG01	GT	36.8	2,724
PILATV01	ST	31.2	2,914
PILATV02	ST	30.4	2,914
PILATV03	ST	70.8	2,626
PILATV04	ST	70.4	2,637
PNUETV07	ST	146.4	2,388
PNUETV08	ST	194.8	2,391
PNUETV09	ST	253.8	2,176
PPNOTG01	GT	116.1	2,600
PPNOTG02	GT	116.1	2,600
RCUATG01	GT	16	3,700
RCUATG02	GT	16	3,700
ROCATG01	GT	124	2,527
SALTTG21	GT	10	4,450
SARCTG21	GT	10	4,400
SARCTG22	GT	10	4,400
SARCTG23	GT	10	4,400
SARNTG22	GT	10	4,400
SCATTG22	GT	14	4,500
SCATTG23	GT	13	4,500
SFOETG21	GT	20	3,800
SFOETG22	GT	20	3,600
SFRATG01	GT	16	3,800
SFRATG02	GT	23	3,605
SHELTVDS	ST	22.1	0
SMTUTG01	GT	111.9	2,617
SMTUTG02	GT	117.2	2,567
SMTUTV01	ST	151.5	0
SMTUCC01	CC	382	1,725
SNICTV11	ST	75	2,724
SNICTV12	ST	75	2,800
SNICTV13	ST	75	2,735
SNICTV14	ST	75	2,900
SNICTV15	ST	350	2,144
SOESTG01	GT	20	3,600
SOESTG02	GT	30	3,600

SOESTG03	GT	30	3,600
SOESTG04	GT	20	3,600
SORRTV11	ST	27	3,700
SORRTV12	ST	30	3,100
SORRTV13	ST	155	2,450
SPEDTG21	GT	19	3,550
SPEDTG22	GT	7	4,500
TUCUTG01	GT	144	2,552
TUCUTG02	GT	144	2,552
TUCUTV01	ST	159	0
TUCUCC01	CC	446	1,757
VGESTG11	GT	14	3,700
VGESTG16	GT	14	3,850
VMARTG01	GT	16	3,650
VMARTG02	GT	16	3,650
VMARTG03	GT	16	3,650

Combined margin calculation

The following Table shows the integrated results obtained from the dispatch data analysis calculation of the operating and build margin emission factors.

year	PG_y (MWh/y)	Avoided CO_2 OM (tCO_2/y)	$EF_{OM,DispatchData,y}$ (tCO_2/MWh)	$EF_{BM,y}$ (tCO_2/MWh)	$EF_{grid,y}$ (tCO_2/MWh)
17/01/00–31/12/00	4,774,009	1,980,694	0.41489	0.44221	0.42855
2001	4,407,728	1,774,760	0.40265	0.36745	0.38505
2002	4,004,162	1,182,056	0.29521	0.31126	0.30323
2003	4,738,157	1,435,027	0.30287	0.33365	0.31826
2004	4,506,173	1,325,891	0.29424	0.38090	0.33757
2005	3,352,701	911,579	0.27189	0.33347	0.30268

- Average Dispatch Data Analysis OM Emission Factor = 0.33029 tCO_2/MWh
- Average BM Emission Factor = 0.36149 tCO_2/MWh

Build margin power plants

The capacity additions to WEM and fuel consumption in the period 2000-2005 are showed in the following Table. The last five power plants installed in the system never cover more than 20% of the total grid generation. Thus, the power plants included in the Table are those that cover at least the 20% of total grid generation.

year	Power Plant	Type	Capacity (MW)
2003	Queb. de Ullum	H	45
2002	Cacheuta Nueva	H	120
2002	El Carrizal	H	17
2002	Pluspetrol Norte	GT	232

2001	AES Paraná	CC	845
2001	CT San Miguel de Tucumán	CC	382
2000	Dock Sud	CC	798
2000	Entre Lomas	GT	15
1999	Central Puerto	CC	798
1999	CT Tucumán	CC	446
1999	Pichi Picún Leufú	H	285
1998	Costanera	CC	851
1997	Genelba	CC	674
1997	Buenos Aires	CC	322

Specific baseline data and calculations are included in the spreadsheet “Emission_Reductions_2000-2005-v2.xls”.

Annex 4

MONITORING PLAN

Background

Capex's Combined cycle

The generation of electricity from Capex's Combined Cycle Project comes from two different types of units. The generation from the gas-fired turbo-generator units —Gas Turbines (GT), one Westinghouse 701 D and five Westinghouse 251 B, for an aggregate amount of 360.5 MWh and the generation from the Steam Turbine (ST) seven (Mitsubishi). The ST generates electricity in its primary stage for an aggregate volume of 185 MW without using fuel, and taking advantage of the exhaust gases of the other units through a recovery boiler whose gases are then used to produce energy for the ST. On a second stage, with supplementary gas-fired boilers, the ST can generate 100 additional MW. The Primary generation stage of the ST does not produce CO_2 emissions.
Considering that the dispatch system in Argentina is based on the ranking of the marginal cost informed by each unit to CAMMESA, the entrance of the ST 7 into the Wholesale Electricity Market caused that the generation of the ST displaces the generation of certain thermal units in average. These displaced units would have produced CO_2 emissions. For the above explained reasons, each MWh generated by Capex ST means that a certain quantity of CO_2 was not emitted.

CAMMESA

There is an entity which regulates the electricity market in Argentina: CAMMESA. In this market CAMMESA dispatches units according to their declared marginal cost. The cheaper unit goes first.

Purpose

The purpose of this monitoring plan is to calculate, taking into account the generation and dispatch hourly data provided by CAMMESA, what quantity of CO_2 is not emitted thanks to the Capex Combined Cycle.

Source of the data[33]

The data used in these calculations comes from different sources, mainly CAMMESA, the Secretariat of energy, the Argentina Second National Communication to the UNFCCC, and IPCC. In all cases the most conservative approach is considered.

CAMMESA dispatch reports

In order to calculate the emissions for each hour the dispatch information of the power system is required. This information is provided by CAMMESA.

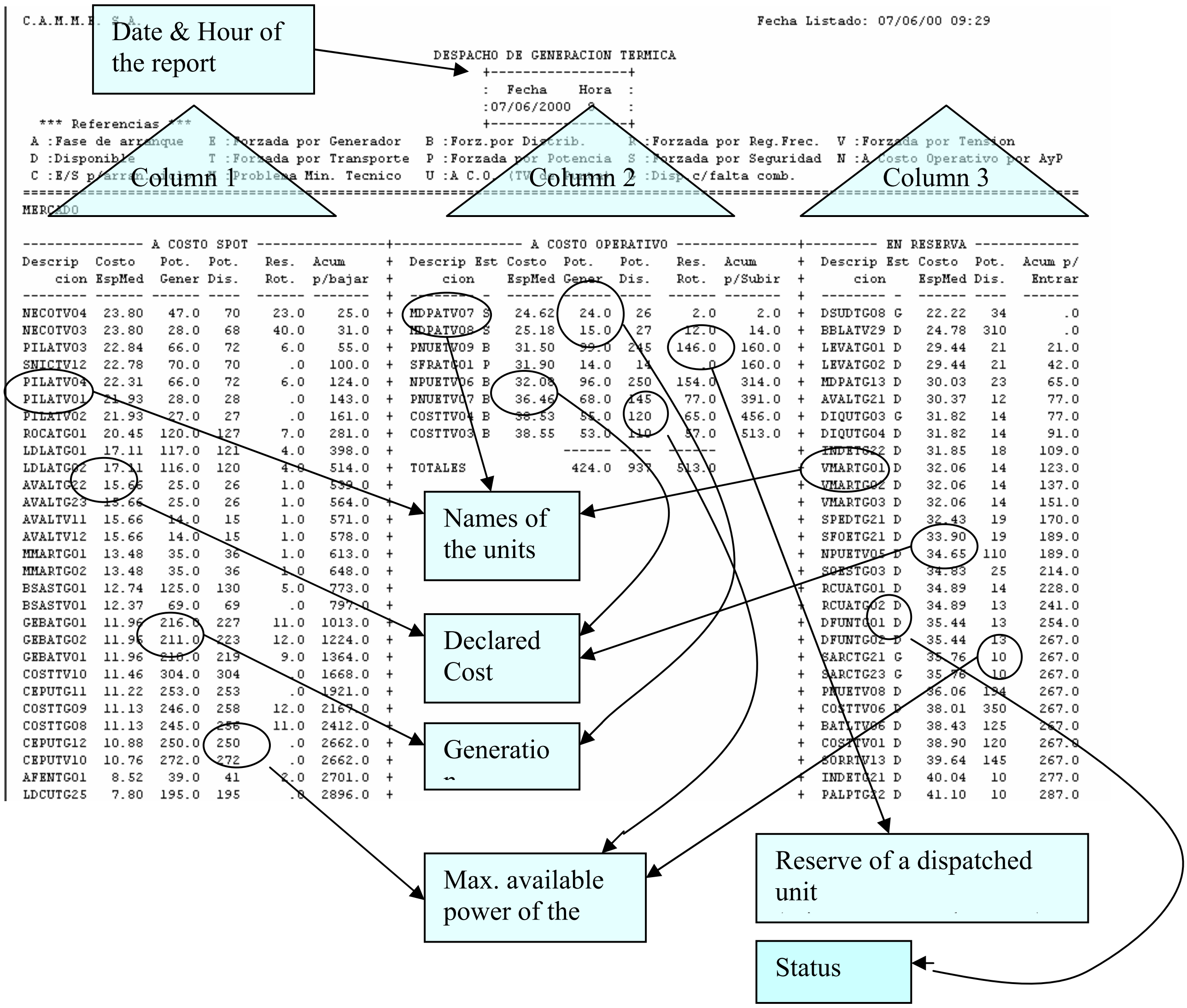
CAMMESA provides an hourly-based report for each unit, every day.

As an example two of them have been taken for thermal plants, as shown below.

[33] Publicly available at: http://memnet2.cammesa.com/inicio.nsf/marcomemnet.

The Thermal Generation Dispatch Report and Hydroelectric Dispatch Report: which show the real dispatched units for each hour, the units which are at Operating Cost and the units that are in Reserve. The two reports have the same structure. They are tree main columns reports.

> **Column 1**: The units dispatched at spot prices. These are the units that are actually generating at the corresponding hour.
> **Column 2**: The units dispatched at operating cost. These units have remaining power. If the demand of the system increases, more energy can be taken from these units.
> **Column 3**: The units that are in reserve. This means that this units are shut down but could be available if required. This depends on the status column. The calculation method is not taking data from this column.



C.A.M.M.E. S.A. Fecha Listado: 07/06/00 09:29

DESPACHO DE GENERACION TERMICA

: Fecha Hora :
:07/06/2000 8 :

*** Referencias ***
A :Fase de arranque E :Forzada por Generador B :Forz.por Distrib. R :Forzada por Reg.Frec. V :Forzada por Tension
D :Disponible T :Forzada por Transporte P :Forzada por Potencia S :Forzada por Seguridad N :A Costo Operativo por AyP
C :E/S p/arran... M :Problema Min. Tecnico U :A C.O. (TV de Punta) :Disp c/falta comb.

MERCADO

A COSTO SPOT

Descripcion	Costo EspMed	Pot. Gener	Pot. Dis.	Res. Rot.	Acum p/bajar
NECOTV04	23.80	47.0	70	23.0	25.0
NECOTV03	23.80	28.0	68	40.0	31.0
PILATV03	22.84	66.0	72	6.0	55.0
SNICTV12	22.78	70.0	70	.0	100.0
PILATV04	22.31	66.0	72	6.0	124.0
PILATV01	21.93	28.0	28	.0	143.0
PILATV02	21.93	27.0	27	.0	161.0
ROCATG01	20.45	120.0	127	7.0	281.0
LDLATG01	17.11	117.0	121	4.0	398.0
LDLATG02	17.11	116.0	120	4.0	514.0
AVALTG22	15.66	25.0	26	1.0	539.0
AVALTG23	15.66	25.0	26	1.0	564.0
AVALTV11	15.66	14.0	15	1.0	571.0
AVALTV12	15.66	14.0	15	1.0	578.0
MMARTG01	13.48	35.0	36	1.0	613.0
MMARTG02	13.48	35.0	36	1.0	648.0
BSASTG01	12.74	125.0	130	5.0	773.0
BSASTV01	12.37	69.0	69	.0	797.0
GEBATG01	11.96	216.0	227	11.0	1013.0
GEBATG02	11.96	211.0	223	12.0	1224.0
GEBATV01	11.96	210.0	219	9.0	1364.0
COSTTV10	11.46	304.0	304	.0	1668.0
CEPUTG11	11.22	253.0	253	.0	1921.0
COSTTG09	11.13	246.0	258	12.0	2167.0
COSTTG08	11.13	245.0	256	11.0	2412.0
CEPUTG12	10.88	250.0	250	.0	2662.0
CEPUTV10	10.76	272.0	272	.0	2662.0
AFENTG01	8.52	39.0	41	2.0	2701.0
LDCUTG25	7.80	195.0	195	.0	2896.0

A COSTO OPERATIVO

Descripcion	Est	Costo EspMed	Pot. Gener	Pot. Dis.	Res. Rot.	Acum p/Subir
MDPATV07	S	24.62	24.0	26	2.0	2.0
MDPATV08	S	25.18	15.0	27	12.0	14.0
PNUETV09	B	31.50	99.0	245	146.0	160.0
SFRATG01	P	31.90	14.0	14	.0	160.0
NPUETV06	B	32.08	96.0	250	154.0	314.0
PNUETV07	B	36.46	68.0	145	77.0	391.0
COSTTV04	B	38.53	55.0	120	65.0	456.0
COSTTV03	B	38.55	53.0	110	57.0	513.0
TOTALES			424.0	937	513.0	

EN RESERVA

Descripcion	Est	Costo EspMed	Pot. Dis.	Acum p/ Entrar
DSUDTG08	G	22.22	34	.0
BBLATV29	D	24.78	310	.0
LEVATG01	D	29.44	21	21.0
LEVATG02	D	29.44	21	42.0
MDPATG13	D	30.03	23	65.0
AVALTG21	D	30.37	12	77.0
DIQUTG03	G	31.82	14	77.0
DIQUTG04	D	31.82	14	91.0
INDETG22	D	31.85	18	109.0
VMARTG01	D	32.06	14	123.0
VMARTG02	D	32.06	14	137.0
VMARTG03	D	32.06	14	151.0
SPEDTG21	D	32.43	19	170.0
SFOETG21	D	33.90	19	189.0
NPUETV05	D	34.65	110	189.0
SOESTG03	D	34.83	25	214.0
RCUATG01	D	34.89	14	228.0
RCUATG02	D	34.89	13	241.0
DFUNTG01	D	35.44	13	254.0
DFUNTG02	D	35.44	13	267.0
SARCTG21	G	35.76	10	267.0
SARCTG23	G	35.76	10	267.0
PNUETV08	D	36.06	194	267.0
COSTTV06	D	38.01	350	267.0
BATLTV06	D	38.43	125	267.0
COSTTV01	D	38.90	120	267.0
SORRTV13	D	39.64	145	267.0
INDETG21	D	40.04	10	277.0
PALPTG22	D	41.10	10	287.0

At the end of the report there is a note that says that this report is provisional. It says: “The information exhibited in this document will be confirmed with the post-operative report.”

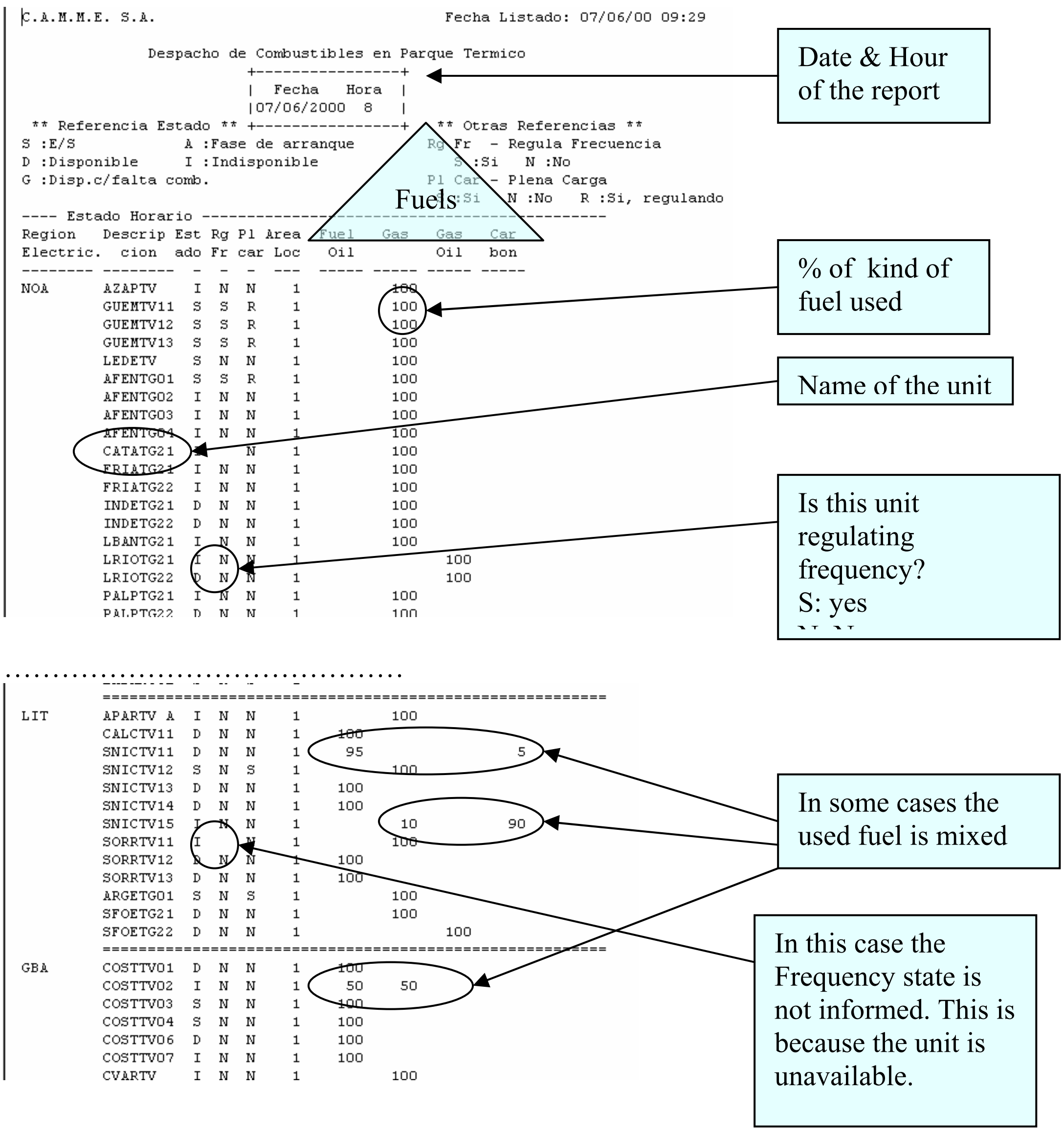
```
GUEMTV13   3.62  128.0  135     7.0  4214.6  +
ARGETG01    .00  170.0  170      .0  4384.6  +
ENSETG01    .00  128.0  135     7.0  4512.6  +
PHUITG01    .00   30.0   30      .0  4542.6  +
LDCUTG23    .00   23.0   23      .0  4565.6  +
LDCUTG24    .00   23.0   23      .0  4588.6  +
PHDZTG01    .00    4.0    4      .0  4592.6  +
LEDETV      .00    1.0    1      .0  4592.6  +
               ------- ----  ------
TOTALES         6246.0 6456   210.0
```

```
+  VGESTG11 D   92.86   15    509.0
+  MDPATG12 D   94.61   15    524.0
+  MDPATG19 D   94.61   14    538.0
+  MDPATG20 D   94.61   14    552.0
+  SFOETG22 D   94.75    0    552.0
+  VGESTG16 D   96.63   16    568.0
+  MALDTG01 D   97.63   20    588.0
+  MDAJTG15 D   97.82   15    603.0
+  MDAJTG17 D  100.33   15    618.0
+  LDCUTG21 D  104.13   23    641.0
+  SARCTG22 D  106.07   10    651.0
+  LRIOTG22 D  106.27   13    664.0
+  CDPITG21 D  113.46   13    677.0
                        ----
   TOTALES              2639
```

```
Nota:
-----
    La información exhibida en este documento será confirmada mediante el Parte de Control Post-Operativo correspondiente
```

This is because this report is intended to determine the order of dispatch. The final post-operative report has the confirmed data (price) of the dispatched units. There it is not any information about the units in reserve in that post-operative report. This is the best source of this kind of data.

The fuel dispatch report informs the kind of fuel declared to be used for each unit for each hour of the day (it obviously does not include the amount of fuel consumed).



```
C.A.M.M.E. S.A.                                   Fecha Listado: 07/06/00 09:29

              Despacho de Combustibles en Parque Termico
                                +----------------+
                                |  Fecha   Hora  |
                                |07/06/2000  8   |
 ** Referencia Estado ** +----------------+  ** Otras Referencias **
S :E/S            A :Fase de arranque        Rg Fr  - Regula Frecuencia
D :Disponible     I :Indisponible               S :Si   N :No
G :Disp.c/falta comb.                        Pl Car - Plena Carga
                                                S :Si   N :No   R :Si, regulando

---- Estado Horario --------------------------------------------------
Region   Descrip Est Rg Pl Area  Fuel  Gas   Gas   Car
Electric. cion   ado Fr car Loc   Oil         Oil   bon
-------- -------- -  -  -  ---  ----- ----- ----- -----
NOA      AZAPTV   I  N  N   1          100
         GUEMTV11 S  S  R   1          100
         GUEMTV12 S  S  R   1          100
         GUEMTV13 S  S  R   1          100
         LEDETV   S  N  N   1          100
         AFENTG01 S  S  R   1          100
         AFENTG02 I  N  N   1          100
         AFENTG03 I  N  N   1          100
         AFENTG04 I  N  N   1          100
         CATATG21 I     N   1          100
         FRIATG21 I  N  N   1          100
         FRIATG22 I  N  N   1          100
         INDETG21 D  N  N   1          100
         INDETG22 D  N  N   1          100
         LBANTG21 I  N  N   1          100
         LRIOTG21 I  N  N   1                100
         LRIOTG22 D  N  N   1                100
         PALPTG21 I  N  N   1          100
         PALPTG22 D  N  N   1          100
.........................................
         ====================================================
LIT      APARTV A I  N  N   1          100
         CALCTV11 D  N  N   1    100
         SNICTV11 D  N  N   1     95                      5
         SNICTV12 S  N  S   1          100
         SNICTV13 D  N  N   1    100
         SNICTV14 D  N  N   1    100
         SNICTV15 I  N  N   1           10               90
         SORRTV11 I     N   1          100
         SORRTV12 D  N  N   1    100
         SORRTV13 D  N  N   1    100
         ARGETG01 S  N  S   1          100
         SFOETG21 D  N  N   1          100
         SFOETG22 D  N  N   1                100
         ====================================================
GBA      COSTTV01 D  N  N   1    100
         COSTTV02 I  N  N   1     50    50
         COSTTV03 S  N  N   1    100
         COSTTV04 S  N  N   1    100
         COSTTV06 D  N  N   1    100
         COSTTV07 I  N  N   1    100
         CVARTV   I  N  N   1          100
```


MONITORING OF CO_2 EMISSIONS

The Commercial and Legal Department is in charge of supervising the implementation of the CDM monitoring plan. The System Division has developed the software to deal with CO_2 emission quantification and is running the numeric model to obtain the emission reductions achieved by the project every year.

<u>General description of the calculation method</u>

For each hour all units that were generating at that moment are considered and the units dispatched covering the greater of either the last 10% of the system generation or the project generation during hour *h* expressed as a percentage of the total grid generation for that hour are identified.

The total tonnes of CO_2 released for the percentage of generation mentioned above is obtained and divided by that percentage of generation.

The value obtained represents the emission factor for that hour, expressed in tCO_2/MWh.

Then the total generated by the project for that hour, PG_h, is considered and it is multiplied by the emission factor. The result shows the tonnes of CO_2 avoided by the project in that hour.

Build margin contribution is added to the above-mentioned value.

Procedure

The general procedure with the sequence of steps is detailed below. It does not necessarily represent a structure of the pseudo-code of the program. The implementation of which can vary due to language technicalities used and performance improvements.

Likewise the names of variables used here do not necessarily correspond to the ones used in the program and are only given in order to clarify the procedure.

Terminology:

Variable: Used for the cases in which a variable should be given.

FIELD: This is the way in which the database tables and their fields are presented.

Screen entry data: Period to be considered: Onset date and time, Ending date and time. Additionally other parameters can be showed such as the detailed level wanted from the list: daily or hourly totals, etc.

Steps

1- For every hour analyzed during the year (or period indicated)
   a. Obtain the total generation for that hour
   b. State the set (percentage) of displaced power plants as the greater of either the most expensive 10% out of the total of MW generated at that hour or the project generation during hour *h* expressed as a percentage of the total grid generation for that hour
   c. Estimate its emission factor for that percentage
   d. Calculate the CO_2 tonnes displaced by Capex project for that hour
2- Add the values calculated in the previous item for all the hours. Then, obtain the total tonnes of CO_2 displaced by the project in the analyzed period.
3- Divide the total tonnes of CO_2 produced during the year by the total energy generated by the project; this value is the "Operating Margin" Emission Factor for the analyzed year.
4- In the case of making annual reports, add to the "Operating Margin" the "Build Margin," calculated through:
   a. The selection of a set of power plants
   b. The calculation of the average annual emissions (tCO_2/MWh) of the set, considering in the numerator the emissions of the set (result of the efficiency times generation times fuel emission factor) being the divisor, the energy generated by the set in the period.

Each step in detail

The most complex steps, which may require clarification, are detailed below.

1-a) Obtain the hourly total generation

It follows a description of how to obtain the total energy generated at a predetermined hour.

Source of the data: Thermal Dispatch and Hydroelectric Dispatch Reports.

There are reports for each hour.

Each one of these two reports provides an orderly record, according to the operation costs, with the information of the units dispatched and in stock for the corresponding hour.

The reports state for each unit:

- Name of the unit
- Operation cost in the spot market (i.e. including transportation costs to the load center of the system)
- Energy generated

Procedure

The values of the row corresponding to the electric energy of the units dispatched (power generated) is summed, in terms of operation costs of the thermal and hydroelectric dispatch reports.

1-b) Determine the set of displaced power plants

Units are listed with its generated power (MW).

The power generated by each unit is considered to select the set (percentage) of displaced power plants as the greater of either the most expensive 10% out of the total of MW generated at that hour or the project generation during hour *h* expressed as a percentage of the total grid generation for that hour.

Usually the MW considered for the last unit in the merit order does not coincide with its generated power, so the necessary energy until the percentage is completed is considered.

Source of the data: Thermal Dispatch and Hydroelectric Dispatch Reports.

Procedure

A *working list* is made with all the units included in the thermal and hydroelectric dispatch reports, which have been already dispatched or are under operation cost. Non-dispatched units as well as the rotating stock is not included.

For each unit in the *working list* the dispatched power stated in the corresponding report and its cost are recorded.

The above-mentioned percentage of the total generation of the system is calculated. Total generation has already been calculated in item 1-a.

The *working list* is arranged according to the declared costs in a decreasing order. For a same cost, they are arranged in a decreasing order by their fuel emission coefficients.

The already arranged *working list* is revised and each unit is copied to an outcome list called *Top list*. This is done until the percentage calculated in the *Top list* is reached.

Here, in most cases, the outcome *Top list* is obtained with an accumulated energy value smaller than the percentage of generation necessary, since if the next unit with all its MW generated were entered into the percentage looked for, this percentage threshold should be surpassed.

In order to complete the remaining quantity of energy to reach the percentage of the total generation, the next unit is added to the outcome list with the total MW generated to overpass the percentage.

1-c) Calculate for this percentage the grid emission factor

The list of units and their MW, representing the percentage of the total system generation (calculated upon the *Top list* in the previous step), is considered.

For each unit in the list the CO_2 emission calculation is made and the result is added to the *Top list*.

Here the *Grid emission factor* of that hour is assigned as follows:

$$\text{Grid emission factor} = \frac{\Sigma\,(CO_2 \text{ emissions for each unit in the Top list})}{\Sigma\,(\text{MW associated to each unit in the Top list})}$$

CO_2 emissions calculation

The calculation of the actual emissions of a unit is described below.

The following variables are defined:

1. *Generation*: It shows the unit power generation at the hour under study or the MW necessary to reach the highest percentage or the MW produced at that hour until the most expensive percentage is completed.
   Source of the data: MW of the unit showed in the *Top list*.

2. *Fuel type percentage*: Percentages for each fuel type used by the unit at that hour.
   Source of the data: CAMMESA Fuel Dispatch Report.

3. *Fuel emission coefficient*: CO_2 tonnes released for each type of fuel per MW. It is estimated through these two variables:
   a. **Emission factor of each fuel type** ($kgCO_2$ per kg or m^3 of fuel)
      Source of the data: Second National Communication of the Republic of Argentina to the UNFCCC. Eventually, values by default from IPCC could be used; data obtained in joules so that they need to be converted using net calorific values of the fuels.

b. **Net calorific value (NCV) by fuel type** (kcal per kg or m^3 of fuel)
Source of the data: National Inventory of GHG of the Republic of Argentina.

4. Heat rate (kcal/kWh): It is the heat rate declared for each unit. It is published by CAMMESA. The efficiencies declared are smaller than the real ones, representing therefore, conservative values.
The table in which the heat rate is recorded has an "*In force date*" label, since efficiency may vary in time. Data is taken form CAMMESA report.
Source of the data: Seasonal Programming and Re-programming for each quarterly period published by CAMMESA during the period considered: "Base de datos estacional – Oferta energética – Térmica – Datos de grupos térmicos."

Therefore, the tonnes released by a unit at that hour is calculated as follows:

Total tonnes of CO_2 of the unit =
(*Generat.* × *% comb. 1* × *Em. factor comb. 1* × *Heat rate / NCV comb. 1* × *Oxid. factor comb. 1*)
+ (*Generat.* × *% comb. 2* × *Em. factor comb. 2* × *Heat rate / NCV comb. 2* × *Oxid. factor comb. 2*)
+ …
+ (*Generat.* × *% comb. N* × *Em. factor comb. N* × *Heat rate / NCV comb. N* × *Oxid. factor comb. N*)

where 1,2,…,N stand for the possible fuels used.

Calculation of CO_2 displaced by Capex project for that hour

For that hour the MW generated by Capex project are multiplied by the *Grid emission factor* at that hour (calculated in the previous item).

To that effect, the following variables are defined:

Capex Project Unit: It is the complete power plant, where the units are identified by "ACAJTG01 to 06" and "ACAJTV07" initials.
Steps: The energy generated by the *Capex Project Unit* is taken from the thermal dispatch report for that hour.
The CO_2 emissions generated by the project are calculated as follows:

Capex Project tonnes of CO_2 = *Power generated by the Project* × *Grid emission factor*

System output

The system will generate an output in a spreadsheet, which according to the degree of details required, will show the following data:

If the maximum degree of detail is required, it will show a record for each hour of the period and for each unit dispatched at that hour with the following rows:

- Type of record: "Detail"
- Date
- Hour
- Identification of the unit dispatched or under operative cost in that hour
- Generation [MW] of the unit showed on the records

- Operation cost of the unit
- Generation [MW] of the unit taking part in the calculation of the higher percentage mentioned above; if the unit did not take part, no value is shown
- Heat rate of the unit recorded
- % of natural gas used by this unit
- Natural gas emission factor converted to the unit used by the system
- % of fuel oil used by this unit
- Fuel oil emission factor converted to the unit used by the system
- % of Diesel used by this unit
- Diesel emission factor converted to the unit used by the system
- % of coal used by this unit
- Coal emission factor converted to the unit used by the system
- CO_2 emissions calculated for this unit, if it participated in the calculation of the most expensive top generation.

In addition, for each hour there will be a summery record that will show the following rows:

- Type of record: "Total per Hour"
- Date
- Hour
- Total power generated by the system for that hour
- Grid emission factor estimated for that hour
- Energy generated by Capex project unit
- Avoided CO_2 emissions, resulting from the calculation

The report should include the content of points 4 to 7 of the "Procedure" of the "General description of the Calculation Method" detailed above, concerning the "Build Margin".

Assumptions and method accessories

- For the time being the Patagonia system will not be considered within the system, since it does not have a relevant physical connection with the SIN (anyway, it is considered by CAMMESA for the dispatch of the generating units). Once it becomes part of the SIN the situation will be evaluated and it will be incorporated if necessary.
- Local prices situations are not considered.
- Special considerations for exports and imports will not be made. Units that export energy or machines from abroad from which energy is imported appear in CAMMESA reports, which are incorporated in the same way than the remaining units. For units from abroad (imports), it is considered that they do not generate CO_2 emissions.
- To determine the top percentage the merit order is considered, even when the machine has a forced dispatch.
- If there are two units at the same cost the unit with the lower CO_2 emissions will be left out.
- Hydropower plants are processed by the cost shown in the corresponding CAMMESA report.
- For the dates in which values are not found, it will be assumed that no unit has been displaced, thus the avoided CO_2 emissions will be zero.

Summary of system features

- 9i Oracle database

- Microsoft.Net programming
- Customer/Server Windows display
- Inclusion of reports through databases sent by CAMMESA
- System output in spreadsheet format

MONITORING OF SUSTAINABLE DEVELOPMENT INDICATORS

Environment

Periodic monitoring of pollutant emissions (particulate matter, NOx, etc.) are performed as requested by ENRE. The Operation Department of the Agua del Cajón power plant is responsible for performing measurements and recording data on emission levels. It is also a part of the Environmental Monitoring Plan recommended in the Environmental Impact Assessment and is embedded into the ISO 14001 standard. Internal auditing is performed every year.

Water analysis are also performed. Thermal water was found and preserved.

A plan for improving external infrastructure (ways, land use, etc.) is under execution. New areas are afforested in order to preserve vegetation.

Social

A close relation with the community is kept to create public awareness and inform people about the power plant features and environmental issues. Labor conditions are monitored and job generation and healthy conditions are recorded. However, these variables are almost not affected by the project activity in the current stage of development.

Economic

The project implementation brings economic benefits for the government through taxes set up for the activity. The Accounting and Finance Department is recording the revenues derived from the project from data on electricity sales.

- - - - -