An Alternative Baseline Methodology for the Power Sector

- Taking a Systemic Approach

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PREFACE

This thesis was initiated out of curiosity. A curiosity that is directed towards the development of mitigation options and political decisions in the field of climate change in general and the *Clean Development Mechanism* (CDM) in specific.

The field of international cooperation on climate change is in constant development; most notably with the *Kyoto Protocol* entering into force 16 February 2005 in the middle of our study and latest with *The Greenland Dialogue* meeting held in August 2005 to discuss the international future strategy of climate policies. Both events put our work into perspective and have further fuelled our interest in this important issue.

We have chosen to look further into evaluating methodologies for projects under the CDM, the so called baseline methodologies, because it is an emerging field for all stakeholders involved. It is however a complex issue, which will, unfortunately, be reflected in this report. There are many definitions and terms with which the reader must be familiar. We have sought to ease this fact by a gradual introduction to the necessary issues, by cutting away issues that are not strictly related to the topic of this study and finally by making a list of definitions and abbreviations that can be found in the beginning of the report.

The report is written in English both in order to enable our friends in the research institute Fundación Bariloche, Argentina, to read our findings, but also because it is our hope to contribute to and sustain the essential international debate on developing the CDM.

We are very thankful to our supervisor Associate Professor, Dr. Tech. René Victor Valqui Vidal for introducing us to systemic thinking and for inspiration and fruitful conversations during our entire learning process from idea to final thesis.

Further we would like to express our warm thanks to Senior Energy Planner, Lic. in Economics Daniel Hugo Bouille. First of all for giving us the opportunity to be an integrated part of Fundación Bariloche while doing our field research in Argentina. And secondly for discussions on baseline methodologies and for supervising us in our case study on forecasting the trends in the Argentinean power sector. We hope that the findings in the study can be of use for the institute.

In this connection we are also grateful to a number of other employees in Fundación Bariloche and the many experts of the Argentinean power sector that we got a chance to interview despite their tight schedules.

Finally we would like to thank Senior Energy Planner Jørgen Fenhann from UNEP Risoe Centre on Energy, Climate and Sustainable Development for establishing the contact to Fundación Bariloche, rewarding conversations, and for answering some very detailed technical questions.

Copenhagen, 20 September 2005.

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ABSTRACT

The objective of this study is to contribute to the process of improving the ACM0002 baseline methodology used to quantify emission reductions achieved through the implementation of renewable power technologies under the Clean Development Mechanism (CDM).

Through a systemic analysis of the ACM0002 and its context, it is shown that this baseline methodology is facing a multitude of interrelated problems, divided on all elements of the methodology. These are proven complicated to manage under the present project-by-project approach.

It is furthermore shown that a sector baseline methodology holds the potential for managing several of the identified problems.

A sector approach is therefore adopted, based on both the estimated implementation of technologies and calculation methods of the ACM0002.

For this purpose two forecasting methods are identified, namely the Delphi and the Scenario Forecasting method, the latter being a multivariate qualitative method developed from principles of both forecasting and scenario methodologies.

Through the application of these methods in a case study in the Argentinean power sector, it is shown that this sector approach can potentially solve several of the identified problems inherent in the ACM0002. On the contrary the methods are time-consuming to perform, and furthermore set some higher demands for both expert assistance and availability of information than the ACM0002.

The time consumption is proposed reduced through minimising the analyses included in the Scenario Forecasting method, but it is uncertain whether this is sufficient to make this approach practicable. More empirical experience is therefore needed to evaluate the true potentials of the proposed baseline methodology.

Through expanding the boundaries for the study it is further discussed that future political choices, regarding managing uncertainty, increasing capacity development and taking into account sustainable development, are necessary parts of a viable alternative baseline methodology and should be seen as an integral part of the improvement process of the ACM0002.

Keywords:
ACM0002 baseline methodology, sector approach, forecasting, power sector, case study, systemic thinking.

RESUME

Formålet med dette studie er at bidrage til den kontinuerlige forbedring af ACM0002 baseline metodologien, som bruges til at kvantificere emissionsreduktioner opnået gennem implementering af vedvarende energiteknologi-projekter til el-produktion under CDM.

Gennem en holistisk og systemisk analyse af ACM0002 og dens kontekst bliver det påvist, at baseline metodologien står over for en lang række sammenhængende problemer, som er fordelt på alle elementer af metodologien. Gennem en evaluering bliver det konstateret, at disse problemer er vanskelige at håndtere under den nuværende projekttilgang.
Derudover bliver det vist, at en sektor-baseline metodologi rejser mulighed for at håndtere mange af de identificerede problemer.
En sektortilgang bliver derfor indført, som bygger på både den estimerede implementering af teknologier og de udregningsmetoder, der bliver brugt i ACM0002.
Til dette formål er der udvalgt to forecasting metoder: Delphi metoden og Scenario Forecasting metoden. Sidstnævnte er en multivariat kvalitativ metode udviklet til formålet på baggrund af principper for både forecasting og scenario metodikken.
Gennem udførelsen af disse metoder i et casestudie i den argentinske elsektor bliver det vist, at denne sektortilgang potentielt kan løse mange af de problemer, som ACM0002 står over for. På den anden side dokumenteres det, at metoderne er tidskrævende at udføre, og at de derudover satte højere krav til både ekspertbistand og information end ACM0002.
Tidsforbruget bliver foreslået reduceret gennem en minimering af analyserne inkluderet i Scenario Forecasting metoden, men det er uvist, om dette er tilstrækkeligt til at gøre de foreslåede metoder fuldt ud egnede. Mere praktisk erfaring er nødvendig for at kunne vurdere de egentlige potentialer af den foreslåede baseline metodologi.
Gennem en udvidelse af problemforståelsen peger studiet også på, at fremtidige politiske valg med hensyn til håndteringen af usikkerhed, kapacitetsopbygning og bæredygtighedshensynet er nødvendige for en holdbar alternativ baseline metodologi. Disse sammenhængende problemstillinger bør ses som en uløseligt forbundet del af den kontinuerlige udvikling af ACM0002.

Nøgleord:
ACM0002 baseline metodologien, sektortilgang, forecasting, el-sektor, case-studie, systemisk tænkning

LIST OF DEFINITIONS

ACM	Approved Consolidated Methodology – A baseline methodology established on the basis of several Approved Methodologies and proposed baseline methodologies
Additionality	The reduction in Greenhouse Gas emissions by sources or removals by sinks that is additional to any that would occur in absence of the CDM Project activity. The Marrakech Accords state that a project activity is additional if anthropogenic emissions of Greenhouse Gases are reduced below those that would have occurred in the absence of the CDM project.
Additionality tool *or* test	The method used to assess the additionality question.
AM	Approved Methodology – A baseline methodology that has been approved by the Executive Board.
Annex I Countries	Countries that have committed to emission restraints under Article 4.2 (a) and (b) of the UNFCCC as listed in Annex I of the UNFCCC (generally developed countries and countries undergoing the process of transition to a market economy).
Baseline Emission	The scenario that reasonably represents the anthropogenic emissions by sources of Greenhouse Gases that would occur in the Baseline Scenario.
Baseline Scenario	The scenario that reasonably describes what would have occurred in the absence of the CDM project
Boundaries	Constructs that define the limits of the knowledge that is seen as relevant to include in the study
CDM	Clean Development Mechanism – flexible mechanism under Article 12 of the Kyoto Protocol with the purpose to (1) assist non-Annex I Parties in achieving sustainable development; (2) contribute to the ultimate objective of the UNFCCC; and (3) assist Parties included in Annex I achieve compliance with their quantified emission limitation and reduction commitments.
CDM Executive Board	The formal governance body established under Article12 to oversee the implementation and administration of the CDM, under the authority and guidance of the COP/MOP.
CDM Project	An emission reduction project which is intended to be registered with the CDM Executive Board and ultimately realise the delivery of CERs.

CER	Certified Emission Reduction - A unit issued under the CDM mechanism pursuant to Article 12 of the Kyoto Protocol and all other relevant requirements and which is equal to one metric ton of CO2e.
COP	Conference of Parties to the UNFCCC, held on a regular basis to establish the rules to implement the UNFCCC.
COP/MOP	Conference of the Parties serving as the meeting to the Parties to the Kyoto Protocol, being the Kyoto Protocol's supreme body. The sessions of the COP and COP/MOP will be held during the same period.
Crediting Period	The period for which the CDM Project can generate CERs.
Delphi method	A method that can be used for creating forecasts and exploiting future possibilities based on a consensus agreement among several experts.
DNA	Designated National Authority – The national authority for CDM designated by Party to the Protocol.
DOE	Designated Operational Entity – An independent legal entity accredited by the CDM Executive Board that can validate proposed CDM Projects and verify and certify Greenhouse Gas emission reductions.
Emission reductions	The difference between the Baseline Emissions and the actual emissions within the boundaries of the project.
Expert	A person widely recognised as a reliable source of knowledge
First Commitment Period	The period between 2008 and 2012 during which Annex I countries are required to reduce their emissions of Greenhouse Gases to the levels established in the Kyoto Protocol.
Forecast	The explicit process with the goal of determining how the studied issue is most likely to develop within the forecasting period.
GHG Reductions	A reduction in emissions of Greenhouse Gases or unit of sequestered Greenhouse Gases equivalent to one metric ton of carbon dioxide equivalent.
GHG	Greenhouse Gas. One or more of the six gases listed in Annex A to the Kyoto Protocol that trap heat when released into the atmosphere, being carbon dioxide (CO2), methane, nitrous oxide, ozone, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF6). They occur through natural and human-induced activities.

Host Country	The non-Annex I country in which a CDM Project is based.
Investor	See Project Proponent
Key Variable	Factors on which the trend of the forecasted item is heavily dependent
Kyoto Protocol	The Protocol to the UNFCCC signed at the third COP meeting, establishing binding Annex I Greenhouse Gas emission reduction targets of 5.2% below 1990 levels by 2008-2012. For the Kyoto Protocol to enter into force, it must be ratified by 55 parties representing 55% of industrial nations' Greenhouse Gas emissions.
Letter of Approval	A letter issued by the Designated National Authority of the Host Country to a CDM Project confirming that the project, as proposed, will assist the Host Country to achieve its goals of sustainable development.
Marrakech Accords	Decisions 2/CP.7 through to Decision 24/CP.7 (inclusive) of the seventh session of the COP/MOP.
Multimethodology	A combination of different methods, tools and approaches, which are combined according to the problem in hand.
Non-Annex I Countries	Countries which are not listed in Annex I of the UNFCCC (generally, developing and least developed countries).
Project Boundary	The notional boundaries surrounding an actual or proposed CDM Project within which Greenhouse Gas emission impacts and effects are considered and quantified.
Project Design Document	The document to be prepared and submitted by Project Participants to an accredited DOE for validation of a proposed project activity.
Project Proponent	The legal entity (both public and private entities) that develop and implement CDM Project activities.
Registration	The formal acceptance by the CDM Executive Board of a validated project as a CDM Project. Registration is the prerequisite for verification, certification and issuance of CERs related to that project.
Scenario Forecast	A flexible qualitative multivariate forecasting method.
Systemic Thinking	A holistic approach to problem solving that focusses on the network of interrelated problems and breaks the boundaries of the traditional understanding of the problem.
UNFCCC	United Nations Framework Convention on Climate Change, signed at the 'Earth Summit' in Rio de Janeiro in May 1992.

Validation	The process of independent evaluation of a project activity by a designated DOE against the requirements of the CDM as set out in the Marrakech Accords on Article 12 and on the basis of the Project Design Document.
Verification	The periodic independent review and ex post determination by the designated DOE of the monitored reductions in anthropogenic emissions by sources of Greenhouse Gases that have occurred as a result of a registered CDM Project activity during the verification period.

CONTENTS

APPENDICES

1 INTRODUCTION

1.1 Emerging context of baseline methodologies

The United Nations Conference on Environment and Development (UNCED), the "Earth Summit" in Rio de Janeiro in 1992, represents the first decisive international response to the growing scientific consensus of the causes and impacts of climate change. At this global event 166 Parties signed the United Nations Framework Convention on Climate Change (UNFCCC)[1] presenting the ultimate objective in Article 2 as the "*stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system*" [UNFCCC 1992].
The Convention commits all Parties both developed and developing countries to adopt policies and measures to mitigate climate change, but it also emphasises the clause on "common, but differentiated responsibilities".

Negotiations on how the commitments of the Convention should be implemented continued at successive Conferences of the Parties (COPs) to the UNFCCC.
At COP 3 in Japan in 1997 the Kyoto Protocol was adopted to the UNFCCC. The unique achievement of the Kyoto Protocol was the binding commitments by its Annex I countries[2] (developed countries) to reduce their common GHG emissions by 5 % compared to 1990 levels within the first commitment period of 2008-2012. They thereby agreed to revitalise and advance the objectives stated in the Convention. The non-Annex I countries (developing countries) did not receive any binding emission targets, but did agree on the emission reduction scheme under the Kyoto Protocol.

Recognising first of all that climate change is a global problem affected by the total man-made GHG emissions, and secondly that mitigation costs varies from country to country, it was agreed to initiate three "*mechanisms*" under the Kyoto Protocol to assist the developed countries in achieving their emission reduction targets. The rationale behind the mechanisms is to include market forces and flexibility so that developed countries with relatively high costs of bringing emissions down can buy or obtain emission credits in countries where mitigation costs are lower. This in turn should lead to the most cost efficient mitigation.

One of these mechanisms, the project based *Clean Development Mechanism* (CDM) [3], was created with the dual objective of: 1) assisting developed countries in meeting their emissions commitments; and 2) assisting developing countries in achieving sustainable development.
In general the CDM represents a pioneering way to approach GHG mitigation as it establishes an international regulatory framework for foreign direct investments that combines technology transfer and sustainable development with mitigation through specific projects implemented in developing countries.
These CDM projects will achieve reduction credits termed *Certified Emissions Reductions* (CERs) that can subsequently be sold and thereby used in a *credit trading* scheme by the developed countries in their effort to meet their emission reduction targets.

[1] The United Nations Framework Convention on Climate Change, UNFCCC and the term "the Convention" are used interchangeably.
[2] In the following we will use the term *developed countries* for the Annex I Parties of the Kyoto Protocol and *developing countries* for the non-Annex I countries.
[3] The Clean Development Mechanism is defined in Article 12 of the Kyoto Protocol.

The CDM is however still in the making, as only 23 projects to date have been registered on a world wide basis [UNFCCC 2005b].

The text of the Kyoto Protocol did only contain an outline of how the CDM should operate and for several years negotiations went on to define its specific design. At COP7 in Morocco in 2001 the Parties made an agreement on several of the unsolved issues and provided through the *Marrakech Accords* [UNFCCC 2001] a "*rule book*" with more specific modalities and procedures for the CDM. It was recognised that to implement such credit trading with emission reductions, clear rules and especially methods were needed to in a fair and transparent manner evaluate CDM projects and determine the emissions reduction achieved. This necessity to evaluate and estimate emissions reductions of CDM projects is the point of departure for the present study which focuses on these methods called *baseline methodologies*.

1.2 A problematic situation

Since the introduction of the Marrakech Accords in 2001 a considerable effort has been undertaken to develop the baseline methodologies. This has been done in a learning-by-doing process, where new methodologies have been developed on the basis of experiences of earlier proposals. Slowly by slowly the present level of standardisation of the baseline methodologies has been reached, but designing them is not an easy task. Moreover different stakeholders hold different perspectives, conflicting goals is in play within the CDM and many project proponents lack technological and methodological expertise.

This picture represents some of the findings we did by attending the international climate conference UNFCCC COP10 in Buenos Aires, Argentina, 6-17 December 2004. During this event we participated in numerous *side events*[4], where problems of baseline methodologies were heavily debated among climate experts, private sector stakeholders, officials of the UNFCCC and nations, and NGOs. From various sides dissatisfaction and critique of the status of the methodologies was detected. Some claimed that the practical use of them impeded the implementation of projects, whereas others were of the opinion that the methodologies compromised the environmental integrity of the CDM.

We further experienced that there was a lack of internal transparency in the concepts used when reading about baseline methodologies. Even among practitioners there were sometimes divergent understanding of concepts and their interpretations.

Getting a deeper understanding through workshops at the conference it became clear that we were facing what is by Vidal (2004) termed a *problematic situation* in the sense that baseline methodologies within the CDM is embedded in a highly complex situation, due to conflicting goals, many actors, lack of structure and many interrelated objective and subjective aspects.

The COP10 also gave us the impression that the development of baseline methodologies is dynamic due to the inherent learning-by-doing process and constant improvements as experience increases.

[4] Side events are workshops and discussions held on the COPs where no political decisions are taken. The side events attended can be seen in appendix 1.

1.3 Objective

The above characterised situation with dissatisfaction and conflicting goals led us to the conclusion that there is a need for improving the design of the baseline methodologies for CDM projects.

It should however first be realised that we have addressed baseline methodologies in plural as many different types of CDM projects can be implemented within different sectors such as power, industrial processes, agriculture, and waste[5].

We have on this behalf chosen to focus on the methodology for renewable grid-connected power generation, called ACM0002[6], as the power sector holds large opportunities in terms of a sizable market for CDM projects. Further this methodology of power sector CDM projects was debated at several workshops at COP10.

With this focus it was decided that *the aim of this study should be to contribute to the process of improvement of the baseline methodology for grid connected renewable power generation projects, the ACM0002.*

In this sense we intend to take part of the learning-by-doing process. In order to contribute to this ongoing process we have therefore chosen to take a practical approach where a case study will play a significant role. This case study was performed on the Argentinean power sector during our stay from November 2004 to March 2005 with following analyses in Denmark. The practical approach also means that the aim does not include some theoretical hypothesis, but that we on the contrary will take our point of departure for improvement in the existing baseline methodology.

We do therefore neither focus on analyses of actor interrelations and possible power relations. Stakeholder interests have however been taken into consideration when it was found relevant for the methodological development.

The overall structure of the report will be given in chapter 3, when discussing the research design of the study.

[5] The Kyoto Protocol in its Annex A gives a comprehensive list of sectors and source categories for CDM projects.
[6] ACM is an abbreviation for Approved Consolidated Methodology.

2 Theoretical framework

It was mentioned in the introduction that the purpose of this study is to improve the ACM0002 baseline methodology. The outcome of this study is thereby meant to solve some of the problems that the existing methodology faces. This study is therefore an attempt of *problem solving*.
Problem solving can be carried out in a number of different ways. Depending on the problem and the specific conditions different approaches can be of varying success. It is therefore important to address the character and the conditions of the problem to find the constraints that this set for the problem solving approach.
The purpose of this chapter is to sketch these different approaches to problem solving and discuss what demands the studied problem sets in this regard.

In this study it is assumed that the problem solving process comprises three frameworks that jointly form the background for the problem solving approach. These are illustrated in the figure below:

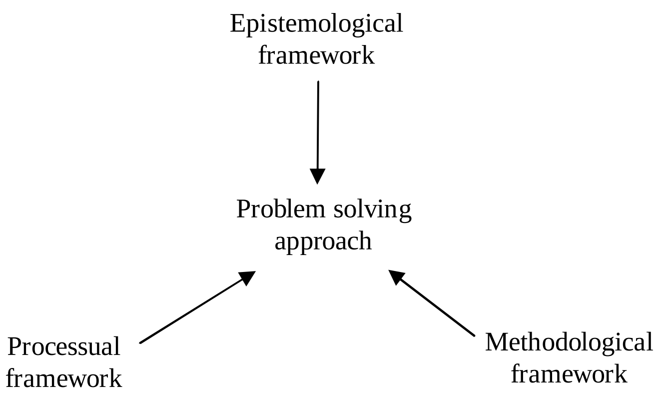

Figure 2.1: The elements that form the background for the problem solving approach [Vidal 2005].

Each of these frameworks will in the following be defined and discussed in relation to the problem raised in this study.

2.1 Epistemological framework

Epistemology is the philosophical discipline of cognition. It addresses the shapes, the definitions, the structures, the origin, and the boundaries of cognition. In this context cognition should be seen in relation to the perception of the problem. In all problem solving as well as research we need cognition of the shapes, structures, boundaries etc. of what is in front of us. These different ways of conceiving the problem are denoted *thinking forms*. Several distinctive thinking forms can be identified from the literature.

Mechanistic or rational thinking follows the principles of reductionism, which is the belief that everything can be reduced to isolated elements. A problem can thereby be isolated from the whole by only considering the elements that are involved, and the problem can be defined unambiguously [Vidal 2004a].

Contrary to this is *systems thinking or systemic thinking*[7]. It is a holistic approach, where things are seen as a part of a larger whole rather than as a whole to be taken apart. Systemic thinking focuses on expanding its view to take into account larger and larger numbers of interactions as an issue is being studied [Midgley 2000]. It does not consider strict scientific traditions but focuses on interdisciplinarity through theoretical and methodological pluralism.
A third form is the *interpretive* or *hermeneutic thinking*, which is based in the human sciences. It emerges from the observer's subjective conceptualisation of the context. Reality, and thereby the perception of the problem, should thus be seen as the subjective interpretation of the situation.
Finally *critical thinking* is characterised by putting the social intervention of the stakeholders in focus. It is hereby a process of empowerment, seeking to change and improve the situation that the stakeholders are facing by showing that the problem at hand comprises elements of social and political character [Vidal 2004b].

These thinking forms can be separate or in some cases combined, creating new approaches. Furthermore each thinking form can integrate an element of *creative thinking*, characterised by the ability to generate new ideas by combining or changing existing ideas, and by making use of envisioning desired futures [Vidal 2004b].

Depending on the characteristics of the problem and the perception of it, the thinking forms and the following approaches can be more or less appropriate in the problem solving process. It is therefore important to address the nature of the problem in order to identify take a relevant perspective.

In the introduction the complex situation in which the baseline methodologies are embedded where outlined. On theoretical grounds such a *problematic situation* can be characterised as follows:

- Highly complex situation, due to many factors, many actors, lack of structure, many interrelated objective and subjective aspects, etc.
- Lack of internal transparency, due to many uncertainties about the relations of the actors, many interrelated communication channels, and internal power relationships.
- Several conflicting goals, due to lack of agreement about the visions and mission of the organisation.
- Dynamic situation, due to permanent interplay between the organisation and environment.
- Lack of technological and methodological expertise.

[Vidal 2004a]

In these situations it is by Vidal (2004a) recommended to address the problem on the basis of *systemic thinking*. We will therefore elaborate more on this thinking form in relation to problem solving.

In a complex situation the processes and the structures have to be understood; how the different elements in the systems work and how they interact. If these questions are not well understood the purposeful action to create an improvement towards the problematic situation

[7] We will in the following use the term *systemic thinking*, which is known in design processes [Vidal 2004b] and further inspired from Midgley (2000), where he describes *systemic intervention* as "*a purposeful action by an agent to create change in relation to reflection on boundaries*".

will easily lead to undesirable consequences in other parts of the system or only result in a sub optimal solution.
When taking a holistic view of the world where everything is seen as connected we must however recognise that we cannot embrace the whole world in a nutshell. It therefore becomes important how an analysis is focussed and where the boundaries for the analysis is set. Reflecting on the boundaries and thereby what kind of knowledge[8] is pertinent for the analysis is an integral part of addressing a problematic situation from a systemic approach [Midgley 2000]. By expanding our knowledge and understanding of the problem at hand the perceived boundaries for the analysis can be changed or broken and in order to frame the problem in other ways [Vidal 2004b].
In performing a systemic analysis some general principles comes in focus that should be considered in the problem solving approach. These are:

- Problem structuring: The situation is structured from a holistic and systematic viewpoint trying to identify the network of interrelated problems.
- Dialogue and participation: A continuous process during the problem structuring and problem solving.
- Focusing: Identification and formulation of the problem to be studied by specifying the boundaries of the knowledge that is pertinent to the problem.
- Expanding: Expanding by breaking the stated boundaries and thereby reformulating the problem followed by an analysis of the changes it creates.
- Problem solving: Developing a designed approach using a set of suitable approaches, methods and tools.

Each element can be touched upon several times during the process, as it is believed that an iterative approach is creating a more nuanced understanding of the issue. Several iterations are therefore recommended [Vidal 2005a].

2.2 Methodological framework

By methodological framework is meant a basis on which to choose the actual methods that should be included in the problem solving approach. The framework does thereby only set the limits for the methodological choice, and does not address the specific methodologies and methods used.

In the complex situation sketched in the above paragraph, there are several factors that influence the baseline methodology of political, institutional and technical character. The problem solving is therefore situated in a mix of different scientific areas calling for the use of methodologies and methods from different scientific disciplines. Each discipline has its strengths in adding understanding from a certain perspective, meaning that if the methodological application is constrained to only one scientific discipline, the complexity of the actual situation will in some cases be ignored [Schön 2001].

[8] When dealing with a problematic situation, some limits to what knowledge is considered relevant is set. If we for example face the problem of reducing health risks of additives to food, relevant knowledge in this connection might be the average digested amount, toxicological tests on animals, risk perception, etc. At the same time some considerations might be left out, for example whether the additives improve the taste of the food products or whether we can simply displace the food products with other. We have by other words set some boundaries for what is considered relevant.

The problem solver can hereby chose between two different approaches. One being the method oriented approach, where the purpose is to test a method. In this case the situation is subordinate to the use of the specific methods, and the complexity of the situation will hence in some cases be ignored. The other approach is the process oriented approach, where the methods that fit the situation are used regardless of the scientific tradition.

Referring to the purpose of this study, which is to improve the ACM0002, it is the practical relevance of the solution that is in focus. It is therefore not considered important whether the methods used in this study is within certain scientific traditions, but whether they are appropriate according to the solving of the problem.
This methodological framework is recognised as multimethodology.

Multimethodology can be described as the use of a combination of methods and tools, composed in a suitable way for solving the specific problem. It can further be described as an unorthodox use of methods and tools from several different scientific disciplines. In a multimethodological approach methods and tools from different traditions can thus be used and combined as long as the methods and tools do not directly contradict each other. The idea behind the approach is that methods and tools stemming from different traditions all have their strengths and weaknesses and are generally best suited for one specific task within the problem solving approach. By a combination and modification of the included methods and tools these weaknesses can be compensated. The combination of methods and tools can be used in continuation or in parallel approaches to mutually deepen the analysis of the studied issue [Petersen & Skuldbøl 2004].
The multimethodological approach can be founded on a more or less theoretical basis. In this study it should be understood as a very pragmatic approach. The choice of the methods and tools used in this study is based on what is considered most suitable and appropriate in the specific situation.

2.3 Processual framework

The processual framework addresses what characterises the process in the problem solving approach.

The processual framework is in this study considered to comprise two dimensions, namely the division between a linear and iterative approach and the level of stakeholder involvement, as illustrated in the figure below:

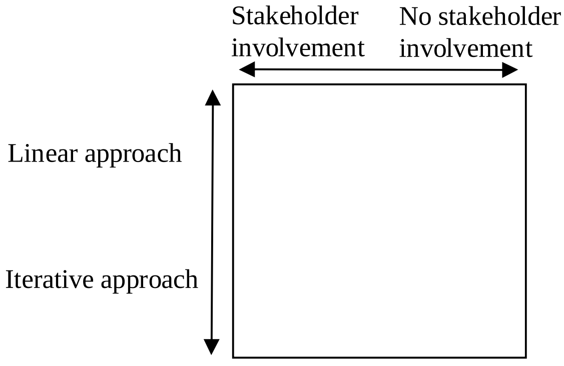

Figure 2.2: A categorisation of processes that are considered in this study.

The process of handling the problem in practice can be addressed from the stance, that it is fully understood. This approach is characterised by a clearly delimited problem, with clear objectives and alternatives, which can be solved by the application of methods within the given scientific tradition. It is a problem where the cause-effect relationships are clearly understood and can be solved in a "one-off", "linear" manner.
Contrary to this is the iterative approach, where the complexity of the problem is acknowledged. The problem solver cannot lean on his theoretical understanding, but must use intuition, experience and a *continuous dialog with the situation* [Schön 2001].

In complex situations like the one addressed in this study, the cause-effect relationships between the baseline methodology and the elements of which it is influenced, can be difficult to establish.
It is therefore necessary to address the problem in a more iterative fashion.
According to Schön (2001) it is a process where the complexity of the problem is acknowledged and accepted to be too comprehensive to understand in every detail and where a trial and error process therefore is needed to gradually match the solution to the problem. The process is done several times through iterative loops until a satisfactory solution is found. It is similarly a process where intuition, flair and knowledge of analogous situations as well as specific scientific knowledge are used as part of the process on equal terms.

Another dimension that can be added to this picture is the level of participation of stakeholders.
The choice of stakeholder participation can, depending on problem, be more or less pertinent or possible.
In this study, the size and dispersion of the potential user group impedes the participation of stakeholders. The baseline methodologies are "multi-user" tools; there are first of all a large amount of investors that are potentially going to use these methodologies and secondly there are the non-annex I countries. Finally there are the key entities within the institutional framework of the CDM, which also constitute a large group. All the above mentioned stakeholders can be regarded as direct or indirect users. The magnitude makes it difficult to include their individual viewpoints.

There is therefore only a limited stakeholder involvement in this study as the stakeholder participation is mainly through our direct contact with stakeholders and participation in workshops and meetings, discussing focal problematic issues.

2.4 Summary

Summing up, because of the foreseen complexity of the situation in which the ACM0002 is embedded, a systemic thinking approach that enable a holistic view is seen necessary. The methods and tools that will be applied during the study should be chosen across the scientific disciplines, depending on the demands of the situation. This was recognised as a multimethodological approach. Finally, again because of the complexity of the situation, an iterative process is adopted. The stakeholder involvement during the problem solving process will, due to the large scattered group of stakeholders only be included to a limited degree.

3 RESEARCH DESIGN

In the previous chapter the theoretical background for the problem solving approach was outlined.
The purpose of this chapter is two-sided: Firstly it is to give a description of how this background for the problem solving approach will be applied in this study. Secondly the chapter will serve as an introduction to the remainder of the report by giving a short presentation of the coming chapters.

As an overall framework for this study we are inspired by the systemic thinking approach sketched in the epistemological framework in the previous chapter.
For this reason we have adopted the five principles or elements which are: Problem structuring; dialog and participation; focusing; problem solving; and expanding.
These elements will in the following constitute some overall steps of the problem solving approach.
Being an open approach, some changes have been adopted in the framework. Firstly the purpose of each step will deviate slightly from the definitions given in the previous chapter, and secondly, since the participation of stakeholders is in this study very limited, the element "Dialog and participation", which in this case is mainly used as an input to the problem structuring phase, is not included as an individual step.

The first step is the **problem structuring**. The purpose of this step is to identify the problems which are inherent in the design of the baseline methodology. Furthermore the boundaries for the knowledge to include in the design of the baseline methodology will be set.

In identifying the problems that are inherent in the ACM0002, the first step is to perform an analysis of the theoretical basis for the baseline methodology. What function is it meant to fulfil, and what elements does it have to include from a theoretical point of view.

This is followed by a description of the framework in which the baseline methodology is embedded, which will result in a list of criteria and definite constraints. These are setting the limits for how the ACM0002 can be designed and point out the knowledge areas and considerations that have to be included in the design of the baseline methodology. The criteria and constraints are finally assessed according to mutual interdependency. The interdependency of the criteria should be understood as one criterion being correlated to another, meaning that an improvement on one will therefore affect the other.

This is followed by a detailed description of the ACM0002 baseline methodology and the elements included. The ACM0002 will be analysed using the theoretical basis for the baseline methodology which will be established as described above.

Finally the ACM0002 baseline methodology will be evaluated according to the established criteria and constraints resulting in a list of problematic conditions in the design of the methodology.

The second step is **focusing**. The purpose of this step is to identify and formulate the problem to be solved. The problem to be solved is interrelated with the other identified problems that comprise the baseline methodology found in the previous step.

In this step a focal problem is identified through expert judgement.

An idea for solving the focal problem is hatched. The list of problems concerning the baseline methodology is compared to the proposal for a solution. Other problems might be solved through the same proposal and some new problems may be created. The needed adjustments are made.
If no solution can be found, alternative ways for managing the problem must be identified. This might imply expanding the boundaries of the knowledge pertinent in the problem solving approach. The consequence for the inclusion of this new knowledge has to be assessed.

The third step is the **problem solving**. The purpose of this step is to develop a designed approach using a set of suitable approaches and methods.

The problem solving proposal established in the "focusing" step is in this study carried out and tested in a case study in order to establish a nuanced approach and gain practical experience with the methodology.

Thereafter the proposed methodologies are evaluated according to the criteria established in the problem structuring step and related to the critique of the ACM0002.

The final step is **expanding** the boundaries. The purpose of this step is to include new knowledge that in the first place was let out. This is done to see whether the focus of the problem solving should be expanded in scope or changed.

A systemic thinking approach often considers several iterations, where new knowledge gradually is included to get a fuller understanding of the problematic situation, meaning that after expanding the boundaries, a new phase, following each of the above "steps" once again, is commenced.
In this study, the above process is only run through once. Expanding the boundaries thereby points to new aspects that should or could be included, without addressing specific proposals for solution.

4 PROBLEM STRUCTURING

The purpose of this chapter is to identify problems and their interrelations which comprise the design of the baseline methodology. Furthermore the boundaries for the knowledge to include in the design of the baseline methodology will be set.

4.1 Methodological choices

The identification of problems within the baseline methodology can be performed in several manners.
In this case, the workshops at the COP 10 are used as a point of departure, identifying the concerns that must be taken in the design of the methodology. This approach is chosen, as the inclusion of the expert opinions is considered crucial for the identification of problems within the existing framework. For the sake of completeness, the statements of the experts are categorised and used to detect the underlying frameworks determinative for the methodology. These frameworks are thereafter analysed and a list of criteria and definite constraints are identified. This list functions as parameters of success for the design. As a reference to the established criteria, previous studies found in literature on the subject are used.
Thereafter the baseline methodology is analysed according to the raised criteria and constraints, thereby creating a list of problems. The problems with the ACM0002 can therefore be of both analytical character stemming from the analysis in relation to the criteria, and of more practical character if directly stated by the stakeholders. Subsequently the criteria are interrelated in order to realise the effect of changing the baseline methodology on one criteria and its potential effect on others.
The critique of the baseline methodology is however often not directed to the baseline methodology as a whole, but specifically to parts of the methodology. An analytical framework for discussing the methodology, dividing it into its sub elements, is made.

The chapter starts out in the opposite direction by providing the analytical framework for the baseline methodology. This is followed by a description of the key actors and the frameworks in which they operate, resulting in the list of criteria and constraints for the design of the baseline methodology. Subsequently the ACM0002 is analysed in relation to these and a list of problems related to the subordinate elements of the baseline methodology is established. Finally the criteria are interrelated.

4.2 Defining the elements in baseline methodologies

From an analytical point of view the challenge of determining and calculating the emission reductions that accrue from CDM projects involves estimating the counterfactual situation to the CDM project. The difference between the counterfactual situation without the CDM project and real situation with the CDM project reflects the impact of the project.

Two related questions arise in evaluating a project activity:
The first is to evaluate whether the project is something that would have happened in the absence of the CDM. If this is the case, the project is not *additional*. A CDM project activity

is by other words additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity.
The second question is about establishing a method for estimating the counterfactual situation without the CDM project; the *baseline scenario*. The quantification of the emissions in the counterfactual situation without the CDM project is denoted the *baseline emissions*. The difference between the actual emissions including the project and this hypothetical case would determine the emissions credit from the project and is here referred to as the *emission reductions*.

In present practice and in literature on the subject the definitions of the elements in the baseline methodology are not clear, but the above introduced distinction gives a conceptual framework for discussing the different parts of the baseline methodology.
The definitions are summarised below:

- *Additionality* of a CDM project. Implies that emissions are reduced below what would have occurred in the absence of the CDM project. The additionality of a CDM project is assessed by using an *additionality tool* or *test*.
- *Baseline scenario*. The scenario that reasonably describes what would have occurred in the absence of the CDM project. The baseline scenario is established through a *baseline scenario method*.
- *Baseline emissions*. An emissions factor for the baseline scenario per output of the service supplied by the project activity is calculated. Baseline emissions of the identified baseline scenario can on this basis be expressed in a mathematical formula. The baseline emissions are estimated using a *baseline emissions method*. The baseline emissions are often in literature simply referred to as the *baseline*.
- *Emission reductions*. Calculations based on the baseline emissions and the actual emissions occurring as a result of the CDM project as sketched in figure 4.1. The actual emissions are dealt with in the monitoring methodology, which is not a part of the baseline methodology. The emission reductions calculations are therefore a result of both the baseline and the monitoring methodology. As the monitoring methodology is not within the scope of this report, and since the emission reductions are partly a result of this, the emission reductions will not be discussed any further in this study.

The phenomena can be illustrated as follows:

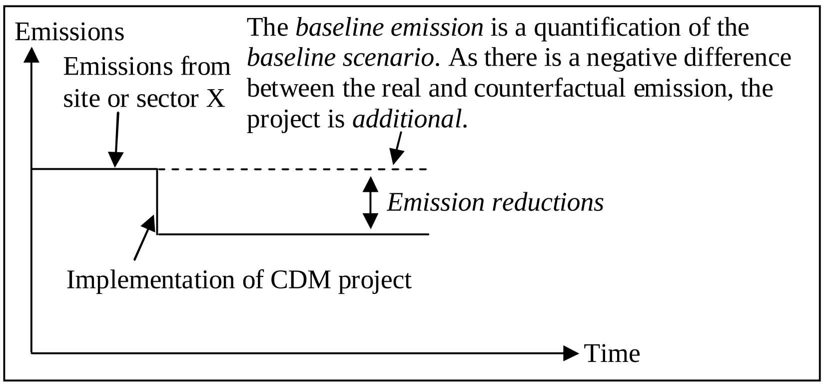

Figure 4.1: Showing the analytical problem arising in relation to estimating the emissions reduction of a CDM project.

4.3 Frameworks for the baseline methodology

Proposing a CDM project, the CDM project proponent has to apply an already *approved baseline methodology* (AM) or develop and apply a new. The AMs are not seen as an imperative and project proponents have still the possibility of suggesting new baseline methodologies, but as sufficient methodologies are submitted and approved it is expected that it would be unnecessary for the project proponents to propose new methodologies [Matsuo 2004]. This also because certain elements from the methodologies would get accumulated and finally merged to *approved consolidated methodologies* (ACM).
The ACMs are thereby applicable to a wider field of activities than the AMs and is expected to entail that the procedure of project implementation will become simpler.
As of August 2005 there were 23 AMs all of which are specified for a certain type of project. Several of these AMs are condensed in, presently, 4 ACMs of which the ACM0002 is one.

The ACM0002 is embedded in a certain context that the successful design of a methodology has to consider. The purpose of the following chapter is therefore to identify these methodological demands into a list of concrete criteria and constraints that must be considered in the design.

This section will start by giving a short description of the key actors that are involved with the baseline methodology. This is followed by an analysis of the frameworks within which these actors operate leading to the establishment of the list of criteria and constraints.

4.3.1 Key actors

In the design, validation and certification of the baseline methodologies there are some key institutions and stakeholders whose role are affecting the design of the baseline methodology. These will briefly be introduced and their role described.

4.3.1.1 The Executive Board

The Executive Board (EB) of the CDM[9] is first identified in Article 12 of the Kyoto Protocol. It was however the Marrakech Accords that at COP7 in 2001 finally established the terms of reference for the EB and paved the way for the first meeting of the board. By the Parties it was given the responsibility and authority to act as an independent body supervising the administration and implementation of CDM projects, however still being fully accountable to the COP being the highest authority.

The EB has through the legal setting of the Marrakech Accords been given the responsibilities of:

- Developing guidelines, rules and procedures for CDM operation;
- Approval of new methodologies related to baselines;
- Assessment of validation report and project registration;
- Accrediting *Designated Operational Entities (DOEs)* (defined below);
- Issuing CERs.

[Baker & McKenzie 2004]

[9] In the following just referred to as the EB or the Executive Board.

The EB is in other words responsible for making the framework law given in the Marrakech Accords operational; i.e. the EB is in practical terms the designer of the ACM0002 baseline methodologies, among others, and the specific project evaluation process.

Making the specific rules and guidelines has been developed in a learning-by-doing process since 2001 as there have been no legal precedents in this new field of project evaluation.

4.3.1.2 The Designated Operational Entity

The Designated Operational Entities (DOEs) are key entities in the evaluation of CDM projects and baseline methodologies. They are accredited independent auditors of the CDM project and are responsible for validation of projects, verification of emission reductions and/or certification of CERs within their particular area of expertise. These auditors must prove to be independent with no interest what so ever in any CDM projects and the project participants must enter a contractual arrangement with DOEs to undertake validation of their CDM project.

Validation is done to see whether it fulfils all the necessary requirements as listed in the Marrakech Accords[10] e.g. approval from host country, comments from local stakeholders etc. Part of the validation is also to check how the baseline methodology is applied for the relevant project [Baker & McKenzie 2004].

4.3.1.3 Project proponent/investor

The development of the baseline methodologies for CDM projects is a bottom-up approach where project proponents are to submit a baseline methodology for approval on a project-by-project basis.
The role of the project proponent/investor[11] in relation to the baseline methodologies is therefore to develop or apply the baseline methodology. The documentation for the eligibility of the project and the amount of emissions reductions it delivers has to follow the procedures and standards given by the EB.

4.3.1.4 CER purchaser

The CER purchaser is the player on the international CO_2 market buying the CERs created by the project. This player will most likely be a developed country with binding commitments under the Kyoto Protocol. The demand for CERs will therefore be related to the cost of other abatement options. It is of course possible that the CER purchaser and the project participant might be the same entity [Baker & McKenzie 2004].

4.3.2 Legal framework for baseline methodologies

The specific legal framework given for the development of baseline methodologies for CDM projects can be traced back to the Kyoto Protocol, but is most profound given by the later specification in the Marrakech Accords [UNFCCC 1997], [UNFCCC 2001].

The legal framework for the baseline methodologies gives some specific demands to baseline methodologies which can be transformed into some constraints and a list of criteria for the

[10] Validation and registration requirements are listed in the Marrakech Accords Articles 35-52 Decision 17/CP.7.
[11] We recognise that a distinction can be made between private sector investors and public funded project participants, since they have different backgrounds, goals and means regarding project developed under the CDM. It is however not within the scope of this study to delve further into this issue.

design. The exact quotations used to establish these criteria and constraints can be found in appendix 2.

First of all the baseline methodology should ensure that projects and the emission reductions in evaluation are real and measurable. If baseline methodologies are too lax or have systematic error this could undermine the fixed reduction targets of the Kyoto Protocol and hence discredit the CDM with its credit trading system. This point to the need for striving for *accuracy* in assessing additionality and the baseline scenario and in estimating the baseline emissions. In relation to the counterfactual situation estimated in the baseline scenario and additionality test, this criterion should be understood as striving for establishing the *most likely* estimate.

Another issue is that *conservativeness* should be enhanced in all methodological choices so as to be on the safe side in estimating the baseline emissions. Uncertainty is inherent in dealing with the counterfactual situation, but is also a result of the assumptions, parameters and data sources needed for the calculations.

Consistency and transparency of the baseline methodology are emphasised and these criteria aim at safeguarding a risk rising from the fact that the project proponent would actually have an incentive to intentionally exaggerate the amount of emissions emitted in the baseline scenario.
Promoting consistency would minimise illogical assumptions and conclusions and transparency would provide clarity on how things are done. Providing transparent evidence for the choices made would also minimise this risk of fake reductions as the validation and approval of the project and the ensuing methodology are put out in the open.

The Marrakech Accords in addition highlights the need for wide *applicability*, which touch upon the basic idea behind baseline methodologies. As mentioned before methodologies are an attempt to standardise the procedures and calculation methods to be used for similar technologies and types of CDM projects. It would ease the whole process of evaluating CDM projects if as many projects as possible could use the same template. At the same time the Marrakech Accords stress that baselines should be able to take into account specific national and sectoral circumstances.

The Marrakech Accords in addition sets some definite constraints for the baseline methodology.
Primarily *additionality* is defined as: "*A CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity.*" [UNFCCC 2001]
Furthermore the *baseline emissions* for a CDM project activity is defined as "*... the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases that would occur in the absence of the proposed project activity."* [UNFCCC 2001]
Moreover some methods for establishing the baseline scenario are given. Furthermore the *time horizon* for the methodology is set and it is claimed that the baseline should be established on a *project specific basis* and should take into consideration *national circumstances*.

4.3.3 Validation process

All potential CDM projects must complete a number of steps on the way to get registered under the CDM. The application of a new or approved baseline methodology is one of these steps.
It is in the Marrakech Accords defined the legal setting for the approval and validation of the baseline methodology.
If a new methodology is developed it will go through a review process including both desk review by experts and the possibility for public comments before review by the EB leading to a final approval or rejection by the EB.
If approved, the application of the methodology is validated by a DOE.

This thorough process of validation involving the project proponent, the DOE and the EB put some demands on the baseline methodologies and thereby on the documentation presented in the process.
Basically the baseline study embedded in the baseline methodology should be subject to validation meaning that *consistency and transparency* are key issues.
Assumptions, calculations, references and methods used in the baseline methodology should be explained clearly and be described in a way so that the validator can *reproduce* and reassess the baseline estimations. Sources of data should be public and explicitly mentioned in the documentation so that they can be verified [CERUPT 2002].

4.3.4 Economic and cost considerations

Like in other project development, economic considerations have a decisive weight in investment decisions about CDM projects. The term “transaction cost”, commonly known in finance and economics literature, can in this context describe the additional costs related to developing and implementing a CDM project. The need for going through the validation process entail additional preparation time and cost on a project.
To be attractive as a CDM project the expected revenue from the sale of CERs must exceed these transaction costs associated with project development. Moreover transaction costs are in focus because the majority of these costs are incurred up-front, while revenues from CERs are generated years after when the CDM project has been approved and implemented.

If a baseline methodology is somehow not *practical* or unduly complex leading to increased transaction costs this can discourage potential investors to participate and thereby block the whole CDM process. Some sort of *cost-effectiveness* has to be enhanced in balancing how meticulous and detailed documentation is needed contra manageable costs of providing this.

One way of preserving the incentives for investors is by streamlining the process of project development and the baseline study by creating some standards. Enhancing wide *applicability* of baseline methodologies would provide economies of scale which would reduce the relative costs of baseline development [Haites 2004].
Baseline methodologies should avoid complexity that is not justified in necessary added accuracy and transaction cost should overall be acceptable in comparison to the economic value of the CERs awarded.

4.3.5 Data demands

In practice when a baseline methodology is applied to a project activity various kinds of assessments are being performed. Depending on what kind of analysis and modelling are being conducted the demand for data, information and expertise will vary.

To give an example on data requirements for electric power projects connected to a grid this might include various types of information such as types of technology in the grid, energy sources used for electricity generation, generation capacity, conversion efficiency, etc. Furthermore the legislation and political plans, data on national circumstances for the power sector will be necessary information to include in the application of a baseline methodology [OECD 2001], [OECD 2002].
This is worth an extra consideration as the complete assessment of additionality, the baseline scenario, the estimation of the baseline emissions and the overall emissions reduction needs to be done in developing countries, whereof some have not very developed statistical agencies and similar official sources of information. Data from official information sources in a given project sector might not be fully up to date or in worst cases not existing at all.

Turning this point around baseline methodologies need to be *practicable* and possible to implement taking into account the essential factor of data availability. The methods suggested in a baseline methodology must be possible to apply in host country or region.

4.3.6 Summing up

Together the above demands can be merged to a set of criteria and definite constraints that a baseline methodology in some way or the other has to live up to in order to be viable and to contribute to the overall objectives of the CDM.

4.3.6.1 Criteria

Accuracy
Accuracy has to do with assuring that emissions reductions are real and measurable, and that projects are additional.
If baseline methodologies are too lax or have systematic error this could undermine the fixed reduction targets of the Kyoto Protocol and thereby discredit the CDM with its credit trading system[12].

Conservatism
In continuation of the above mentioned the lower range of plausible baseline emissions should be selected when facing uncertainty. This will prevent overestimation of emissions reductions and warrant the environmental integrity.

Transparency
Baseline determination can be rather technical and result in opaque documentation. Therefore the baseline methodology should provide a transparent and complete picture of the baseline assessment and calculation process. The logic, methods, data and assumptions should be clarified and specified in such a manner that they can be validated and verified. This will enhance credibility of the methodology and the overall credit trading system.

[12] Accuracy is an assessment that can be made after the end of the forecasting period. When a baseline scenario and additionality test is established, they address the future or counterfactual situation, meaning that it cannot be assessed whether the baseline scenario or additionality test are accurate. It is however assumed that if a development is assessed to be *the most likely*, it will also on average prove to be the most accurate.

Consistency
A systematic and objective procedure should be adopted to ensure similar results each time the methodology is applied and to give similar projects in similar circumstances the same possibilities for validation.

Wide applicability
Baseline methodologies should be versatile and applicable across many contexts and activities.

Practicability
The baseline methodology should at the same time be easy to make operational and based on simple, well-tested and functional principles. It should also account for availability of reliable data and institutional constraints.

Cost-effectiveness
Minimising the transaction costs for the baseline development process could provide important incentives to initiate projects. Baseline methodologies should avoid complexity that is not justified in necessary added accuracy and transaction cost should overall be acceptable in comparison to the economic value of the CERs awarded.

Rather similar criteria can be found in literature, see for example CERUPT (2002) and OECD (2002).

4.3.6.2 Definite constraints

Beside the list of criteria for the baseline methodologies, a list of definite constraints for the design of the baseline methodology was found in the legal framework. These were:

- Definition of additionality.
- Definition of the baseline emissions and the methodological foundation on which it can be established.
- Setting of the time horizon for the baseline methodology.
- Inclusion of considerations regarding the national circumstances.
- The baseline scenario and emissions should be established on a project specific basis.

4.3.7 Interrelationship of the criteria

The above criteria focus on different aspects of the baseline methodology. The criteria can however not be addressed in isolation. In the following it will be discussed how these criteria mutually constrain the others. Improvement on one criterion may therefore restrict another. This is important in relation to the later identification of solution proposals for the problems that will be addressed below.

Accuracy and conservatism clearly aim at securing the environmental integrity by ensuring a stringent and valid calculation of emissions reductions, where the ideal is that one CER should equivalent one real reduction unit. Conservatism is more a principle than a criterion and could be said to represent a precautionary principle as it merely addresses which approach to take when facing uncertainty. It helps the baseline methodology being on the safe side.

Transparency and consistency shall seek to enhance reliability and facilitate the necessary task of validation and verification of baseline emissions and credit awarding in a reasonable manner.
Wide applicability and practicability will make the baseline development process easier and will reduce transaction costs connected with the project cycle.
Finally the broad criterion on cost-effectiveness is important to safeguard that baseline methodologies can maintain investment incentives and produce a flow of projects.

The criteria thereby represent three overall concerns, which can be represented as three poles, namely the *environmental integrity*, the *validation process*, and *attractiveness to the investor* that mutually constrain each other.
If the environmental integrity is emphasised by for example increasing conservatism, it could lead to a more costly methodology. At the same time if the validation process is given primary considerations, it may conflict with the environmental integrity, as the concern regarding consistency on one side and complexity of the methodology on the other can become contradictive. Another example is the need for transparency in the validation process that may inflict an extra burden on the investor and thereby decrease the attractiveness of the methodology.

The three poles can be illustrated in a triangle, where each corner represents the overall concerns that the baseline methodology must consider:

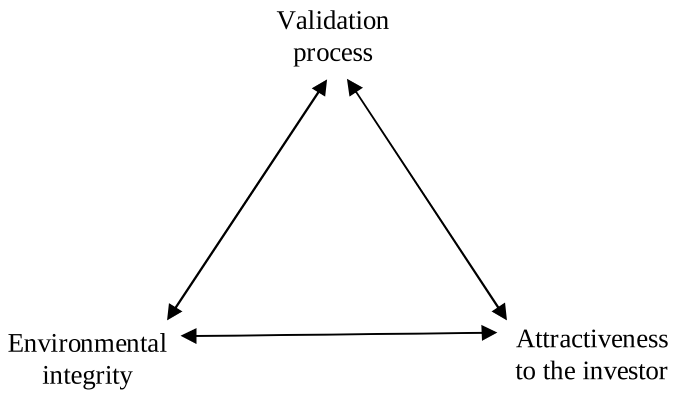

Figure 4.2: The triangle shows three poles, where each corner represents the overall concerns that the baseline methodology must consider. Each of the three corners mutually constrains the others.

4.4 Description of the ACM0002

The ACM0002 is an approved consolidated baseline methodology for "grid-connected electricity generation from renewable sources". It is thereby applicable to grid-connected renewable power generating projects. That is run-of-river hydro power plants; hydro power projects with existing reservoirs where volume of the reservoir is not increased; wind sources; geothermal sources; solar sources; and wave and tidal sources. Other applicability conditions are that the geographic and system boundaries of the relevant electricity grid has to be clearly identifiable and information on the characteristics of the grid available. Further the methodology cannot be applied to activities that involve switching from fossil fuels to renewable energy at the site of the project. (The ACM0002 is attached to the report as appendix 3).

In the following a description of how this methodology addresses the elements in the conceptual framework presented in chapter 4.2 above will be given. The elements are:

- The additionality test;
- the baseline scenario; and
- the baseline emissions

The emission reductions will, as already mentioned, not be considered in this study (See chapter 4.2).

4.4.1 Additionality

In the ACM0002 it is recommended that the "*Tool for the demonstration and assessment of additionality*" is used (see appendix 4). This guideline tool is like the consolidated baseline methodologies a condensation of the additionality tests suggested in previous AMs. It is a tool that, unlike the AMs and ACMs, is applicable to a wide range of proposed CDM projects[13]. The flowchart below shows the steps of the additionality tool.

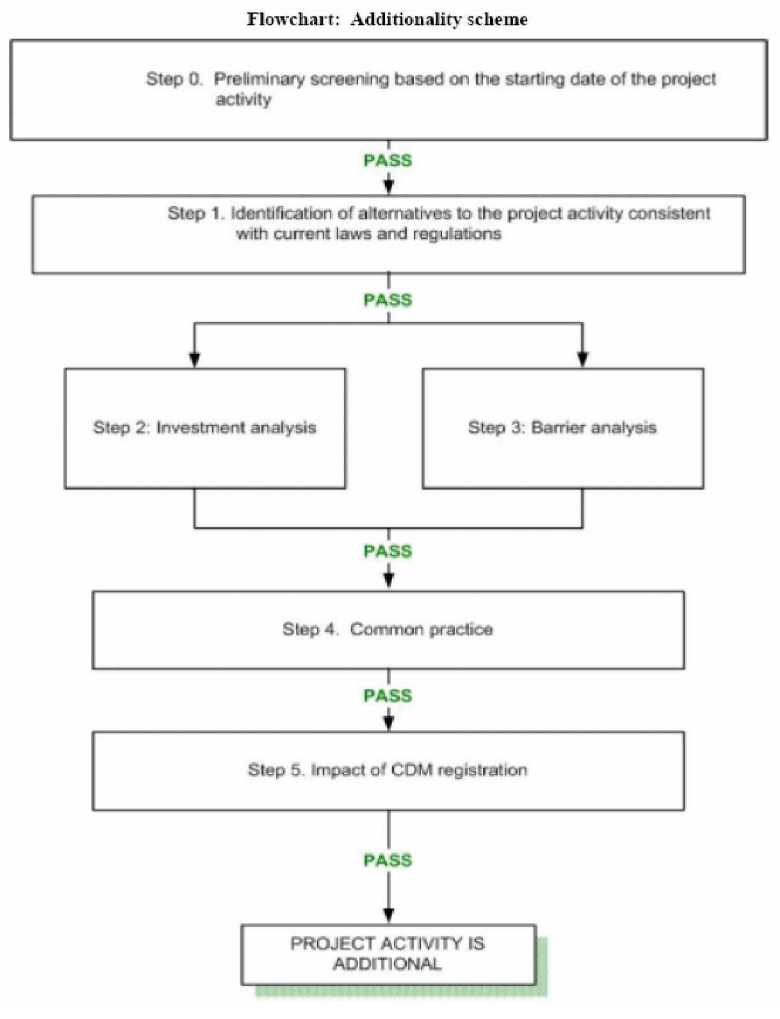

Figure 4.3: Flowchart showing the steps in the additionality tool [UNFCCC 2004].

[13] The term CDM project is here and in this chapter used for proposed projects that in reality may or may not become a real CDM project.

Step 0 describes a possibility for those project participants who wish to have their crediting period to start before registration of the project activity for the reason that incentives from the CDM was seriously considered in taking the decision on implementing the project. This possibility only runs until 31 December 2005. From there crediting will follow registration.

The first step in the additionality test is to identify realistic and credible alternatives to the project activity that is available to the project proponent, i.e. alternatives that provide outputs or services comparable with the ones of the project activity and are consistent with current laws and regulations or at least follow the current practice of the region or country under consideration.

The following steps *Investment analysis* and *Barrier analysis* constitute a specific test or filter to determine additionality for the project against its alternatives. Either one of the analyses or both may be used to indicate additionality.
The *Investment analysis* should evaluate if the project activity is economically and financially less attractive than other alternatives without the revenue from the CERs or simply is unlikely to be financial attractive in itself. The evaluation is based on calculation and comparison of investment indicators of the project and alternatives. The methods are called investment comparison and investment benchmark analysis.
The *Barrier analysis* examines barriers that prevent the implementation of the project activity at the same time as it does not prevent at least one of the alternatives, meaning that this alternative will be more likely to happen than the project activity. The barriers can be technological, e.g. that there is no availability of skilled labour or lack of infrastructure to handle the technology, or due to prevailing practice, i.e. the project activity is the “first of its kind” in the host country or region.

To demonstrate the above mentioned barriers, transparent and documented evidence need to be presented. This information could include relevant legislation and norms; statistical data; market data; written documentation of the project proponent and other actors involved in the implementation of project; written documentation of independent experts judgements.

Step 4 is the *Common practice analysis*, which should show to which extend the project activity (e.g. technology or practice) are already part of common practice in the relevant sector and region. This is done by analysing other activities similar to the proposed project and discussing why there are distinctions between these similar options. Changes in circumstances over time such as new policies or barriers may cause distinctions between similar project and hence change common practice.
Common practice analysis is thereby a sort of credibility check, which also counts for the final step

Step 5 is the *Impact of CDM registration*. In this step the project proponent should explain how the project activity will overcome the above mentioned difficulties and barriers as a consequence of the benefits and incentives achieved by becoming a CDM activity.

If a project activity passes the screening in step 2 and/or 3 and the credibility check in step 4 and 5 it is judged to be additional.

If relevant, other barriers may be included. The barriers are sufficient grounds for demonstrating additionality if they would prevent the proposed project from being carried out if it was not to be registered as a CDM project and if the barriers would not prevent at least one other investment alternative to the CDM project to be implemented [UNFCCC 2004].

4.4.2 Baseline scenario

The baseline scenario represents the situation that would have happened without the project activity, which is defined as "*electricity would have been generated by the operation of the grid-connected power plants and by the addition of new generation sources*" [UNFCCC 2005a].

The baseline scenario is in other words, that the existing power plants will continue their operation and will be supplemented by some new generation sources.

These new generation sources are estimated to be of the same type as the five most recently built power plants or the latest 20 % capacity additions to the system, whatever sample comprises the larger annual power generation.

The baseline scenario can be estimated both *ex-ante* (before), and *ex-post* (after), the implementation of the project. In the ex-post case, the effect of the project would be assessed after the implementation.

The ex-post baseline scenario variant has however not been significantly used, because the CDM project proponent is not guaranteed a certain amount of CERs before the implementation of the project, if the reduction is to be measured after the implementation. The ex-post baseline scenario is therefore increasing the insecurity for the investor, and can as well increase the cost and administrative burdens [Lazarus et al. 2001].

4.4.3 Baseline emissions

Calculation of the emissions in the baseline scenario is based on the operating power plants, represented in the emission calculations by the *operating margin*, and the additions of the new power plants, represented by the *build margin*.

The idea behind the *operating margin* is that the power plants connected in a grid will be operated on the basis of operation costs. Normally the power plants with the lower operation cost will be operated preferentially, whereas the more expensive plants will be operated when needed. The power plants are therefore arranged on the basis of costs in a certain order – a dispatch order. Depending on electricity demand, the power plants will be switched on and off corresponding to their ranking in the dispatch order. The plant that is the next in line to be switched off with reduced power demand is the plant operating at the *margin*. The logic behind using this marginal approach is that a new plant will change the dispatch order. If the new plant is, say, number 10 in line to operate, it will delay the turning on of the previous number 10, which will now be number 11 and so on. The implemented plant will therefore displace the plant at the margin. The emissions from the marginal power plant will hereby be displaced by the emissions from the new power plant.

The underlying principle for the *build margin* is that the implementation of new capacity follows the development in electricity demand. When the difference between the generation capacity and the demand becomes smaller than a certain capacity, new power plants will be installed. A CDM project, however small it may be, will according to this assumption delay the coming power plants in the period of its operation. Calculating the effect of this displacement in this simple example shows that the CDM project displaces a capacity of coming installations corresponding to its own generation capacity. This phenomenon is explained in the figure below:

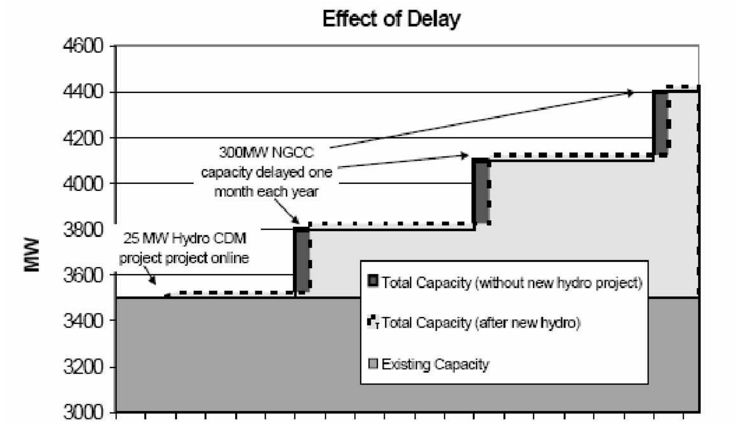

Figure 4.4: Power plants are delayed due to the installation of a small electricity generating CDM project [OECD 2002].

The *operating margin emission factor* can be calculated in different manners with different complexities, depending on the data availability, dispatch order, and the occurrence of low-cost/must run power sources.
The general principle is to calculate an emission factor (EF_{OM} with the unit tCO_2/MWh), based on the amount of fuel consumed by the relevant power sources, the emission coefficient of the fuel and the electricity delivered to the grid. In a simple form the EF_{OM} is calculated as:

$$EF_{OM} = \frac{\text{Total amount of fuel used by each plant* emission coefficient for each plant}}{\text{Summed electricity delivered to the grid (MWh) for each plant}}$$

The *operating margin emission factor* can be calculated with different complexities. The four different methods are: A*verage; simple*; *simple adjusted*; or *dispatch data analysis*.

The *average* method in calculating the EF_{OM} is like in the above formula.
The *simple* is like above, but excluding low-cost/must run power plants in the calculations.
The *simple adjusted* method is different from the simple method, as it is separating low-cost/must run power sources and other power sources, and calculating how many hours per year low-cost/must run sources are on the margin. The EF_{OM} calculated using the simple adjusted method thereby include the consideration that an implemented CDM project will not in all situations displace other power plants, i.e. when the low-cost/must run power plants are on the margin.
The *dispatch* method uses data from the National Dispatch Center computerised hourly generation-weighted average emissions of the power plants on the margin. The displacement of the CDM project is therefore in this calculation method set directly according to the power plants working at the margin.

The *build margin emission factor* (EF_{BM}) is calculated as the average method operating margin, but uses the data from the power plants that are estimated to enter the system, as described in the establishment of the baseline scenario.

The *baseline emission factor*, including both the build and the operating margin, is calculated by weighting the EF_{BM} and the EF_{OM} by a default of 50 % each and thereafter summing the two factors.
The method seeks to reflect the assumed displacement effect of projects and operation of power plants. The operating margin could be considered to apply for the first half of the

baseline period, whereupon the build margin comes into play in the second half, which is the reason for the fifty-fifty weighting [OECD 2002]. A more comprehensive explanation is given in appendix 5.

4.5 Evaluation of the ACM0002

In evaluating the present design of the ACM0002 we will assess how the methodology lives up to the criteria and constraints set for the baseline methodology in chapter 4.3. The ACM0002 will be evaluated on the criteria and constraints according to the performing of the above described elements of the baseline methodology, namely the additionality test, baseline scenario, and baseline emissions.

4.5.1 The additionality tool

The additionality tool is a completely standardised algorithm to show that any given project activity is additional. It includes several criteria in the many sub-analyses and constitutes in this sense an interpretation of the very broad definition of additionality given in the Kyoto Protocol and the Marrakech Accords.
If applied on renewable power technologies it is a “reverse proof” stating that the renewable technology project is less likely to happen than other alternatives looking at normal business practice or that it faces barriers that prevent it from being a likely alternative in the power sector.
The investor has thereby to identify realistic and credible alternatives delivering the same output and service, in this case electricity and they should be “*available*” to the project proponent. In a footnote in the additionality tool it is clarified that “*…a coal-fired power station or hydropower may not be an alternative for an independent power producer investing in wind energy…”*. The realistic alternatives are therefore specifically related to technology, circumstances as well as to the investor.
This investor dependent identification of alternatives leaves quite some room for interpretation because it is an open question what can be said really to be *available* to the investor.
At the COP 10 many private sector participants in different workshops stressed this point about the additionality tool including subjective reasoning making it less reproducible and verifiable. The harshest comments stated that the additionality test could be compared to an essay contest and a rhetorical question about making the arguments seems probable [COP10 meeting 1].
Others argued that when complying with the additionality tool their ideas and motives for investing in the project had to be stated, meaning that they had to share their business rationales with potential competitors. It therefore appeared unpractical to the investor [COP10 meeting 1].

The impracticality can be further intensified by the lack of definitions and descriptions of approaches in the additionality tool. In this connection another point of critique that was mentioned is that it is not explained how to define realistic and alternative scenarios in the first step of the additionality tool, making the tool difficult to use for the project proponent [COP10 meeting 2].

4.5.2 The baseline scenario

The baseline scenario is based on the estimation of the implementation of new power plants and the operation of the existing power plants. The baseline scenario therefore comprises two elements; the estimation of new power plants and the operation of existing power plants.

The baseline scenario method is within the discipline of forecasting. Forecasting is characterised by the establishment of one, ideally the most likely, future scenario, which will turn out as accurate as possible. The forecast in the baseline scenario method predicts that the future generation capacity on the grid will be the present operating power plants, adding the coming generation capacity, which will be similar to the newly installed power plants on the grid. The forecast is in other words based on extrapolation [Armstrong 2001].

In the Marrakech Accord it is stated that as baseline scenario is "*... the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases that would occur in the absence of the proposed project activity".*

The following will give a discussion of whether the use of extrapolation as a basis for the baseline scenario results in a *reasonable* representation of what would occur in the absence of the proposed project activity.

4.5.2.1 Evaluation of the use of extrapolation in the baseline scenario

A methodological validation can be theoretical and empirical. Regarding extrapolation, theories in relation to its applicability are very scarce. Its suitability is therefore mainly developed and evaluated through experience [Armstrong 2001].

Since the ACM0002 is a relatively new methodology, there are yet no experiences with the accuracy of the forecasting method used. The method will therefore be applied to some hypothetical examples in order to establish empirical validation.

This hypothetical empirical validation is done through looking at the development of the fuel mix and thereby technology mix in power generation in different parts of the world and considering how the baseline scenario method would have predicted the actual outcome in these contexts. This example will consider three cases: Chile, Hong Kong and India in the period between 1972 and 2002.

The figures below show the mentioned development.

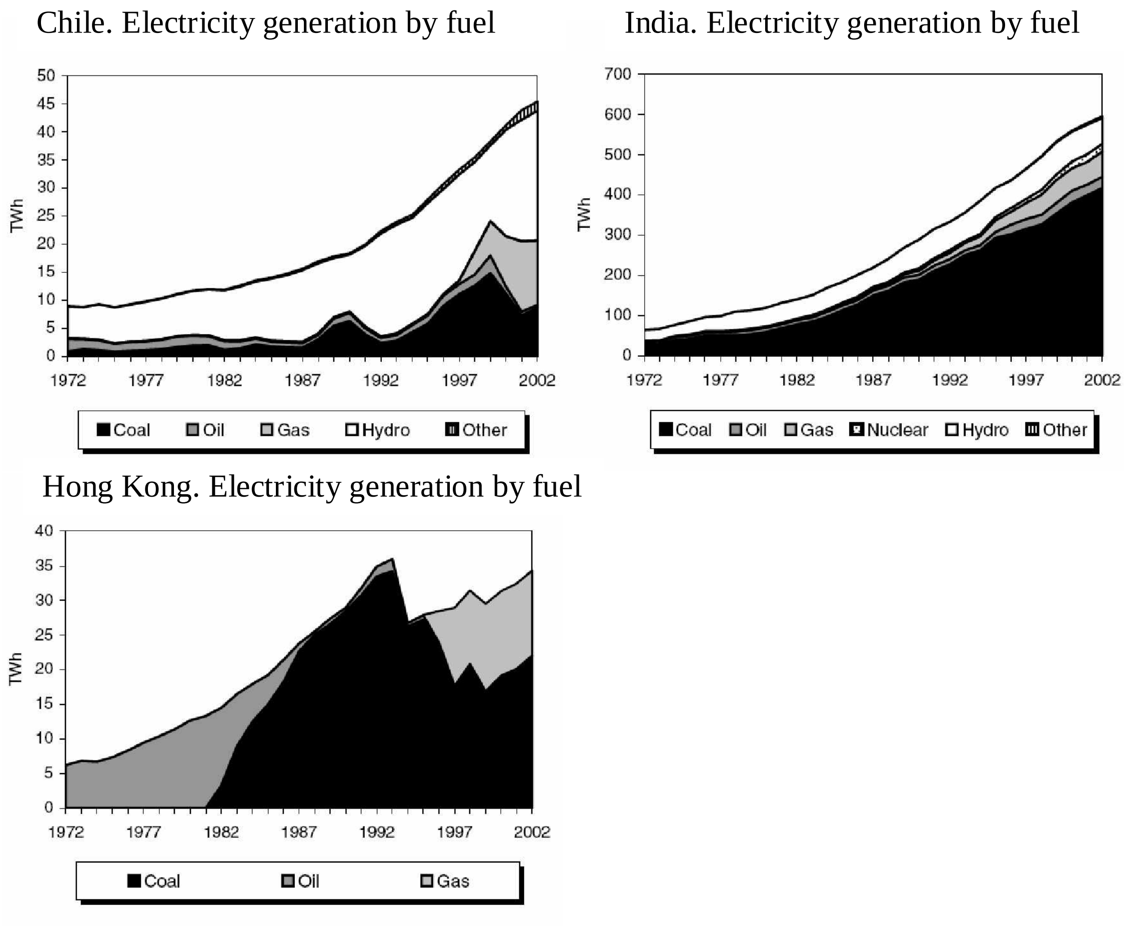

Figure 4.5: The Electricity generation by fuel in Chile, India and Hong Kong in the period from 1972-2002 [IEA 2004].

Considering the electricity generation in Chile for the period 1972-2002 shown in figure 4.5 opens up for several different baseline scenarios depending on the point in time the extrapolation is conducted[14].
Taking the period from 1972-1977, the main increase, however small, originates from an increase in the electricity production from hydro power plants. A baseline made in 1977 would therefore probably assume that the amount of hydro power plants would increase, which is more or less consistent with the actual development in the period from 1977-1987 (the maximum time span for a baseline scenario without revision).
If a baseline scenario was made in 1997 based on historical data from the previous years where coal power was rapidly being introduced the prediction would be that coal power is the marginal built technology. This however would have proved to be very wrong.

The two other figures above showing the development in India and Hong Kong gives two other examples where an extrapolated baseline would respectively give very suitable and very misleading results[15]. In the India case, the technology was introduced in a very linear manner,

[14] For the reason of exemplifying it is here assumed that a change in the electricity generation by fuel is proportional to a change in the amount of installed capacity for the given technology. An increase in the electricity generation using gas would thereby correspond to an increase in the installed capacity of gas technology power plants

[15] In this connection it is however not investigated whether the Indian electricity grid is operated as one interconnected network or several networks. This is a crucial factor in this regard, as the regional developments easily can have a more abrupt character.

and would therefore be well predicted with extrapolation, whereas the development in the Hong Kong case is far from stable, and would resultantly be very poorly predicted.

This indicates that if the ACM0002 baseline scenario method had been used in the historical examples above, it would often have given inaccurate results, meaning that the forecast of new power plants will often not provide a description of the most likely future, which is the goal of this forecast.
A reason could be that the development of an electricity sector is not explained only through its own historical development but by other factors.
This assumption is held by many planners and forecasters in the power sector. They argue that the development in any power sector is dependent on a mixture of sector-specific and country specific variables. Disruptive power systems operation, volatile fuel prices, availability of resources, major changes in institutional framework, new legislation and unstable economic and investment situations are but a few factors influencing power sectors especially in developing countries.
A list of these key factors must be included in a structured manner to give a reasonable and consistent picture of the most likely future development of the power sector [Matsuo 2004a], [CERUPT 2002], [Bravo & Groisman 2003]. It is therefore likely, according to the above mentioned cases and experiences in forecasting in the power sector, that if these factors are included in the development of the baseline scenario, a more likely scenario can be achieved.

The Wigton Wind Project from Jamaica [Ecosecurities 2004], which was proposed in 2004 as a CDM project, exemplifies several different possibilities for a baseline scenario. The baseline scenarios are quantified through the resulting baseline emissions in the figure below.

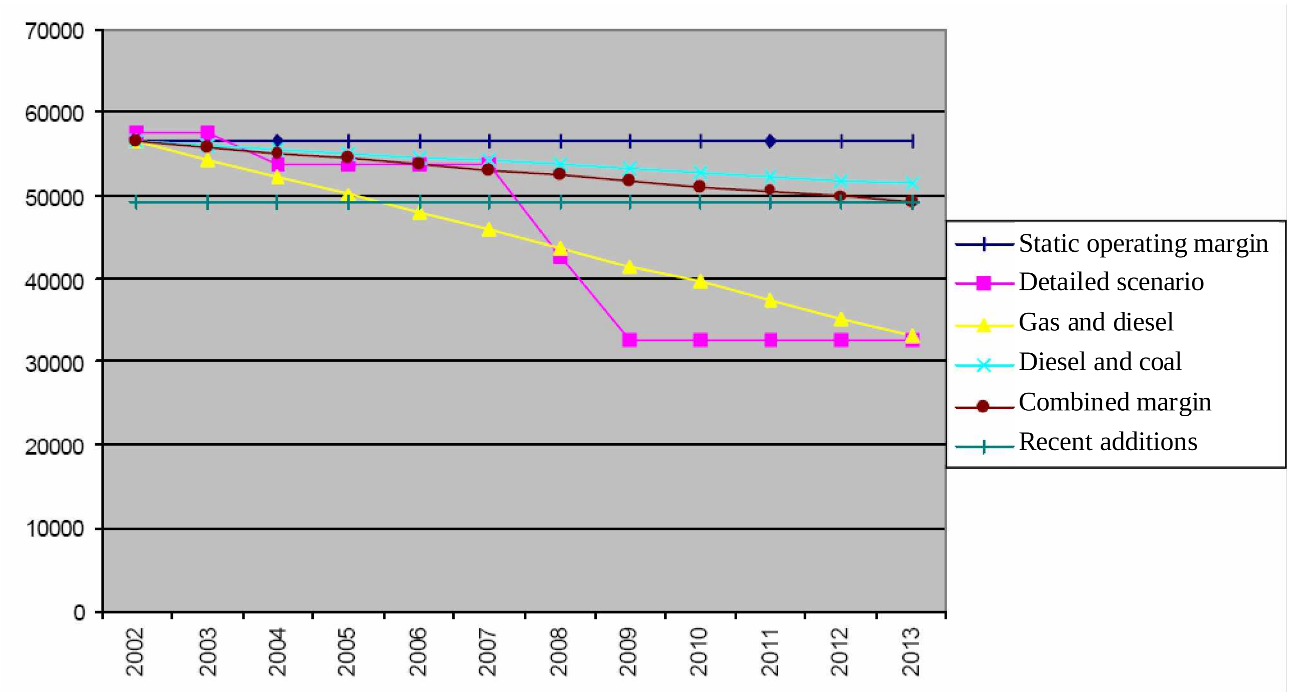

Figure 4.6: The Wigton Wind Project, Jamaica, proposed in 2004 as a CDM project. The figure shows different ways of calculating the baseline emissions, as a result of the baseline scenarios. The combined margin scenario reflects the way in which the baseline emissions are calculated in the ACM0002, a combination of the static operating margin and the recent additions scenarios. The detailed scenario is based on several specific national circumstances, whereas the gas and diesel and the diesel and coal scenarios are relative coarse estimates of the future additions to the electricity grid.

Figure 4.6 gives an example on the difference between extrapolation and a detailed forecast including key variables relevant for the power sector. In this case, the detailed scenario, where national circumstances were included, resulted in baseline emission around 20 % lower than those of the combined margin approach of the ACM0002.

4.5.2.2 Evaluation of the use of extrapolation in relation to the operation of the power plants

Regarding the forecast of the operation of the power plants is, as a difference from the forecast of the implementation of new power plants, based on a shorter time span. The latter uses as a minimum the newest additions to the system corresponding to 20 %, as the basis for the extrapolation. These 20 % have been build in the years before the establishment of the baseline scenario, meaning that the rationale for choosing the same technology as expressed in the last 20 % has had several years to change when beginning the baseline period. Furthermore the forecast is in principle only included in the calculations during the last half of the baseline period as explained in chapter 4.4. It therefore stretches over a relatively long period.
The forecast of the operation on the other hand is only included in the first years of the baseline emission calculations (see chapter 4.4), which is extrapolated based on the most recent dispatch data. It therefore endures for a shorter period.

The forecast of the operation comprises in realty two forecasts; one that forecasts the power plants in operation, and one that forecasts how these will be operated.

Regarding the former forecast, it is simply assumed in the ACM0002 that no power plants will leave the system. This is only valid if it is expected that no power plants are withdrawn from the system due to attrition, lack of fuel, large increases in fuel prices, policy changes, and so forth.
It is not requested to validate these assumptions in the baseline methodology, which potentially leads to an unlikely forecast of the operating margin.

Regarding the latter forecast, it is similarly assumed that there will be no changes in the operating of the system during the baseline period.
This assumption is contradicting the foundation of the formation of the baseline methodology. It is implicitly assumed in the fifty-fifty weighting of the build and operating margin that there is a constant increase in electricity demand (see appendix 5). An increase in the demand without a corresponding increase in supply will inevitably lead to a change in operation. The plants that were previously operating at the margin will by an increase in demand operate more often and plants that were previously only used in extreme situations will become the average marginal power plants. The significance of this inconsistency of the establishment of the operating margin will depend on what type of power plants are operating at the margin in relation to the power plant in reserve and the rate of the increase in electricity demand.

4.5.2.3 Conservatism in relation to the baseline scenario method

The baseline scenario in the ACM0002 is uniformly decided, through extrapolation as previously described. There are therefore no possibilities for being conservative and downsizing the baseline emissions on behalf of uncertainty.

4.5.2.4 Constraints in relation to the baseline scenario method

Another point stems from the list of constraints for the design of the baseline methodologies. In the Marrakech Accords it is stated that baselines[16] should take into account "*relevant national and/or sectoral policies and circumstances, such as sectoral reforms initiatives, local fuel availability, power sector expansion plans, and the economic situation of the project sector*".
The baseline scenario and thereby also the baseline emissions only includes the trajectories of the operation and implementation of power plants and does therefore not include these elements.

4.5.3 The separation of the baseline scenario method and additionality test

The baseline scenario and the additionality test are in reality two sides of the same coin. In theory, what is not in the baseline scenario is additional (if it at the same time has a lower emission level than the baseline emissions).
The baseline scenario and the additionality test are however in the ACM0002 established as isolated issues as described in chapter 4.4.
Being isolated methods there are no guarantees that the estimations made in the analyses support each other, which inevitably lowers the consistency of the ACM0002 methodology.

4.5.4 The baseline emissions

When calculating the baseline emissions, the operating and build margin is used and each weighted 50 % of the total. This assumption is however not true in several situations. In the case of either extreme scarcity of electricity or if demand is stable or decreasing, the operating margin will be dominant. The reason is that in extreme scarcity, an additional CDM project will not delay the implementation of other projects, since there will still be scarcity. In the opposite case, where the demand is either stable or decreasing, a CDM project will not delay any projects, as there are none.
On the other hand, if the system is stable and the investors are behaving as rational economic actors, the build margin would be dominant, as the inclusion of the operating margin is only a result of the inertia of the implementation of power plant, as discussed in the previous chapter.
A more nuanced use of the operating and build margin could therefore lead to more accurate representation of the baseline emissions.

Another point of critique is, that many of the renewable energy sources that uses the ACM0002 if implemented as CDM projects are interruptive power sources, where the energy production varies according to wind speed, solar radiation etc. In the baseline emission calculations however, the production is credited according to an average production, and will thereby be less accurate.

4.5.5 About ACM0002 in general

Minimising the transaction costs for the baseline development process could provide important incentives to initiate projects.
A survey made among 104 project participants in the CDM addressed among others the question about transaction costs for CDM projects. By transaction costs is meant both issues connected to the baseline methodology as well as other elements, namely the preparation of feasibility study and project design document, and project registration. The issues regarding

[16] In the Marrakech Accord, there are no strict distinction on the baseline and the baseline scenario. It is therefore considered that baseline in this context refers to them both.

the baseline methodology comprises the development of a baseline and/or new baseline methodology as well as its validation.
The transaction costs thereby includes more than costs only connected to the baseline methodology. It can however still be used as an indication for whether the costs connected to the CDM and the baseline methodology pose a problem for the investors. The critique therefore also points to the ACM0002, being one of the baseline methodologies.
In the survey 16 % found that the transaction costs is a barrier for the CDM whereas 62 % found that it has a negative influence. 19 % and 2 % found that it has no influence or a positive effect respectively. The issues regarding the baseline methodology and its validation are seen as important focus areas for improvement especially when it comes to the simplification of baseline methodologies and proving project additionality [IETA 2004].

4.5.6 Summary of critique

In the matrix below the critique that has been raised above is gathered.

<table>
<tr><th rowspan="3">Criteria</th><th colspan="4">Element in baseline methodology</th></tr>
<tr><th rowspan="2">Additionality tool</th><th colspan="2">Baseline scenario</th><th rowspan="2">Baseline emissions</th></tr>
<tr><th>Implementation of new power plants</th><th>Operation of existing power plants</th></tr>
<tr><td>Accuracy</td><td></td><td>Using extrapolation will often not result in the most likely scenario, especially when no justifications for using the method is given.</td><td>Using extrapolation for estimating the operation of power plants is inaccurate.

Assuming no shut down of operating power plants during forecasting period.</td><td>Fifty-fifty weight of operation and build margin.

Electricity production assumed to be constant.</td></tr>
<tr><td>Conservatism</td><td></td><td>No possibilities for choosing conservative baseline scenario.</td><td></td><td></td></tr>
<tr><td>Transparency</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Consistency</td><td>Additionality tool is by investors argued to be very subjective.</td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Additionality and baseline scenario considered isolated, resulting in possible conflicts between the analyses.</td><td></td></tr>
<tr><td>Applicability</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Practicability</td><td>Investors have to reveal their motives for investments.

No explanations for how to establish alternatives.</td><td></td><td></td><td></td></tr>
<tr><td colspan="3">Additionality and baseline scenario considered isolated, making the analyses more cumbersome.</td><td></td></tr>
<tr><td>Cost-effectiveness</td><td colspan="4">Baseline methodology in general considered costly by investors.</td></tr>
<tr><td>Constraints</td><td></td><td colspan="2">Considerations regarding national circumstances are not included in the baseline scenario.</td><td></td></tr>
</table>

Table 4.1: A summary of the critique of the ACM0002. Each element in the ACM0002 is evaluated according to the found criteria and constraints.

5 FOCUSING

The purpose of this chapter is to identify how to improve the ACM0002 baseline methodology.

The chapter above presented several problematic conditions in relation to the ACM0002. In this chapter several of these problems will be sought managed through proposing a methodological change in the ACM0002. This change must however be considered in relation to all criteria from table 4.1 above. If the proposal conflicts with other criteria, this consequence should be mitigated. If mitigation cannot be achieved, it can be necessary to consider another methodological change in the ACM0002.
As we shall see below, what is considered the main problem of the ACM0002, is interrelated with other criteria, meaning that changing the main problem will lead to undesirable consequences. The proposal of how to change the ACM0002 therefore has to be reconsidered. A new proposal is made, which however affects institutional and political questions. These new issues therefore have to be evaluated to assess whether the new proposed change in the ACM0002 is acceptable.

5.1 Methodological choices

Choosing what problem to solve can be performed in many ways, for example by the use of multi-criteria analyses, surveys among participants, or expert opinions. In this case, the choice was made on a dual basis being expert opinions [Bouille 2004], [Matsuo 2004b] and a good idea for improvement, which seemed promising in relation to several of the above raised problems.

As stated above, the proposed change in ACM0002 calls for including new issues, as the proposal conflicts with these. These new issues are found through literature, expert opinions, workshops at the COP10 and critical reviews.

The chapter begins by presenting the idea for improvement. This is followed by a discussion of how this proposal will affect ACM0002. As the proposal conflicts with other considerations in the ACM0002, it is found that in order to solve the focal problem, a more radical change in the problem solving proposal is needed. In this attempt it is found that new issues must be considered. These are therefore discussed in order to assess whether the proposed change is acceptable. As this is the case, it is thereafter considered how the change is expected to be affecting the ACM0002.

5.2 Ideas for improvement

Our starting point for meeting the critique of the ACM0002 is the way the baseline scenario is estimated within the ACM0002. In order to preserve the integrity of the whole CDM as a means to help Annex I countries to achieve their emissions reductions, it has to be assured that the baseline methodology for assessing these projects is as accurate as possible.
Trend extrapolation can be well suited if the system forecasted show a stable trend with all key factors unchanged, while in many developing countries this is however not the case.

Extrapolation will therefore often not lead to the most likely scenario. Suggesting that it should be the default method for the critical issue of identifying the plants that the potential CDM project will be measured against can be questioned.

To improve this aspect we will therefore seek another type of forecasting that can include knowledge about national power system circumstances and trends in representing the baseline scenario in the most consistent way.

Such an analysis should ideally present the most likely development in a transparent and reasonable way that can be validated. It should be consistent with most likely business preference and practice among investors in the country.

Further to this from a holistic point of view having a consistent and well substantiated analysis of the baseline scenario for the entire power system, we would be able to screen which renewable or conventional power sector technologies in the specific grid under investigation would be and not be viable business options. In other words it can be decided if this type of technology would have gone ahead anyway. This means that if this thorough baseline scenario is made, it can at the same time be used as an additionality test.

The new suggested additionality test would not depend on the investor estimating and documenting the profitability of the project from his point of view. Consistency and transparency can on this point thereby be enhanced. In a more holistic analysis several barriers would at the same time be cross related and could give a fuller overview.

The lack of possibilities for assessing the incentives of the investor can be argued to be problematic since the possibilities for investments may be dependent on the investor. A gas power plant might for example not be an alternative for a small investor, who instead may only be able to finance a smaller wind mill project. The wind mills are therefore for the smaller investor not an additional project, whereas for the large investor who can afford the gas power plant and which from an economic point of view may be a better alternative, the wind mills may be additional.
In a sector specific additionality test, these considerations cannot be included.

In designing a new way of dealing with the counterfactual situation it should however not unduly compromise the other criteria important to a baseline methodology. Recalling the established criteria, transaction costs is a crucial factor and introducing a new and more complex analysis within the methodology will undoubtedly increase the cost burden on the project proponent.
It is therefore not possible to ask each investor to carry out a more complex and costly analysis, meaning that within the existing ACM0002 framework it is not possible to overcome this dilemma.

In the search for a more optimised baseline methodology solution, there is therefore a need to rethink the setup of the baseline methodology by more radical means.

5.2.1 Sector vs. project baseline methodologies

Realising that the proposed baseline scenario and additionality test are not made on a project specific basis but on a sector basis opens up for new perspectives. The ACM0002 (as well as the other AM and ACM baseline methodologies) has to be applied to each project by each investor. A sector baseline scenario and additionality test only has to be applied once,

whereupon it can be applied to an unlimited number of projects[17]. As the proposed baseline scenario and additionality test are sector specific, these methods can readily be applied as the baseline scenario and additionality tool of a sector baseline methodology.
Considering the overall reduced analytical demands if several projects should only make one analysis, the costs of the proposed baseline scenario method and the additionality test could be significantly lower or the complexity of this one analysis could be increased correspondingly.

Changing the baseline scenario method and the additionality tool of the ACM0002 will not inflict any changes in the calculation principles of the baseline emissions or applicability conditions of the methodology. The overall principles of the methodology, besides the changes that a sector approach fosters for the baseline scenario and additionality test, therefore remain the same.

The sector approach holds different potentials in different sectors. In the power sector, the emission reductions that occur due to a CDM project are dispersed throughout the electricity grid. By the installation of for example a wind mill, the power produced by the mill will displace the marginal power source. The reduction is therefore not on-site but somewhere in the grid. A baseline methodology in the electricity sector must therefore take into account the sectoral conditions. This means that two different CDM projects will have the same sector baseline scenario and be tested against the same additionality test if issues regarding the spatial distribution can be neglected.
An opposite example could be a landfill. A CDM project reducing the methane emissions from a landfill by flaring will only lead to emission reductions on-site. In this case, other landfills do not have to be considered.
The baseline scenario and additionality test can therefore in the power sector easily be made sector-based instead of project-specific. The power sector is therefore in contrast to for example landfills suitable for sector methodologies.

5.2.2 Sector baseline methodologies

Sector methodologies can however be many things. As a starting point for this analysis let us therefore have a look at different sector baseline methodology proposals.
The general difference between project-specific and sector baseline methodologies is that while the project-specific baseline methodology is related to a specific CDM project, meaning that the additionality test, the baseline scenario and the baseline emissions, are related to a project, a sector baseline relates to a sector.
From a methodological point of view the question that arises is how to set the additionality test, the baseline scenario, and the baseline emissions in a proper way. This question has in literature been dealt with in three different ways.

5.2.2.1 Benchmarking baseline methodologies

Probably the most debated sector baseline methodology is the benchmarking approach. The general idea behind this proposal is to set an efficiency standard, meaning that a given technology should per emitted GHG unit be able to produce a given product or service. In the power sector, this could for example be a certain amount of GHG emissions per produced kWh. The setting of this standard is debated. Proposals have been that it should reflect the business-as-usual trend, while others argue that it should reflect “best available technology” or something in between.

[17] It will obviously need to be updated relatively frequently.

A project is credited according to the difference between its emission per service produced and the efficiency standard.
Regarding the additionality test, a project is deemed additional if its emissions per service are below the efficiency standard. The baseline emissions, the additionality test and implicitly the baseline scenario are therefore all represented in the efficiency standard [Lawson et al. 2000], [CCAP 1999], [Bosi & Ellis 2005].

5.2.2.2 Top-down baseline methodologies

A second option is the so-called top-down baseline methodology. This methodology is not usable for developing countries in general but merely those who have accepted or are close to accept voluntary emission targets. The idea behind the methodology is that a project baseline is derived from a more aggregated baseline. The allocation of emission baselines for projects is undertaken by the national government, and emission reductions from these projects would be additional.
[Lawson et al. 2000], [CCAP 1999], [Bosi & Ellis 2005].

5.2.2.3 Technology matrix baseline methodologies

The third possibility is the technology matrix baseline methodology. This methodology is a bit similar to the benchmarking approach, but instead of considering an efficiency standard it considers technologies. A baseline scenario is defined as a list of technologies that are expected to be implemented. Taking again the power sector as an example, the technology that is expected to be implemented and therefore set as the baseline scenario could be combined cycle gas power plants. How these technologies should be found is however still an open question.
The emission baseline is calculated as being the emission rate of these technologies.
A project is considered additional if it introduces technology with GHG emissions lower than the specified baseline technology [Lawson et al. 2000], [CCAP 1999], [Bosi & Ellis 2005].

5.2.2.4 Positioning of the proposed baseline scenario and additionality tool improvement in relation to the sector methodologies.

The change that has been proposed in relation to the existing ACM0002 is to make a baseline scenario method not based on extrapolation, which at the same time can handle the additionality test. The proposed baseline scenario and additionality test should furthermore be sector instead of project specific.
The baseline scenario and thereby also the additionality test are focussed on forecasting the technologies, making the proposal very much in line with the technology matrix approach presented above.

5.2.3 Pros and cons of the sector baseline methodologies

After having presented the overall ideas in the existing sector baseline methodologies including a positioning of this proposed approach in relation to the established methodologies, the positive and negative aspects of these types of baseline methodologies can be raised.
The items below are found through literature [Bosi & Ellis 2005], expert opinions [Fenhann 2005a], COP meetings [COP10 meeting 3] and critical reviews of proposed sector baseline methodologies. The positive items are:

- Risks
- Validation process
- Reliable results

5.2.3.1 Risks

In the present validation process undertaken project-by-project, the investor faces the risk, that the project is rejected after an often long validation period. In the sector approach the additionality question could by the investor be assessed before proposing the CDM project. This would eliminate the uncertainty in relation to whether a project will be accepted or not, which is in theory deciding whether or not the project will be implemented.

5.2.3.2 Validation process

Assuming that several projects will use the same baseline scenario and additionality test, the validation process would be facilitated, simply because fewer analyses should be assessed.

5.2.3.3 Reliable results

Being a sector approach the baseline scenario and additionality test could be made by local experts instead of the investor, making the results more reliable, both because of the local expertise and because a third party would have fewer incentives to bias the results.

These positive items will not be addressed any further and are only included for the sake of completeness. The negative items, which will be addressed below, on the other have to be mitigated in order for the sector approach to be acceptable.
The negative items in relation to the sector baseline approach are the following:

- Accuracy
- Institutional setup
- The legal boundaries

5.2.3.4 Accuracy

In relation to accuracy two aspects are important, namely monitoring and free riders.

Monitoring

The critique regarding monitoring refers to issues about measuring the emissions of the implemented technology, used to calculate the emission reductions (See chapter 4.2).
The problem regarding monitoring is that in a situation where the implemented technology is plenty and greatly dispersed, like household equipment, it is very difficult to monitor every unit. Some average therefore in these cases has to be assumed, which will inevitably lower the accuracy of the monitoring.
The critique does nevertheless not apply to power sectors, as projects will be relatively large and few, making the monitoring a simple post. Monitoring can therefore, in relation to this proposed approach in the power sector, not be considered to represent a problem.

Free riders

Free riding refers to a CDM project being accepted as additional even though it is not. It is a problem related to a lax additionality test, which becomes especially relevant in relation to both the benchmarking and the technology matrix approach.
The benchmarking approach assumes that a technology will be more difficult to implement the less GHG it is emitting. This is so because it is assumed in the methodology that a project is additional if its emissions are below the efficiency standard. There is however several cases, where a less GHG emitting technology from an economical perspective is a better option than a more GHG emitting [COP10 meeting 3]. The additionality test of the benchmarking approach in these cases does not suffice, as a project hereby easily can be

considered additional even though it is the most attractive course of action and would probably have happened in the absence of the proposed CDM project. This is the main reason why a benchmarking approach is not considered in this study, and a proposal more in line with the technology matrix approach is favoured.

The additionality test of the technology matrix approach is however also relatively lax, as it is considering all technologies that are not within the baseline scenario and at the same time has a lower emission level than the technologies in the baseline scenario as being additional. This is so because establishing a most likely scenario through a forecast will inevitably include some uncertainty. One technology might be the most likely to be implemented, but others might at the same time be likely, however not most likely. An additionality tool that accepts projects that are likely to be implemented as being additional will obviously open up for free riding, meaning that a more conservative additionality test has to be made. This will be considered later in the specific design of the proposal.

5.2.3.5 The legal boundaries

Recalling the *problem structuring* chapter the Marrakech Accords states that "*a baseline shall be established on a project-specific basis*". Taken literally this would conflict with the sector based approach where a common additionality test and baseline scenario is developed to be used for a range of projects. A potential problem is therefore whether there is political will and stakeholder support to change this provision. Whether this is a likely course of action will be analysed below.

Perspective from the Parties of the Kyoto Protocol

At the COP10 in Buenos Aires the sector approach was not on the official agenda among Parties to the Kyoto Protocol. This picture has however changed during the past year. In March 2005 the OECD and International Energy Agency Secretariats at the request of the Annex I Expert Group on the UNFCCC prepared an analytical paper to give a general overview of the sector approach [Bosi & Ellis 2005].

On the policy level these ideas were adopted in a Policy Discussion Paper from "*The Greenland Dialogue on the Climate Change*" held in Greenland August 2005 as an informal ministerial meeting with the participation of a broad range of developed and developing countries[18]. In the Policy Discussion Paper it is stated that "*With the aim of making the CDM more attractive and effective, it has been suggested to scale up the CDM to include sector-wide or region-wide projects or policies (sector-CDM or policy-CDM). This would involve quite a different interpretation of the CDM from its current form, but could bring significant benefits both in terms of technology transfer and GHG reductions.*" [Pallemaerts et al. 2005]. The summary from the Chair of the meeting in support of this emphasised that "*It is crucial to accelerate and expand the implementation of the Clean Development Mechanism (CDM) without impairing its environmental integrity. The conditions for the continuation and further development of the CDM beyond 2012 should be created as soon as possible.*" [GMD 2005].

This meeting was seen as a preparation for the COP11 in Canada and given the fact that both many big potential CDM host countries and many big potential CER purchasing Annex I countries were participating the sector approach seems to be ready for negotiations.

[18] The list of high-level participants at the Greenland Dialogue included ministers or vice-ministers from Argentina, Austria, Brazil, Canada, China, Denmark, Faeroe Islands, Finland, France, Germany, Greenland, Iceland, Indonesia, Japan, Mexico, Norway, Russia, South Africa, Sweden, Tuvalu, United Kingdom, and United States.

Developing country perspective

In general from a developing country perspective the CDM promises technology transfer, sustainable development and investment flows from developed countries. If only focusing on the issue of changing the institutional setup for the baseline methodologies the developing countries would be favoured by increased efficiency and an increased flow of CDM projects. From a survey and literature this statement is supported by Cosbey et al. (2005) that concludes that many developing countries are also critical of the present institutional setup and would like to see reforms.

Investor perspective

From the COP10 it was evident that from a business and investor perspective the overriding concern of the baseline methodologies is ensuring that the CDM does not become unattractive as an investment vehicle. Any suggestion for changes of the CDM will therefore in principle get support if it increases investment opportunities, hereunder reducing risks and transaction costs.

In sum this small actor analysis show that the sector approach is on the political agenda and could meet support from the most significant actors, so the legal constrain is likely to be overcome in a near future. This legal issue is therefore not considered as barrier for the development of the sector baseline methodology presented in this study.

5.2.3.6 Institutional issues

To establish sector baseline methodologies both international coordination and national management is needed. A sector based approach would naturally build on most of the current requirements and key institutions. Projects would undergo the same project cycle with CDM project design, approval by host country, validation by a DOE (third party), registration by the EB, and finally monitoring by project participants and verification of CERs (see chapter 4.3 for descriptions of institutions).

However one significant difference would be that in a sector approach, the baseline scenario and additionality test should be provided by some institution within the host country and not the project proponent.

This analysis could be undertaken in the Designated National Authorities[19] or similar entities with capability of applying the sector baseline methodology. This might in turn require significant expertise in power sector development and forecasting, which could be a problem for some developing countries. Such issues on practicability, but also on costs, would however depend on the design of the methodology to be applied.

The national governments of host countries would need to develop the necessary institutions and regulations for private investor participation with CDM projects in the power sector. Bosi & Ellis (2005) states that when sectoral baselines are agreed upon and clear, the transaction costs associated with generating emissions credits could be very limited. The costs to implement the new framework of providing the combined additionality and baseline scenario study could in that way be allocated to the private investors given as indicated above that the sector approach gives lower transaction costs than under the project-based approach.

[19] The national authority that presently confirms that the CDM project activity assists the host country in achieving sustainable development. The institution furthermore often functions as a facilitator for project proponents within the host country [Baker & McKenzie 2004].

As the overall costs hereby are expected to be lowered and on the basis of the probable political will to use the sector baseline methodology it is assumed that this change in the institutional setup is possible.

The negative issues connected to the sector approach were in the discussions above considered acceptable or possible to mitigate in the design process of the sector methodology. From an overall picture therefore the sector approach can be accepted. In the search for improving the ACM0002, let us therefore address the potential merits that this approach can have in this regard.

5.2.4 Evaluation of the proposed sector approach

Whether the proposal for a sector baseline scenario and additionality test proves to be a solution for increasing the accuracy of the baseline scenario without compromising the practicability of the methodology and raising the overall costs depends, apart from the design of the sector approach, on two open questions. First of all whether the sector approach will be politically acceptable, and secondly, whether the institutional changes can be made especially in relation to allocation of costs. As described in the paragraph above, it is assumed that these problems can be overcome.

Looking at the critique mentioned in relation to the ACM0002 the sector based proposal has several merits in comparison to the project-specific proposal:

- The costs could be reduced in comparison to the ACM0002 as several projects could use the same analyses [Bosi & Ellis 2005].
- In relation to the additionality tool used in the ACM0002, the investor had to reveal his motives to invest making the approach impractical. Following the sector approach these analyses are unnecessary.
- Being a sector approach, the motives of the investor are irrelevant in relation to the additionality question, meaning that the analyses that the claimed subjective analyses demanded in the project-by-project additionality test will not be necessary.

Depending on the design of the methodology several other points of critique that was stated in relation to the ACM0002, can be met:

- Using other forecasting methods than extrapolation could lead to the establishment of more likely baseline scenarios. Making a more complex analysis, justification for the assumed development of the forecasted scenario can also be included.
- As already mentioned above, in a sector approach the baseline scenario and the additionality test will be the same. This means that potential conflicts between the two will be eliminated.

Changing the focus from improving the elements in the baseline methodology to a discussion of a sector approach instead of a project approach in the ACM0002 holds, as illustrated above, a large potential for improvement. It is however important that the baseline methodology is designed in a proper manner to avoid the important points of critique that has been raised in connection to the sector baseline methodologies.

If these challenges are met satisfactory, it is assumed that following problems can be mitigated or solved:

Criteria	**Element in baseline methodology**			
	Additionality tool	**Baseline scenario**		**Baseline emissions**
		Implementation of new power plants	**Operation of existing power plants**	
Accuracy		Using extrapolation will often not result in the most likely scenario	Using extrapolation for estimating the operation of power plants is inaccurate Assuming no shut down of operating power plants during forecasting period	Fifty-fifty weight of operation and build margin. Electricity production assumed to be constant
Conservatism		No possibilities for choosing conservative baseline scenario		
Transparency				
Consistency	Additionality tool is by investors argued to be very subjective.			
	Additionality and baseline scenario considered isolated, resulting in possible conflicts between the analyses.			
Applicability				
Practicability	Investors have to reveal their motives for investments. No explanations for how to establish alternatives.			
	Additionality and baseline scenario considered isolated, making the analyses more cumbersome			
Cost-effectiveness	Baseline methodology in general considered costly by investors.			
Constraints		Considerations regarding national circumstances are not included in the baseline scenario		

Table 5.1: If the demands for the design of the sector baseline methodology is satisfactory met, it is assumed that the problems written in black can be solved or mitigated. The problems written in grey are considered not to be affected by the proposal.

6 PROBLEM SOLVING

The purpose of this chapter is to design a method that can be used as a sector approach for establishing the baseline scenario and additionality test in the ACM0002 framework, replacing the existing baseline scenario method and additionality tool.
The method should take into considerations the demands that are set for the baseline methodology through the established criteria (see chapter 4.3), and at the same time mitigate the problem concerning a lax additionality tool which easily is a consequence of the sector approach.

6.1 Methodological choices

The first methodological considerations in this chapter are within the choice of forecasting methods used as a sector approach. This choice is extensively elaborated on in appendix 6.

In relation to the evaluation of the ACM0002 in chapter 4.5, the critique was based on both practical experiences from project proponents, through expert opinions, and on a more theoretical level, through the criteria analysis. In order to enable a practical critique of the forecasting methods that will be selected in this chapter, the forecasting methods are applied to the Argentinean power sector in case studies.
Thereafter the alternative methods will be evaluated both in relation to the criteria and to the practical experience gained through the case studies.
This approach was chosen to make the evaluation comparable with the evaluation of the ACM0002.

The chapter begins with a description of the chosen forecasting methods. Subsequently the methods will be described and procedures followed will be outlined. Thereafter the application of the forecasting methods on the Argentinean power sector will be presented. Finally the forecasting methods will be evaluated according to the general demands for the design of the methods from a practical and theoretical point of view.

6.2 Outline of demands for the forecasting method

Firstly a forecasting method that is more suitable than the extrapolation method for making a baseline scenario and the additionality test has to be identified. The method should be chosen on the basis of the criteria established in chapter 4.3, so that it does not contradict the aims of the baseline scenario. The method should focus on the future implementation of technology and should present the most likely development. Furthermore in order to establish a more conservative additionality test than in the technology matrix approach discussed in chapter 5.2.2 the less likely and unlikely developments should also be established.

6.3 Forecasting methods

As previously mentioned setting the baseline scenario and checking the additionality of a project is a matter of forecasting. Forecasting is here understood as the explicit process with

the goal of determining how the studied issue is most likely to develop within the forecasting period.
Many different forecasting methods exist, divided on knowledge on which the forecast is based. The figure below shows a possible categorisation of the different types of forecasting methods:

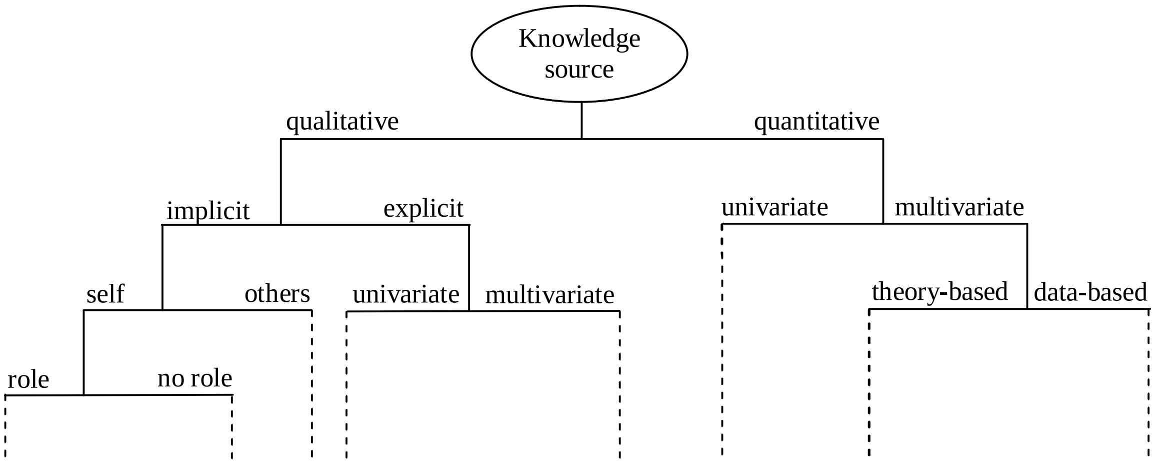

Figure 6.1: The "methodology tree". A classification of forecasting methods.

Each stipulated line in the methodology tree in figure 6.1 is connected to one or several specific forecasting methods. The model is made on inspiration from [Armstrong 2001], [Makridakis et al. 1997].
Besides the types of forecasting methods presented above, another previously widely used method was the "genius forecasting", where a "genius" was found and asked about his or her intuitive forecast [Martino 1992]. This method is not considered relevant in this analysis.
The methodology tree can be used to select a suitable forecasting method by considering what kind of information is available and what demands are set for the forecasting method.

On the basis of the analysis carried out in appendix 6, two suitable forecasting methods were selected. They are both within the qualitative branch of the methodology tree; one in the "explicit – multivariate" branch, denoted the Scenario Forecasting method, and one in the "implicit – others" branch, known as the Delphi method. Each of these methods will be described in short below.

6.3.1 The Scenario Forecasting method

The multivariate qualitative forecasting methods, in which the Scenario Forecasting method is included, is a very open and flexible approach. The Scenario Forecasting method is based on inspiration from forecasting proposals in the electricity sector [CERUPT 2002], [Matsuo 2004a]. It does furthermore draw on experiences from the scenario methodology and forecasting tradition [Godet 1994], [Graf 2002].

A common element for the above mentioned scenario and forecasting proposals is that they characterise certain important variables, denoted here as key variables, which are influential on the evolution of the sector. The forecast of the sector is based on an analysis of the evolution of these key variables and their mutual interactions and interactions with the power sector. The evolution of the included variables can be based on different kinds of forecasting,

but what characterises this method is that the mutual cause-effect relationships between the key variables and the development of the electricity sector are qualitative.
In chapter 4.5, it was argued that the extrapolation method often would prove inaccurate as it is a univariate forecasting method. It is therefore assumed that since the methods within this branch are multivariate they will more often lead to an accurate result, all things being equal. Diverse forms of information can be incorporated into the methodology as it can include different approaches for forecasting the key factors. This makes it an open and flexible approach that can be fitted in many different contexts. A risk is however that the forecast will be to subjective and opaque if not conducted in a stringent and systematic way.

6.3.2 The Delphi method

The Delphi method is a forecasting method using judgements from anonymous experts, normally between 5 to 20. It normally consists of two or three rounds. In each round a questionnaire is filled and commented by each expert. Thereafter the answers are gathered and comments are used to support statements. Questions where agreement among the experts is found are left out from the next questionnaire and a narrowing of possible answers are made on the basis of comments. Gradually during the rounds consensus is established.
The Delphi method is a relatively open framework, based on some key principles. It involves several unbiased experts and uses structured questions which are summarised in an objective way.
The Delphi method can therefore be applied to all kinds of different questions and are especially favoured when data are poor or lacking. It is a method that is suitable in complex and dynamic situations. Furthermore it is relatively inexpensive to perform. On the downside, the Delphi method has shown to be overly effected by the current situation [Dale & English 1998], [Fowles 1978].

6.4 Combining methods

In chapter 5.2 it was mentioned that the principal point of critique regarding the ACM0002, was the forecasting method used, as it was stated that it would often lead to inaccurate results. In order to improve the average accuracy of the forecast made in the baseline scenario and additionality test two methods were found, that because of their ability to handle multiple variables and deal with complexity and dynamic situations, were argued to make more reliable forecasts in this context.
In the effort to increase the average accuracy the results of the two methods will be combined. Armstrong (2001) argues that the accuracy of forecasts increases significantly by combining different methodologies if different data is used as input to the methodologies. The Scenario Forecasting method is primarily based on literature studies and quantitative analyses, whereas the Delphi method is based on expert opinions. The inputs are therefore distinctly different and the methods should, if the results are used in combination, increase the average accuracy. The combining of the forecasts should be done mechanically, and it is by Armstrong (2001) suggested to use a simple average.

Accuracy is however not obtained only by choosing and combining the right methods. It is perhaps even more important that the methods are properly applied [Armstrong 2001]. It is therefore important to gain experience in the application of the methods and thereby begin to establish a “code of conduct” for establishing a baseline scenario and additionality test within the power sector by the use of these forecasting methods.

6.5 Case studies

Using a case study to assess the methodological proposal for another baseline scenario method and additionality tool is controversial in the sense that the accuracy of the result gained through the use of the proposed methods cannot be evaluated, as it addresses a future situation. The accuracy of the proposed methodologies simply has to be assumed on the basis of the arguments raised above. There are however several reasons for using a case study rather than just a theoretical discussion of the problem solving proposal.
Firstly several of the criteria relate to either the possibilities for validation of the results and the usability of the methods for the project proponent. These are assessable through the practical experience with the application of the methods.
Another perspective is that very little experience has been gained in relation to establish a more thorough baseline scenario and additionality test, especially within a sector approach. Performing two case studies therefore might give some insight in the use of different methodologies which can be adopted in further studies within the baseline methodology issue.

6.6 The Scenario Forecasting method

In this chapter the Scenario Forecasting method will be discussed and following applied on the Argentinean electricity sector in order to establish a baseline scenario and additionality test.

6.6.1 Introduction to the Scenario Forecasting method

This method has, as mentioned above, drawn inspiration from several forecasting studies made in the power sector[20] and general scenario methodologies and forecasting methods[21]. It has thereby roots in both phenomena: It follows the scenario methodology in its qualitative logical cause-effect chains that are created between the key variables[22] and the forecasted item in order to establish possible futures.
But at the same time this approach diverges from the scenario methodology in the purpose. The scenario methodology has to purpose to establish knowledge of *several possible futures* [Godet 1994] whereas it is the purpose of the forecasting methodology to establish knowledge of the *most likely future*[23]. The manner, in which the projections of the present situation, is considered, will therefore diverge from the “plural future” form in the scenario methodology to a “singular future” form characterised by the forecasting methodology. A methodological change therefore has to be introduced at this level. Godet (1994) argues that by analysing the key variables regarding their possible trends and interactions with the forecasted item and at the same time including the influence and strategies of the actors, the path to possible future scenarios can be found. In order to change this approach into a forecasting method the focus should be changed from using *several possible* outcomes of the key variables to choosing the *most likely* outcome of the key variables and in this manner choose a singular future path for the power sector.

[20] The forecasting studies all address the methodological question relatively superficial and it is therefore mainly their overall qualitative forecasting approach for the power sector that has been used as inspiration. The studies include: [CERUPT 2002], [Matsuo 2004a], and [UNFCCC 2004].
[21] [Godet 1994] and [Graf 2002].
[22] The key variables are defined as factors on which the trend of the forecasted item is heavily dependent.
[23] As discussed earlier in this report, the most likely future is assumed to be the development that on average results in the most accurate forecast.

The overall approach followed here is therefore to establish a most likely future based on trends and cause-effect relationships and interactions between the forecasted item and the key factors that are influencing its evolution.
The figure below gives a conceptual overview how the forecasted item evolves as a consequence of the evolution of the key variables:

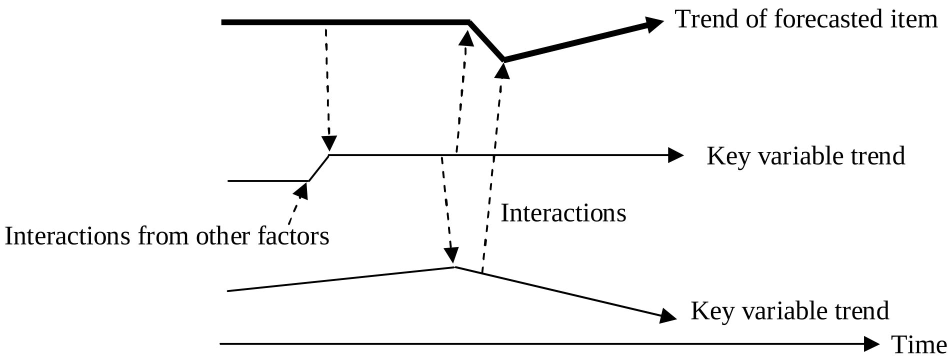

Figure 6.2: The evolution of the forecasted item is a result of the trends and interactions of the key variables. The trends in both the key variables and the forecasted item are constant until they are influenced by interactions. The interactions are created through the trend of the key variables. An example in relation to forecasting the implementation of new power plants could be: The rapid decline in the production of natural gas (the trend of a key variable), interacts with the forecasted item, as gas scarcity occurs. This results in a new trend for the forecasted item, which is that no new gas power plants are implemented. Notice that the forecasted item is only influenced by the key variables, whereas the key variables can be influenced by factors that are not included in the studied system.

6.6.2 Methodological distinctions, assumptions and considerations

The forecast will assume a *frozen* development. By frozen is meant that no elements that does not exist today will be included. This is especially relevant for technology which plays an important role in this forecast. The technological development can be divided in an improvement of existing technology and the invention of completely new technology. The former can be forecasted by looking at the trend and the improvement potential and will be included, whereas forecasting the latter is impeded by our incapability of imagining something which does not presently exist. This forecast will therefore not include the invention of completely new technology.

As an amendment there are some key variables that have to be kept not only frozen but constant in the forecast. The difference is that while the frozen development only assumes a development within something existing, the constant key variables will not develop at all. These constant items are of societal and institutional character, which in their nature are very difficult to forecast.

Considering the timeframe of the study, which is 10 years, this frozen or constant situation is assumed to be acceptable.

As mentioned above, the forecast will be based on the evolution of certain important key variables and how they influence the forecasted item. There are however several important factors that will not be included in the analysis, which collectively can be characterised as extreme events, such as wars and natural disasters. Even though the forecasted item is highly dependent on these, they are nearly impossible to forecast and a continuation of the present situation have to be assumed.

The forecasting method will potentially result in situations where two or more future outcomes of the forecasted item are equally likely. With reference to the criterion about conservatism of the baseline methodology, a conservative path should be chosen, if a case of high uncertainty about the future path of the power sector occurs. Conservatism in this connection refers to a forecast with less emitting power generation technology.

6.6.3 The Scenario Forecasting method step by step

Below the forecasting method used here will be sketched and subsequently each step will be explained.

1. Identification of key variables from literature and experts.
2. Construction of database on key variables.
3. Organisation of trends and interactions.
4. Establishment of baseline scenario, additionality test and consistency check.

6.6.3.1 Identification of key variables from literature and experts

In chapter 4.3 it was discussed that the transparency of the baseline methodology and thereby also for the forecasting methodology is of crucial importance. In order to establish a consistent and transparent method that can be applied in many contexts it is important that the key variables that should be studied in order to make the forecasting are generalised. If this is not the case it can easily be imagined that different interpretations of what to include in the analysis will influence the transparency and the consistency of the forecast.
It is reasonable to assume that such a generalised list of key variables can be used to make forecasts in different contexts, as the development of different power sectors in broad terms are dependent on the same factors in a higher or lesser degree (See for example [Matsuo 2004a]).
The approach to establish a list of key variables was in this case through literature studies and interviews.

6.6.3.2 Construction of the database

Second step in the methodology is to construct a database. By database is meant to establish sufficient knowledge about the key variables, so that:

- The trend of the key variables can be estimated, including possible interactions with other underlying factors influencing the key variables; and
- The web of interactions between the key variables and the forecasted item can be identified.

Regarding the first item, the information should reveal the trend within the key variable and if the trend seems to be stable, or if there are some factors, both within and outside the list of key variables, that contradict this trend. The information should be able to tell when, in what direction and how much these factors influence the key variables.
The second item addresses the forecaster’s ability to answer when, how much and in what way the key variables influence the forecasted item.
The items are not meant as a step-function, but more as an iterative learning process.

The information about trends and interrelations can be both quantitative and qualitative. Depending on issue, some key variables are better served with quantitative data and vice versa. The sources of information can therefore be diverse, but should for the sake of reliability be from official sources. In the additionality tool used in the ACM0002 [UNFCCC 2004] it is proposed that these sources being transparent and documented could be:

- Relevant legislation, regulatory information or industry norms;
- Relevant (sectoral) studies or surveys (e.g. market surveys, technology studies, etc) undertaken by universities, research institutions, industry associations, companies, bilateral/multilateral institutions, etc;
- Relevant statistical data from national or international statistics;
- Documentation of relevant market data (e.g. market prices, tariffs, rules);
- Written documentation of independent expert judgements from industry, educational institutions (e.g. universities, technical schools, and training centres), industry associations and others.

6.6.3.3 Organisation of events and interactions

The next step in the method is to structure the information in the database, so that the important evolutions of the key variables are highlighted. An important evolution is defined by its ability to directly or indirectly inflict a change in the technologies that are to be implemented in the power sector. By indirect influence is meant a key variable causing a change in another key variable, which through a chain of causes and effects is able to affect the power sector. Why the event in the key variables will occur should be stated together with the highlighted change in the key variable. The question whether a given event in one of the key variables will occur, can, because of its future character, not be stated with certainty, and a given event will most often be contradicted by other factors. The statements why a given event will occur are therefore a question about likelihood; which of the arguments for and against are strongest. To make the forecasting as transparent as possible, also the reasons why the event in the key variables *will not* happen should be stated whenever possible. By other words, the important event in the key variables should be organised as follows:

- Important trend in key variable
    - *The reason why this trend will occur*
    - *The reason why this trend will not occur*

The reasons why or why not a given trend will occur is, as it was shown in figure 6.2, an interaction from one of the other key variables. Hereby the trends and the interactions are illustrated.
For some of the key variables their most likely trend is not inflicting a change for the power sector, and does therefore not need to be mentioned in the forecast. If no changes are mentioned, a status quo is expected, which is not inflicting a change in other key variables.

The important events are divided by likelihood, based on the stated reasons why or why not they will occur. This is done to fulfil the forecasts purpose in relation to both the baseline scenario and the additionality question.
The baseline scenario is dependent on one single most likely scenario. The baseline emission calculations have to use a certain scenario as a point of departure to reach an unambiguous emission factor.
The additionality test, on the other hand, is different. The purpose of the additionality test is to state whether a given potential CDM project will happen in the absence of the CDM. In

reality this very sharp distinction between *will happen* and *will not happen* is impossible to draw. The additionality question will inevitably be answered with a scale of *likelihood*. One project will in the absence of the CDM be deemed *unlikely*, whereas another will be judged *likely*. If a given project is *likel*y to happen, it is normally not considered additional, even though it is still not considered *the most likely*.
It is therefore not enough only to state *the most likely* scenario, but also further graduations, should be included if the forecast is to address both the baseline scenario and the additionality test.
In this study, *the most likely* scenario is first addressed. Thereafter other *likely* events are mentioned, followed by the categories *less likely*, *unlikely* and *very unlikely*.
The graduation method is clearly somewhat subjective. In this context, however, the exact naming of the graduation is not that important. What is important is the characterisation of the most likely events to establish the baseline scenario and to answer the additionality question by characterising other events as unlikely to happen. The rest of the graduations are established to comprise the likelihood of the implementation of all the assessed electricity generation technologies.

6.6.3.4 Establishment of the forecast

The development and operation of the power sector can be read from the series of most likely events. These most likely events are considered to be the baseline scenario. The baseline scenario should be checked for consistency, by addressing whether events in the forecast are contradicting. A consistency check for baseline scenarios is suggested in “Operational guidelines for Baseline Studies for Grid Connected Electricity Projects” [CERUPT 2002], which comprises a check whether the baseline scenario is consistent with the physical, legal and social, and economical constraints. This approach should also be followed here.

The additionality question is answered through the graduation of the likelihood of events. A project will in this context be considered additional if it is either *unlikely* or *very unlikely*. A consistency check is equally carried out for the additionality test. This is done similarly as for the baseline scenario, but contrary to the baseline scenario, the constituency check should substantiate the unlikelihood instead of the likelihood of the stated events.

6.6.4 Results

6.6.4.1 Key variables

As described in the method chapter above, the first step is to identify the key variables, which in this case is done through literature and interviews with experts.
Following sources were used:

- “Operational Guidelines for Baseline Studies for grid connected electricity projects” [CERUPT 2002]
- “CDM Methodologies Guidebook” [Matsuo 2004a]
- “Tool for the demonstration and assessment of additionality” [UNFCCC 2004]
- “El Sistema Energético Argentino: su evolución reciente” [Bravo & Groisman 2003]
- Interview with experts within the area of scenarios in the power sector [Bouille and Dubrowsky 2004].

Each article or interview deals with the aspect of key variables in different ways and are more or less generalised and comprehensive. The key variables are categorised and standardised for

this explicit purpose in order to make a list of key variables that with reasonable comprehensiveness controls the implementation and operation of power plants.
The key variables described in the articles and in the interview will be presented in appendix 7, together with a short description of each article. These have been condensed to the list below:

List of key variables including forecasted item:

- External context: International economic situation, energy prices and openness of domestic economy to the international market.
- Electricity system, comprising:
  Demand: Domestic and external demand, losses and peak demand.

  Supply: Electricity generation capacity, availability of this capacity, distribution of technology, transmission capacity of electricity grid, import of electricity and planned expansions of both grid and generation capacity. The evolution of the supply is the forecasted item.
- Institutional setup: Authorities and entities connected to the electricity sector, operation, and electricity price setting.
- Power sector policy: Legal and regulatory framework for the development of the power sector and political goals.
- Resources: Availability of resources.
- Status for technology: Use of technology in the country, future prospects for the technology, legal and social issues connected to technology, Installation and production costs, infrastructure at the location of the technology, plant size, and lead time.
- Investments: Investors' strategies.

Table 6.1: The key variables that has to be included in order to make forecasts within the power sector.

6.6.4.2 Construction of database

Each of the found key variables are thoroughly analysed according to the items mentioned in the method chapter above. In the following, only the summaries of each analysis are included. The actual analyses of the key variables can, together with all references, be found in appendix 8.

External context
The analysis of the external context should include the international economic situation, energy prices and openness of domestic economy to the international market.

The international economic development as well as the economic development in Argentina is expected to continue more or less in the same pace, following the present international development rate at 3.5 and 3.4 % respectively. This development is supported by the increased internationalisation of the Argentinean economy, which means that the Argentinean economy will tend to be positively correlated to the economic development of its main trade partners.

Regarding the international energy prices, the oil, gas and coal prices are expected to follow the course from before the present price rise, which means that the oil and coal prices will fall back at the 2000 prices and thereafter slightly increase throughout the studied period.
The gas price in Argentina could however be subject to rising prices due to the present low price level in comparison to the international gas prices. The Argentinean gas price is presently to a large extent set politically. With stable oil and coal prices and a potentially large increase in the gas price, this can potentially have an influence on the preferred electricity generation technology. Whether this is an issue will be addressed in the "Technologies" chapter further below.

Electricity system: Demand
The analysis of the electricity demand should include both domestic and external demand, including both transmission and distribution losses and peak load.

The electricity demand until 2015 was estimated on the basis of an official forecast made by the Energy Secretariat. The analysis included both domestic and external demand, which was as an average expected to increase 3.9 % yearly. The losses were found to be approximately 12.5 % as an average in the grid. The peak demand has in the latest years been around 15 % higher than the average consumption, and is assumed to continue the present trend. The result is a graph showing the maximum supply needed in the forecasted period in the entire interconnected grid.

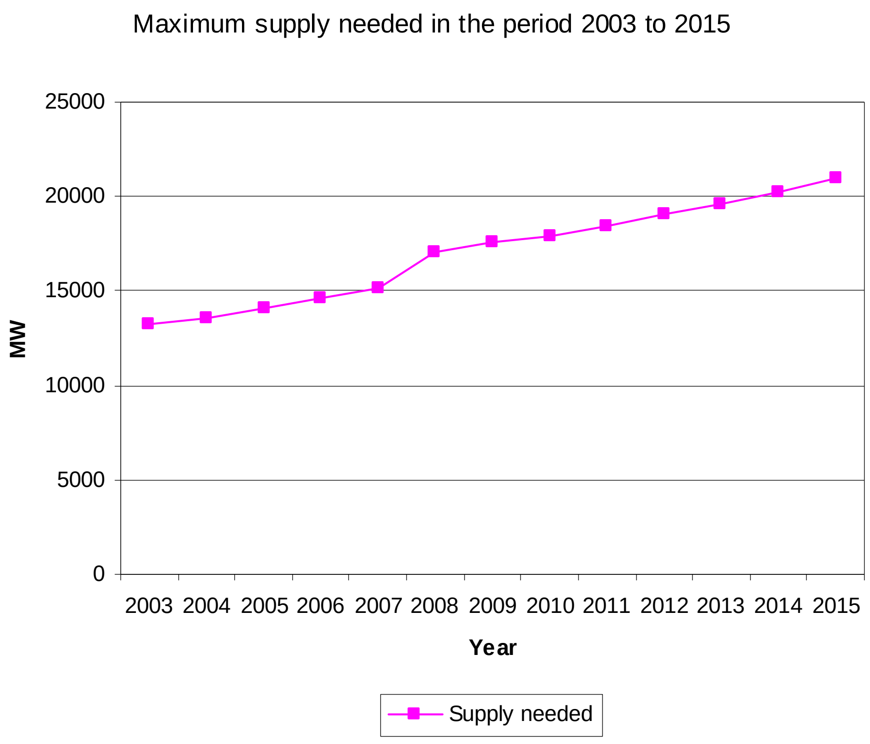

Figure 6.3: The maximum needed supply in the interconnected Argentinean grid until 2015.

Electricity system: Supply
The analysis of the electricity supply should include the electricity generation capacity, availability of this capacity, distribution of technology, transmission capacity of electricity

grid, import of electricity and planned expansions of both transmission grid and generation capacity.

The interconnected Argentinean electricity generation capacity is in the table below divided on energy resource:

Energy resource (%)					
Gas	Hydro	Nuclear	Coal	Diesel	Wind
52.7	**39.6**	**4.1**	**2.6**	**0.9**	**0.1**

Table 6.2: The capacity of the power generation technologies divided on energy resources in the Argentinean interconnected electricity grid as of 2003.

The availability of the generation capacity was analysed showing that the thermal power plants (gas, coal and diesel) in average are 75.5 % available. For hydro and nuclear power plants and wind power the corresponding numbers are 43, 85 and 35 % respectively.

Import of electricity from neighbouring countries operate at market conditions, which also means that since amounts are not contracted, the import arrangement does not offer significant security of supply. An exception is however the agreement with Brazil to dispose of 500 MW.

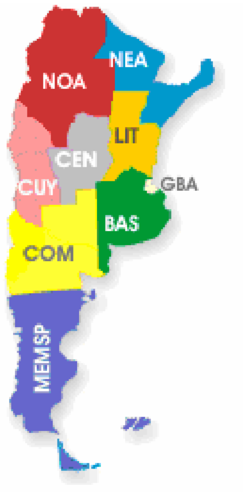

Figure 6.4: The regions in Argentina

Regarding the transmission system, it was concluded that there presently exists a bottleneck between the Comahue (COM) and the Buenos Aires (BAS) regions during peak periods and also that the transmission between the Central (CEN) and the Litoral (LIT) regions can be close to maximum capacity likewise during peak periods.
There are at the moment plans for carrying out several expansions to the existing transmission grid that will alleviate bottleneck situations. At the same time the situation will be improved by the installation of the planned new power plants, where the largest share will be located in the eastern electricity importing regions (BAS and LIT) and regions with a surplus transmission capacity (NEA).
It is therefore estimated that there will be a very limited number of bottleneck situations when the new transmission lines enters into operation, which implies that all the available generation capacity can be used to cover the peak demand.

The power plants planned to be implemented in the grid are the following:

- Gas power plant. 850 MW installed capacity in 2007
- Inclusion in the grid of the TermoAndes gas power plant. 344 MW installed capacity in 2007
- The dam of the Yacyretá hydro power plant will be elevated in 2008, yielding 1400 MW extra capacity.
- Atucha II, a nuclear power plant. 692 MW installed capacity in 2009.

Comparing the available installed capacity, including contracted imports and the power plants that are planned to enter into the system, with the expected demand for the coming 10 years period (See “Electricity system: Demand” chapter), the following picture emerges:

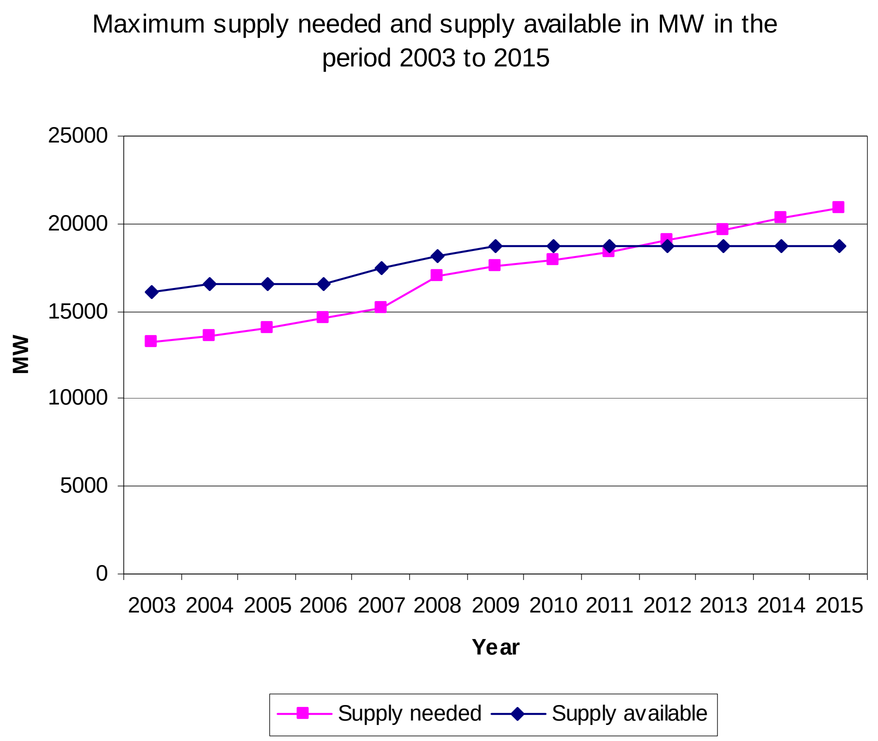

Figure 6.5: A comparison between the maximum needed supply including maximum export to Brazil and Uruguay, losses and peak demand and the net available supply for the period, including planned power plants.

Institutional setup

Since 1992, there has been a large-scale privatisation of state assets in the power sector. In broad terms the state gave up its role as administrator and planner to enter a new role as supervisor and regulator of the activities in the sector. The privatisation process was commenced to encourage market competition.

In the Argentinean power sector there are some key institutions, which are:

- The Energy Secretariat, who formulates and implements policies, and grant permissions;
- the National Regulatory Entity for Electricity (ENRE) who enforces regulations; and
- the Wholesale Electricity Market Managing Company (CAMMESA) is managing the electricity market by dispatching the power plants and price setting as well as responsible for the transmission and distribution lines.

The electricity is either sold on contracts or on the spot marked. The price on the spot market is set by the market conditions on an hourly basis.
The dispatch is made according to economical dispatch based on short run marginal costs.

Power sector policy
With the enforcement of the Energy Act in 1992 the role of the State changed considerably with the reorganisation and privatisation of the power sector.
In theory the State should intervene as little as possible in the market and prices should result from market forces. However, with the severe economic and financial crises as of 2001 including a sharp contraction of economic output and a significant rise in the inflation the power sector was distorted like everything else in the Argentinean society.
In the Argentinean environment of macroeconomic instability the urgency of stabilisation drained most of the political energy. The adaptation of the power sector to the new Argentinean context required systematic and rigorous fine tuning of regulation, but it was seen to be a difficult challenge to regulate with decrees and resolutions. Abandoning the fixed exchange rate and having revenues “pesified” and frozen, and all prices to consumers fixed in pesos made it very difficult for the generators and distributors to cover their costs and invest in new capacity.
In combination, these circumstances created instability and significant uncertainties surrounding the performance of the power sector. In the present situation there is still a lot of instability as generators and distributors have debts and costs they can hardly pay with the present low electricity prices.

During 2004 the political and social situation showed signs of stabilisation. The Argentinean peso appreciated against the dollar, and the economy started to recover.
Even though the political path forward is still with some uncertainty to how normalisation on prices will actually be put forward and how new capacity can be installed, the government has with the National Energy Plan and the additional legislation outlined the direction it will follow.

The process of normalising the regulations and electricity prices will continue to the end of 2005. It has thereby been postponed from its original setup, which will delay the plan of normalisation. Though the present stable government and economic situation will help and make normalisation possible in 2007 only a little later than stated in the National Energy Plan. Development of the price level will tend to go from artificially low and partly subsidised towards more market constituted. More transparency will be experienced in the power sector as regulations are adjusted, but it will only be reached slowly by slowly. The normalisation will not only affect the power sector, but also the gas sector will experience similar changes, with higher prices and more transparent regulations as a consequence.

An electricity crisis can have a detrimental effect on industry, and there is at the moment a lack of investments in the power sector. A fund has therefore been established with the purpose of financing a new gas power plant in 2007.

Resources
These analyses should address the availability of the resources for power generation. For some resources the availability is not an issue, as they can easily be transported. This is the case for oil, coal, and uranium. These will therefore in the following not be discussed. Other resources, such as gas, can be transported in pipelines or in tankers in pressurised or liquefied form. The two latter alternatives have, however, not been assessed as they are generally more

expensive and are therefore not considered probable. Finally there are resources that are strictly bound to a given location. These are hydro, wind, solar and geothermal potential.

Gas
A forecast of the gas demand bade by the Energy Secretariat showed that the gas demand is going to rise 3.6 % annually on average in the period from 2003 to 2015 including both national demand and increasing export rates. It was also concluded that the gas peak demand is expected to be 34 % higher than the average demand. This ratio between the peak and average demand was assumed to be constant throughout the period. Regarding the occurrence of gas in Argentina it was shown that the R/P ratio[24] is around 19 years as an average for the 5 producing basins. The gas occurrence in its neighbouring countries was shown to be scarce except for Bolivia which has about the same amount of gas at their disposal as Argentina and is presently exporting a smaller portion to Argentina.
The bottleneck regarding the future increase in demand was found to be in the transmission system.
The transmission system is presently able to keep up with the average demand, but in peak demand periods, scarcity occurs. The following figure shows the expected average and peak demand until 2015 together with the transmission capacity:

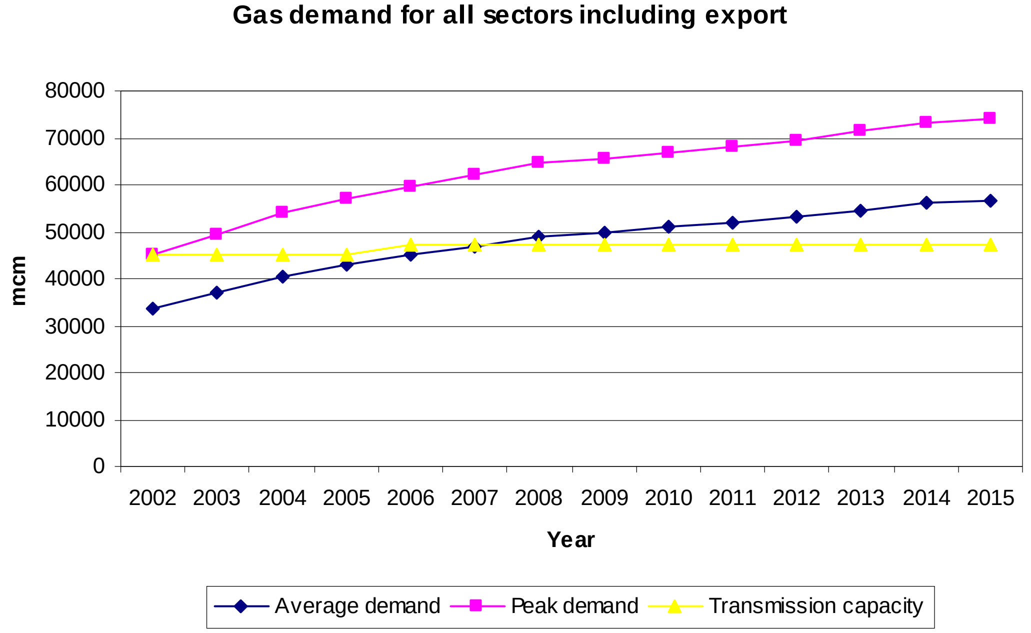

Figure 6.6: The average and peak gas demand in Argentina until 2015 including the gas transmission capacity.

Gas users are divided into "permanent" and "impermanent" users. Especially the impermanent users, among those the gas power plants, are affected by this lack of availability as they in the peak periods have to use more costly liquid fuels instead of gas.

Investments in the gas sector is achieved through the initiative of the private sector, but the investment milieu is presently very unfavourable because of fixed low gas prices and opaque regulations. A normalisation of these conditions is expected by the government to occur in 2007.

[24] The R/P ratio is an abbreviation for reserves/production ratio and is calculated on the basis of proven reserves and utilized production.

The two most likely extensions of the transmission system is either a new gas pipeline from the southern gas basin or a new pipeline from Bolivia to the Buenos Aires region. Whereas the domestic solution is limited by the unfavourable investment environment, the pipeline from Bolivia is facing problems due to the politically unstable situation in the country.

After or during the expected normalisation in 2007, it is likely that investments will take place in new pipelines, most likely the domestic solution because of the political unrest in Bolivia. The Bolivian project is however very economically attractive and when the riots end, it is very likely that it will be continued as it is politically encouraged in both countries. When this will happen is uncertain.

Hydro

Hydropower is another very important source of electricity in Argentina. This source is however contrary to natural gas abundant. Argentina has a large hydro power potential whereof a modest part is today utilized in the electricity generation. In 2003 33.7 TWh was produced by hydro power corresponding to more than 40 % of the total electricity production. Argentina has a hydro potential of around 130 TWh/year which is technically feasible to exploit, which means that only around 26 % is utilised.
Considering this large potential it can be concluded that the hydro potential is not a limiting factor within a foreseeable future.

Wind

In the Patagonian province in the far south, Argentina has a huge wind potential, estimated to be one of the highest in the world. Also in the southern part of the Buenos Aires province large wind power potentials can be found. A preliminary estimate has been made, which indicate that the large land areas combined with the favourable wind conditions results in a total generation potential of 170 TWh/year. Presently 26 MW of installed capacity exists, resulting in a generation of 78 GWh in 2003 or 0.05 % of the total potential.
On this basis it can be concluded that the availability of wind will not be an issue.

Solar power

Argentina also has a large potential for solar power, especially in the Mendoza and San Juan provinces as well as the northern Chacho and Formosa provinces where the radiation reaches around 5 kWh/day*m^2 which is comparable to northern parts of Africa.
Virtually nothing of this potential is currently used as only 26 kW of installed capacity is presently operating in Argentina, located in the northern province Jujuy. This resource is therefore also abundant.

Geothermal power

The geothermal potential is difficult to estimate, but a worldwide exploration of the geothermal potentials suggests that the Argentinean conditions are not particularly favourable in this regard.
Only one small geothermal power plant presently exists in the province of Neuquen with an installed capacity of 0.6 MW. The plant is presently out of order. Some geothermal potential is however exploited in relation to spa therapeutic recreation centres, whereas only very few projects are dealing with domestic use. In total 25.7 MW of geothermal heat is used within these facilities.

Technologies

The analyses of the electricity generation technologies should include the use of the technology in the country, future prospects for the technology, legal and social issues connected to technology, installation and production costs, infrastructure at the location of the technology, plant size, and lead time

The table below will give a condensed presentation of the discussed technologies:

Technology	**Installation costs (US$/kW)**	**Price per kWh (US cents)**	**Lead time (years)**	**Installed capacity (%)**	**Availability of resources**	**Issues regarding infrastructure**	**Legal and social issues**	**Future prospects**
Gas	350-800	4-6.5* (4**)	1-3	52.7	Medium-high, but low gas transmission capacity			Slightly lower costs are expected
Hydro	1000-1600	7	5-7	39.5	High	Main hydro power potential is far from demand centres	Opposition against large hydro plants	
Nuclear	1000-2500	4 (6.5**)	6	4.1			Nuclear power is only on national hands. Expansion plans have been poorly managed.	
Coal	1000-2000	4 (6**)	4-6	2.6				Possible marginal decrease in production costs
Oil	1300	8.5***	?	0.9			Strict environmental regulations, resulting in higher production costs	
Wind	1000-2600	6	1-2	0.1	High		Remunerated by 1 to 1.5 centavo per produced kWh (~ 0.3-0.5 US cents)	Drop in prices on around 20 % during next decade are expected
Solar	3000-10000	60	1	0	High		General political support	Price level is expected to drop significantly
Geothermal	1500-5000	4-15	5-7	0	Medium		General political support	Slightly lower costs are expected

Table 6.3: Prices, pros and cons for a number of different electricity generation technologies. Prices are based on international data, whereas the pros and cons are explicit for the Argentinean situation. Future prospects for the technologies are likewise international.
**The operation costs are probably lower in Argentina, as the prices indicated above are based on international fuel prices. The fuel constitutes a large part of the operational costs for gas power plants, and the gas in Argentina is, even with the expected price rise due to the normalisation of price levels, below the international level.*
***According to Argentinean study.*
****Probably higher in Argentina because of legislation.*

The table above shows that in the case of abundance of gas, and a focus on low initial investments, gas power plants would, in relation to the evaluated parameters, be the preferred choice. If higher initial investments can be accepted, and the long lead time is likewise acceptable, nuclear and coal power could be a possibility. Nuclear power can however only be owned by the State. Also hydro power should be mentioned in this connection, but is unfavourable in relation to the social opposition against the technology and the higher price per kWh. Oil power plants do not from this analysis seem attractive.
Other technologies such as solar or geothermal power plants does not from this analysis seem attractive to the investor, both because of higher prices, but also because of the unfamiliarity with the technologies. Wind power is comparable to nuclear and hydro, but is restricted by its uncontrollable production. It does however seem more attractive than geothermal or solar power.

Investments
With the privatisation experienced in Argentina the management of the power sector lies to a very large extent in the hands of private agents. From the analysis of the investment environment and investor preferences it can be concluded that "normalisation" of the power sector as for regulatory safety, concessions, and prices are of crucial importance to further investment in capacity additions. In the present very risky investment environment it is unlikely that any private player will invest. The normalisation is however impeded by the tendency that the government has protected the customers from a radical price jump, which will be an inevitable consequence of an immediate liberalisation of the prices.
In the privatised market one way to deal with the high risks in Argentina has been by oil and gas companies entering power generation. The strong interrelationship between energy industries was emphasised by looking at the position of the three biggest oil and gas companies in Argentina, Repsol-YPF, Total and Petrobras, whom all will be able to hedge the risks in the gas and electricity market and profit from their participation both upstream and downstream in the natural gas production chain.
Their strategies are likely to indicate a common trend or even condition the remaining ones' decisions as they deliver gas to the region. At the same time they have the regional basis to become investors in power generation when the investment environment betters.

The State is still a large player in the electricity market. Unlike the private investors, the State has some economic considerations at a more macroeconomic level than the private investors. From a macroeconomic perspective hydro power becomes more attractive, as hydro power is, contrary to for example gas power plants, build on-site. This means that hydro projects create new jobs, which at the same time means that less hardware have to be imported. Hydro projects can also create some secondary effects such as irrigation.

6.6.4.3 Organisation of trends and events for the implementation of new power plants

Most likely events

- Normalisation of gas and electricity prices and regulatory framework in 2007.
  This <u>will</u> happen because:
  - *As both sectors are highly privatised, the normalisation is necessary in order to make the sectors attractive for the investors.*
  - *The normalisation is politically planned to gradually take place, and be finalised in 2007.*

  This <u>will not</u> happen because:

  - *It is politically unpopular to pass on the costs of rising electricity prices to the citizens.*
  - *A price rise would put pressure on the inflation rate, while it is a political goal to minimise it.*

- New power plants and transmission lines as described in the National Energy Plan are implemented in the period from 2007-2009.
  This will happen because:
  - *The plants are highly needed and are financed by the government and funds already established.*
  - *Electricity shortages are very detrimental for the industry and it is therefore of high priority to the government to guarantee a supply.*

  This will not happen because:
  - *As earlier experienced, the construction of power plants, especially the nuclear power plant under construction, has several times been postponed. It is therefore possible that the construction will be further delayed.*

- Investments in the Argentinean gas sector become more attractive and a new pipeline, most likely from the southern Argentina, opens in 2008.
  This will happen because:
  - *A normalisation of prices and a more transparent regulatory framework makes investments in the gas sector more attractive.*
  - *The pipeline is highly needed and it can therefore be expected that it will be extensively used. An investment under these conditions is normally favourable.*

  This will not happen because:
  - *The investors are not willing to invest in a high-risk country.*

- The first privately financed gas power plant after the normalisation is built around 2009, with a generating capacity of around 800 MW. In the following years, similar power plants will be installed continuously.
  This will happen because:
  - *The normalisation of electricity prices and high electricity demand makes investments in the power sector attractive.*
  - *The increased gas supply and the low cost of gas power plants make this technology the most attractive electricity generation option.*
  - *The large investors are interested in gas power plants to hedge risks.*
  - *The size of the power plant is comparable to other implemented gas power plants in the country.*

  This will not happen because:
  - *The investors are not willing to invest in a high-risk country.*

- At one time in the period 2007-2015, the pipeline from Bolivia will be completed. When exactly this will happen is highly uncertain, because of the politically unstable situation.
  This will happen because:
  - *The construction is approved by the governments of both countries.*
  - *The project is economically attractive.*

  This will not happen because:
  - *The politically unstable situation in Bolivia might continue.*

Likely events

- Normalisation of gas and electricity prices and regulatory framework is delayed, and therefore not concluded in 2007.
  This will happen because:
    - *It is politically unpopular to pass on the costs of rising electricity prices to the citizens.*
    - *A price rise would put pressure on the inflation rate, while it is a political goal to minimise it.*

  This will not happen because:
    - *As both sectors are highly privatised, the normalisation is necessary in order to make the sectors attractive for the investors.*
    - *The normalisation is politically planned to gradually take place, and be finalised in 2007.*

- The delayed normalisation will lead to that the San Martin pipeline will not be completed as early as 2008.
  This will happen because:
    - *The delayed normalisation will lead to a less attractive investment environment.*

- The delayed normalisation will entail the State to look into the construction of hydro power plants.
  This will happen because:
    - *Gas and electricity supply are relatively scarce and the investors are awaiting the situation. The State is compelled to invest.*

  This will not happen because:
    - *From a microeconomic perspective, hydro power still is more expensive than gas, which means that gas will be the preferred technology.*

- The Gasoducto Noreste Argentino (the pipeline from Bolivia) cannot be accomplished.
  This will happen because:
    - *The unstable situation in Bolivia continues throughout the period.*

  This will not happen because:
    - *The construction is approved by the governments of both countries.*
    - *The project is economically attractive.*

- The lack of gas will encourage investors to look into hydro power.
  This will happen because:
    - *There is a large hydro potential in Argentina.*
    - *The technology has an acceptable price level.*
    - *Many investors are familiar with the technology.*

  This will not happen because:
    - *From a microeconomic perspective, hydro power still is more expensive than gas, which means that gas will be the preferred technology.*

Less likely events

- The State will after the completion of Atucha II (the nuclear power plant that is expected to be finalised in 2009) continue the implementation of nuclear power.
  This will happen because:
    - *The State wants to increase the security of supply*

  This will not happen because:
    - *The technology is relatively expensive compared to other alternatives.*
    - *The role of the State is not to invest in the sector if this can be avoided.*
    - *The completion of the Atucha II has been a slow and uncertain process. It can be assumed that the State will therefore hesitate in commencing another similar project.*

- The State or other investors will in the end of the period (between 2010 and 2015) invest in wind power.
  This will happen because:
    - *There is a politically focus on wind power generation technology and it is economically remunerated by the State.*

  This will not happen because:
    - *The likelihood for the State or other investors to invest in wind power increases during time because of the expected lowering of the costs per kWh for the technology. It is however still relatively expensive compared to other alternatives, and the experiences with the technology is limited.*

- The State or other investors will invest in coal power plants
  This will happen because:
    - *The price level for coal power plants is comparable to hydro power.*

  This will not happen because:
    - *There is very little experience with coal power in Argentina.*

Unlikely events

- The State or other investors will invest in wind power within the next 5 years.
  This will happen because:
    - *There is a politically focus on wind power generation technology and it is economically remunerated by the State.*

  This will not happen because:
    - *The technology is expensive and the experience with the technology is limited.*
    - *Even though it is a political goal to increase the amount of wind power in the power sector, the main objective for the State is to increase the security of supply. This can be done more cost-efficient using other technologies. It is therefore unlikely that the state will invest in wind in this period.*

- The State or other investors will invest in geothermal power.
  This will happen because:
    - *There is a politically focus on renewable power generation technologies.*

  This will not happen because:
    - *The technology is expensive and the experience with the technology is limited.*

Very unlikely events

- The State of other investors will invest in grid connected solar power.
  This will happen because:

- *There is a politically focus on renewable power generation technologies and resources for solar power are high.*

This will not happen because:

- *The technology is very expensive compared to other alternatives even though the price level is expected to drop significantly in the next decade.*
- *It is mainly an option where there is no grid connection.*

6.6.4.4 Organisation of trends and events for the operation of power plants

Most likely events

- No existing power plants will be shut down in the period

  This will happen because:
  - *There is a general lack of generation capacity.*

6.6.4.5 Establishment of baseline scenario

The most likely events can now be used to establish a baseline scenario for the power sector in Argentina in the period from 2005 to 2015. Both the operation and implementation of power plants is included. The operation of existing power plants is however assumed constant, as no power plants are expected to be shut down during the period. If this was not the case, the shut down power plants would appear as a negative capacity addition in the table below.
The baseline scenario according to the scenario forecasting method:

Year	Technology	Capacity (MW)	Remarks
2005			
2006			
2007	Gas	850 MW, 344 MW	Both included in the National Energy Plan
2008	Hydro	1400 MW	Included in the National Energy Plan
2009	Nuclear, gas	692 MW, 800 MW	Nuclear is included in the National Energy Plan, gas is forecasted
2010			
2011	Gas	800 MW	Forecasted
2012			
2013	Gas	800 MW	Forecasted
2014			
2015	Gas	800 MW	Forecasted

Table 6.4: The baseline scenario according to the scenario forecasting method.

Consistency check of the baseline scenario

The consistency check should consider whether the baseline scenario is consistent with the physical, legal and social, and economical constraints.

Physical constraints

The physical constraints will in this context be defined as the availability of skills and knowledge on technologies the constraints set by the electricity demand and the availability of resources to fulfil this demand.

The technologies in the baseline scenario are already widely used in Argentina as can be seen in the “Technologies” section above. The technologies in the baseline are therefore not impeded by the lack of skills and knowledge.

Looking at the electricity supply/demand curves keeping in mind the above development, following picture emerges:

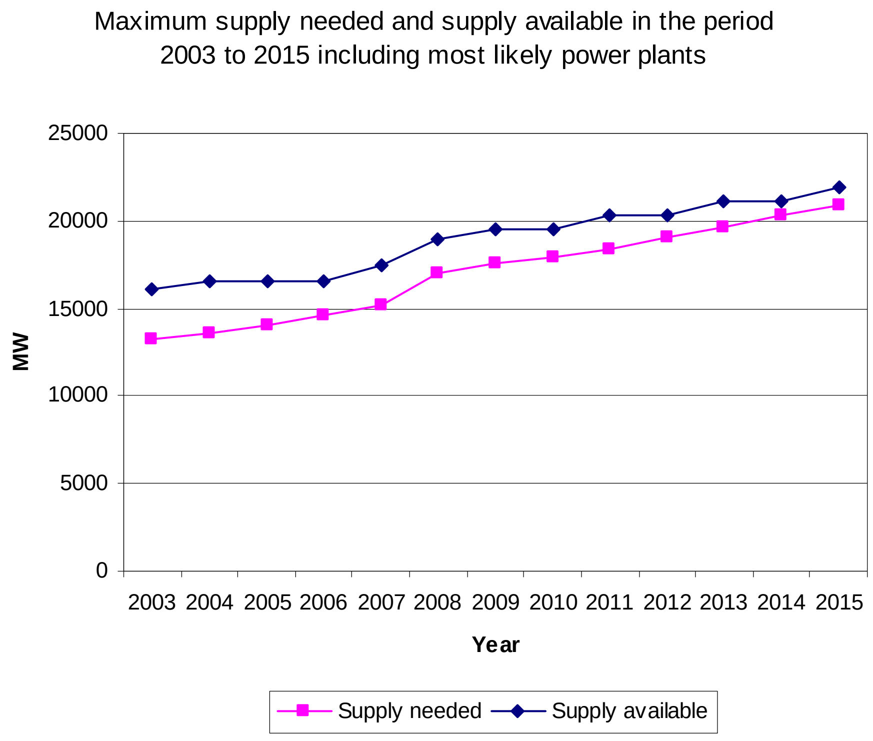

Figure 6.7: The development of electricity supply and demand until 2015 according to the baseline scenario.

The availability of resources for the power production in the baseline scenario is in this context the availability of gas and to some extent hydro power potential. The availability of hydro power potential was addressed in the "Resources" section above, and was found to be abundant. The availability of gas can be checked by comparing the supply and demand in the baseline scenario. This is done in the figure below:

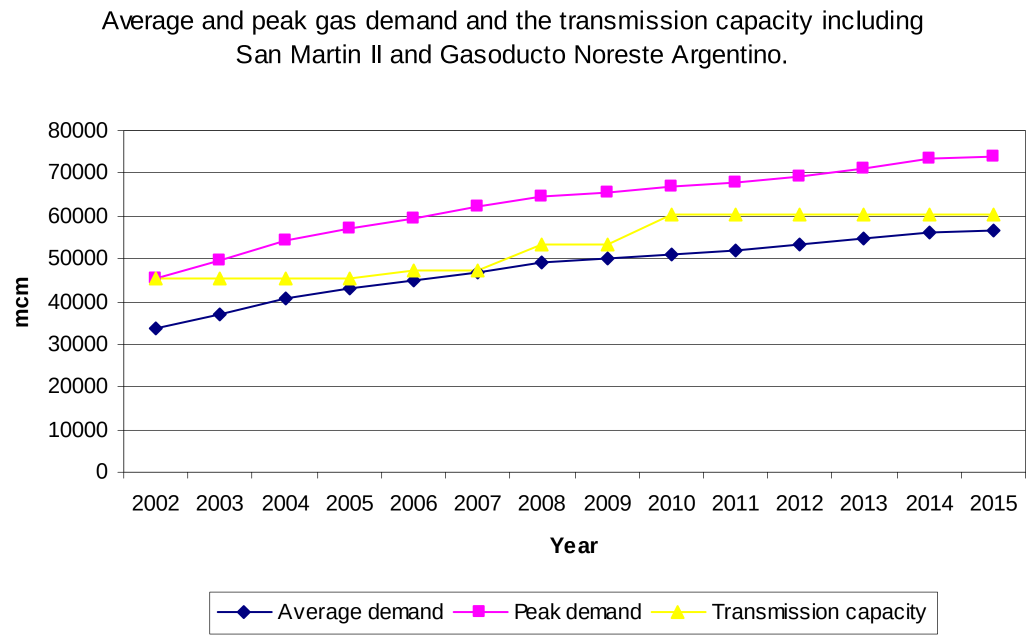

Figure 6.8: The average and peak gas demand curve from the "Resources" section, but includes the San Martin pipeline from southern Argentina in 2008 and the Gasoducto Noreste Argentino from Bolivia in 2010. The latter could however both be before and after the stated time.

The analysis of the gas supply and demand points to that there will be sufficient gas supply to cover the increase in the average demand. The peak demand will, as is also the case today, not be met. However, this has shown not to be a decisive constrain, as a gas power plant is planned to be build in 2007 without having a guarantee for a better gas supply.

On the basis of these analyses the baseline scenario is consistent with the physical constraints.

Legal and social constraints
The availability of gas in the baseline scenario is based on the construction of the Bolivian-Argentinean gas pipeline, which can only be conducted if the social unrest in Bolivia comes to an end. Whether this will happen is as mentioned uncertain. In the baseline scenario it is however assumed to be most likely that the unrest will end within the timeframe of the scenario, which means that the baseline scenario is most likely not socially constrained. There are no legal constraints in the baseline scenario.

Economical constraints
The baseline scenario can be constrained by the investors' lack of interest, if the technologies chosen in the scenario are not the most cost-efficient.
The baseline scenario is according to the analysis made in the "Technologies" section above the most cost-efficient, apart from the construction of the already planned hydro and nuclear power plants.
The baseline scenario is therefore generally consistent with the economical constraints.

As a conclusion on the consistency analysis, the baseline scenario can be regarded as generally consistent with the physical, legal and social, and economical constraints.

6.6.4.6 The additionality test

Regarding the additionality question, a project can on the basis of the above forecast be considered to be additional if it is within the categories *unlikely* or *very unlikely*. Following renewable power generation projects can therefore be considered to be additional:

- Grid connected solar power
- Geothermal power
- Wind power (until 2010).

Consistency analysis of the additionality test
The consistency analysis of the additionality test will, as the consistency analysis of the baseline scenario, be based on the physical, legal and social and economical constraints.

Physical constraints
The three technologies are all constrained by the lack of skills and knowledge about them in Argentina, as they presently only collectively constitutes 0.1 % of the total installed capacity.

Legal and social constraints
There are no legal and social constraints.

Economic constraints
The three technologies, especially solar power, are more expensive that other alternatives and are therefore constrained by the investors' lack of interest.

The three technologies are both physical and economical constrained. A scenario including these technologies will therefore be inconsistent. The consistency analysis hereby confirms that these technologies are additional.

6.7 The Delphi method

In this chapter the Delphi method will be presented in general terms and thereafter applied on the Argentinean electricity sector in order to establish a baseline scenario and additionality test.

6.7.1 Introduction to the Delphi method

The Delphi method was developed in the 1950s and 1960s by the RAND Corporation[25] to make forecasts on future developments; at first hand about the military prospective of and political issues concerning future technologies. Since then the Delphi method has been used in various national and organisational future studies to design roadmaps and forecasts of technological developments [Gordon 2003]. It should in this context be realised that using the Delphi technique is not a firm method, but more an open approach with possibilities for adaptation.[26]

The technique recognizes human judgement as a legitimate and useful input, and it allows experts to deal systematically with a complex problem and to generate forecasts. This collective judgment of experts, although made up of subjective opinions, is considered to be more reliable than individual statements and should therefore be more objective in its outcomes [Ludwig 2005]. The basic reasoning is that two brains think better than one.

A key rationale behind the Delphi method is however that it tries to avoid the bias in opinion forming that often takes place through certain social interactive behaviour at normal group discussions. Conventional face-to-face settings are often dominated by the people who talk first, loudest or have most prestige. Therefore the Delphi method was designed to encourage a debate free of context influencing factors and independent of personalities. Anonymity is then required in the sense that no one knows who else is participating and making the forecasts. The statements obtained are not identified as to who said what, when and how, but are presented to the group in such a way as to suppress any identification [IIT 2005].

At the same time this offers the possibility of dealing with group communication among a panel of geographically dispersed experts. Traditionally the technique comprises a series of questionnaires sent out to the same group of experts several times, each time adding the results of the previous rounds. A basic element of the method is further to give all experts equal “weight” on the subject under investigation and then feedback to the group as a whole for further analysis.

Summing up, the above listed aspects of anonymity and feedback represent two of the key elements of the process of conducting a Delphi study. Further it is possible to talk of a broad procedural outline that all Delphi studies follow, keeping in mind that there is a range of

[25] RAND as an acronym for Research and Development was a “think tank” in California, USA.
[26] The Delphi method is on this behalf also in literature named the Delphi technique or Delphi approach.

Delphi techniques used and adapted for numerous purposes. Fowles (1978) systematize the Delphi method in the following ten steps:

1) Formation of a team to undertake and monitor a Delphi on a given subject.
2) Selection of one or more panels to participate in the exercise. Customarily, the panellists are experts in the area to be investigated.
3) Development of the first round Delphi questionnaire.
4) Testing the questionnaire for proper wording.
5) Transmission of the first questionnaire to the panellists.
6) Analysis of the first round questionnaire.
7) Preparation of the second round questionnaire.
8) Transmission of the second round questionnaire to the panellists.
9) Analysis of the second round responses.
10) Preparation of a report by the analysis team to present the conclusions of the exercise.

These steps will be explained in further details below concluding with special considerations regarding a power sector Delphi forecast.

When the goal and scope of the Delphi study has been settled the designated research team can plan the undertaking of the study.
Next step will be identifying the experts from the required disciplines and organisations. The number to include can vary according to scope and possibilities. Armstrong (2001) talks about at least 5, but seldom more than 20, and Gordon (2003) states that most studies use between 15 and 35 experts.
The selection of participants is key to a successful Delphi study, since the result depends on the knowledge and cooperation of the experts. Persons who are likely to contribute valuable insights are essential to include.
During the initial contact, the nominated persons are told about the Delphi and invited to participate. They are assured of anonymity in the sense that none of their statements will be attributed to them by name.

Step three and four outlined above is about designing the first round in the Delphi study. The classical Delphi operated solely with traditional questionnaires, but in-depth interviews with experts have in later Delphi studies been used with great success as an alternative [Gordon 2003]. The technique to use will depend on the goal and scope of the investigation, the geographical distribution of the experts and available resources for the study. This illustrates the open structure of the Delphi method.
The first round and questionnaire could take several forms, but would most likely be one or two unstructured and open-ended questions enabling the experts to comment on the investigated issues.
Formulating the questions in a proper manner is important. The questions must be sharp and answerable, and much literature on the Delphi method finds it is desirable to perform a test of the design of the questionnaire to find flaws or opacity [Gordon 2003], [Armstrong 2001]. The questions may imply any sort of judgement for example forecasts on the occurrence of future developments, desirability of some future state and more. Each objective would require different types of questions.

After transmitting the first questionnaire to the expert panel and receiving their answers the responses are then analysed and synthesized by the research team. This gives the basis for developing a series of structured items for the second round. The second questionnaire would normally ask participants to review important items identified from the first round of the Delphi (steps 6 and 7).

The questions are in this sense refined by the researchers and pursued through a number of sequential questionnaires and steps 7 to 9 are reiterated as long as desired or necessary to achieve stability in the results.

6.7.2 Consideration for making a power sector Delphi forecast

When using the Delphi method with the objective of including the results in the baseline methodology for power sectors some general considerations can be stated.
The Delphi must of course focus on providing a detailed representation of the baseline scenario through a forecast of future operational patterns and capacity additions to the power grid.

The experts required for such a power sector forecast should for reliability reasons cover a broad range of public and private entities within the specific power sector including national/regional planning departments, regulatory entities, grid operators, dispatch centres, private power generators, transmission and distribution companies etc. The experts chosen should have a firm knowledge and be familiar with planning issues and trends relating to the power sector development. The number of experts cannot be stated specifically, but it should be justified that the most important players in the sector are included.
The first round should be used to diverge, explore and gain knowledge of the present state and key factors for the power sector as well as likely trends for the power sector technologies, investments and key actors.
Subsequent round would then be an exercise of converging until the most likely development for grid operation and capacity additions can be stated with specific outline of year of commission and type of technology.

6.7.3 Delphi forecast of the Argentinean Power Sector

Below the case study with the specific adaptations, steps and results of the Delphi method in relation to the Argentinean power sector will be presented.

The objective of providing a detailed representation of the baseline scenario through a forecast of future operational patterns and capacity additions to the Argentinean interconnected power grid guided the choices and design of the different steps.

The final outline and outcome of the study was however also dependent of our temporary stay and the specific circumstances in Argentina. For instance the study was made possible through our cooperation with the research institute Fundación Bariloche in Buenos Aires.

6.7.3.1 Performing the Delphi - steps:

The Argentinean Power Sector Delphi was conducted through a first round of qualitative personal interviews and thereafter a second round of questionnaires performed through mail.

Formation of the Delphi team - Selecting the experts:

The design and execution of the Delphi was done by the two authors of this thesis. We though had some assistance from Senior Energy Planner Daniel Bouille in Fundación Bariloche. The characteristics and qualifications of desirable experts were discussed with him and he also provided the initial contacts to most of the experts. As our supervisor he was himself excluded from the expert panel, but as an experienced energy analyst in Argentina he could guide us in pointing out experts from different organisations and companies.

Our selection criteria were diversity of expertise and diversity of institutional backgrounds to cover as many aspects of the power sector development as possible and not getting biases from the respondents having similar background or interests.
Nine experts were chosen to participate and the first round was conducted in the period 21 January to 7 March 2005. One of these experts was not directly interviewed. One was answering the first round questions by mail. The second round answers were obtained in May 2005.

The experts were representing the following institutions:
Energy Secretariat (Two different departments)
National Regulatory Entity for Electricity (ENRE)
Wholesale Electricity Market Managing Company (CAMMESA)
Argentine Association of Electric Power Generation Companies (AGEERA)
Private electricity retail company (CEMSA)
Private energy consultant
Lecturer and expert in Energy Scenarios
Fundación Bariloche

The initial contact was established by sending out a letter by mail giving a description of the project, its objectives and the Delphi method. The letter also invited each of the selected experts to participate, informed of anonymity and asked for a first round personal interview.

Development of the first round

Given the number of experts and that we had the opportunity to get a personal interview with them; we designed the first round as a qualitative interview. It would give us the chance to explore the advantages that face-to-face interviews can give on behalf of flexibility. Secondly it would give an in-depth understanding of the power sector development seen through the eyes of different experts.

The next step was to formulate the questions and make an interview guide (see appendix 9). To make the interviews as uniform as possible we posed the same open ended question to everybody. This question was: "In your view what are the perspectives in the medium term (10 years) for the technologies in the power sector and the electricity grid?".
Depending on how thoroughly the respondent elaborated on the broad opening question we added questions of clarification and deepening. We would for instance make sure that each of the present and possible future technologies on the Argentinean power market was analysed.

6.7.4 Results of the first round

The first round gave a picture of the status of different power sector technologies and their future development within the Argentinean power sector.[27]

Among the experts there was a common understanding on key trends for the Argentinean power sector. Of course they were emphasising slightly different perspectives and the importance put on each technology was not completely identical, but there were no significant

[27] Some interviews were transcribed and are included in appendix 9. However, some did not want their exact wording in the report.

deviations on how they would characterise the present status of the power sector and the main trends concerning the technologies of the sector.

Below the main points and statements have been condensed to a summary of the first round interviews.

6.7.4.1 Political issues

From all the interviews the crucial role of political and economical stability for the privatised electricity market was emphasised. Since the economical breakdown in 2001 and the subsequent laws of the presidency declaring the country in a state of emergency the regulation of the power sector has been irregular and unpredictable. Most experts found it unlikely that any investments would occur until these risks have been minimised and electricity prices have been brought back in line with costs of production. A normalisation of price level and regulation are therefore seen as a requisite for further investments and stabilisation of the power sector.
The government and the power sector are further in a stage of renegotiation of contracts for e.g. transmission and distribution companies, which would also be decisive for the future development.

6.7.4.2 Investments

No private company would invest until the prices are stabilised on a higher level so production costs can be covered for new capacity additions. Because the political and economic instability during the past years Argentina is a high risk country for investments and for the past four years there have been no significant investments in the power sector.

6.7.4.3 Coal and oil

It was indicated that coal and oil as fuels in the power sector would be most unlikely in new capacity additions. Argentina does not have any significant coal reserves and only one very old plant (*San Nicolas*) is powered by coal.

Even though Argentina has oil it is mainly exported and the oil price on the world market is very high compared to the domestic gas price. So the experts did not see any future for new oil power plants also because of environmental regulations. One expert emphasised that even if the oil price would drop to a level below the present high international oil prices gas would still be cheaper.
Coal and oil would only be considered as backup if gas for periods was not available for power generation. That is they were not considered as real options, because of the availability of gas domestically or from Bolivia.

6.7.4.4 Nuclear

General agreement that a third nuclear power plant, Atucha II, that has been in process for many years will be finished in the near future. Financing has been the main problem going even back in the nineties before the economic collapse of Argentina in 2001. All experts however agreed that the government now had found the necessary capital for finishing the nuclear plant.

6.7.4.5 Hydro

Argentina has still got a big potential for hydro power, but developing projects takes big initial investments and with the present tense economic situation in the country the private investors are very reluctant to put money in new hydro projects.

The state has plans for elevating the dam of the *Yacyreta* hydro power plant (1400 MW). Further they have negotiations with Brazil on a future bi-national hydro power plant called *Garabi* (1800 MW). On a longer perspective initial investigation have also been made on a bi-national hydro power plant with Paraguay called *Corpus Cristi*. Most experts did however not see these plants happening in the near future.

6.7.4.6 Gas

Experts were not in doubt that gas would be even more important in the future as the major source of fuel for the power sector. Gas was from all sides characterised as the better investment option from a business point of view as soon as normal conditions were obtained. All experts pointed however out that the government had made plans to intervene in the liberalised market and suggest a combined public-private investment in two gas power plants. On the operational side the experts noted that during a period of one or two months in winter time some power plants suffer from shortage of gas supply due to very high gas demand in other sectors[28]. This was the only significant factor distorting operation in the future.

6.7.4.7 Renewables

In general with the tight economic situation in the country and the high risk investment environment no experts saw a wide penetration for renewable technologies within the next decade.
The most promising future renewable technology in Argentina would be wind energy, but on a small scale and mostly in isolated areas in Patagonia in the far south. In this case it would be outside the interconnected grid.
Solar panels, micro hydro and geothermal power options were not left many chances in a 10 years horizon in an Argentinean power sector struggling with finding investors at all and meeting future demand.

6.7.4.8 Operation of the system

The experts in general agreed that there were no signs of abrupt or discontinued operation of the present power plants within the interconnected grid.

6.7.5 Development of the second round

The information gained in the first round was synthesized and then transformed into a questionnaire dealing with the trends for the present and potential power sector technologies. The second round could in this sense confirm and specify with more precision, how the expert panel would forecast new capacity additions.

The final questionnaire for the second round was designed with 23 questions.
Considering that the experts were very busy and that we as students from Denmark could not compensate the time they would have to spend on the Delphi study we had to limit the amount of questions considerably.

For this reason and on the basis of the clear statements in the first round we excluded questions on coal and oil as power technologies. None of the experts found it likely that they would penetrate the market as long as Argentina had either gas locally or provided from the region. We also excluded specific questions on the operational matters as none of the experts

[28] Metaphorically speaking it was by the experts called “la ventana” – the window where shortage hit the power sector.

saw any changes in the coming years. Instead we focussed on the development of hydro, nuclear and gas.
The questions touched upon when specific hydro projects would be finished and the amount of hydro power introduced in the future; how much new capacity of gas power plants would be installed; and when the foreseen nuclear power plant would be ready. Further we needed to clarify if non-conventional renewables within the horizon of 10 years would become common practice or at least penetrate the market in a significant way. This to make a check on which technologies could be stated to be additional to the baseline scenario for the power sector. Some of the 23 questions were added as a consistency check to see if the forecasted trends in one question would be in line with the development of interrelated key variables[29].
An example would be cross checking the amount of MW new hydro capacity projected to be installed and the specific forecast of known hydro power plans. Similarly within the development of gas power plants this was cross checked with future gas supply.

As an example of the typical structure of the questions an example is included below. The whole questionnaire and the incoming answers are presented in appendix 10.

Nuclear power

When will Atucha II be finished?

1)	2008-2009
2)	2010-2011
3)	2012-2013
4)	2014-2015
5)	2016 or later
6)	It will never be built

Comments:

Table 6.5: An example of a question in the Delphi forecast

In order to maintain clarity and a consistent layout six answer options was the standard.[30] It was judged that listing every single year giving often more than 10 answer options would make the questionnaire less assessable and lead to more confusion than a simple layout. To enhance the easiness of assessing the questionnaire instructions were given in a clear and concise manner how to fill it out. All questions further had space for comments in case the respondent needed to clarify their statement.

Together with the questionnaire an introduction letter was attached explaining the rationale behind the Delphi study and specifically about the second round. These were sent by email to the nine experts from the first round.

[29] This term is equivalent to the key variable definition presented in the Scenario Forecasting method and are defined as a factor on which the trend of the forecasted item is heavily dependent.
[30] In a few questions either five or seven answer options have been chosen to cover the range needed. See Appendix 10.

6.7.6 Results

We received six answers out of the nine initially participating and these were the basis for the final Delphi baseline scenario presented below.
The analysis and full view of the second round questionnaire are presented in appendix 10.

Gordon (2003) states that the results of the Delphi should "*be based on the median rather than the mean, since single extreme answers can ´pull` the mean unrealistically*". In our case only very few extreme answers were given. This was e.g. answering "never" to a question on when a fourth nuclear power plant would be built. The construction of such a fourth nuclear plant would anyhow be in the far future way beyond the ten years time scope, so in this case the answer did only indicate the uncertainty of such long term forecasting.

In appendix 11 we have reported estimated the median as well as the spread. The spread is reported to show the homogeneity within the answers. The experts were actually very much in line with each other.

6.7.6.1 The baseline scenario

On the basis of the median values for the specific questions on power sector technologies a technology forecast of the most likely capacity additions can be presented.

Year	Technology	Capacity (MW)
2005		
2006		
2007		
2008	Gas, Combined Cycle	2 x 800 MW[31]
2009	Hydro (Yacyreta)	1400 MW
2010	Nuclear (Atucha II), Additional Gas	692 MW, 275 MW
2011	?	
2012	?	
2013	?	
2014	?	
2015	?	

Table 6.6: Capacity additions according to the Delphi method.

For the period after 2010 the second round Delphi questionnaire was not specific enough to plot the likely capacity additions.
Besides *Yacyreta* another big hydro plant *Garabi* is projected to be introduced by the very end of the period or just after. It would therefore have no effect within the ten year crediting period of a CDM project.

No private hydro plants are projected in the short term, but to get a forecast on what will happen during a 10 years period would demand at least one Delphi round more.
The first round statements pointed to that gas would be the preferred technology of investments. This was stated unanimously and constructing new gas power plants beyond 2009 would therefore most likely be part of the baseline scenario.

[31] The size of these combined cycle gas power plants were announced by the two experts from the Energy Secretariat.

6.7.6.2 Additionality test

The experts further forecasted that non of the renewables neither wind, solar panels, micro hydro or geothermal was going to penetrate the Argentinean power sector before after 2015. These technologies would therefore from this assessment be stated to be very unlikely as part of the baseline scenario and they are therefore considered to be additional in Argentina.

Normal hydro projects cannot from the Delphi be determined to be either additional or not as this was not explored in depth. Big hydro plants are however likely to be part of a longer baseline scenario.

6.7.6.3 Consistency check

As mentioned above some questions were included to serve as a consistency check.
In general it was no surprise that the experts were consistent in combining the development of key variables with their technology forecast. As an example checking each experts' responses show that private investments in gas is not expected until after a price and/or regulatory normalisation is forecasted.

In general the Delphi questionnaire forecasts that the stagnation experienced in the Argentinean power sector since the severe economic difficulties began in 2001 is still going to prevail for some years to come. Private investments in new gas power plants that were the trend before 2001 is not projected until after 2009. This is consistent with the foreseen normalisation.
Electricity prices that have for long been distorted because of the economic crisis will from around mid-2007 reach a level where prices can be said to match costs of production in the power sector. This first step is followed by a normalisation of the power sector regulation by 2009 and these stable conditions were pointed out in the interviews to be very vital to domestic but especially foreign investors.

Investments in gas power from 2009 is moreover cross related with the availability of gas and in this regards it is estimated that the gas pipeline from the south of Argentina will be delivering gas to the main consumer centres in mid-2007. This is backed up by the other supply channel from Bolivia that is expected to deliver gas some years later around mid-2010.

6.8 Combining the results from the case studies

In order to increase the average accuracy, it was argued that the results of the two forecasts should be combined. As described in chapter 6.4 this should be done through a simple average.
The forecasts have provided three separate forecasts, namely in the operation of the existing power plants, the implementation of new power plants and finally the additionality test.
Regarding the operation of existing power plants, it was in both methods found that no power plants will be shut down in the forecasting period.
Looking at the operating margin, it is in both methods stated that no power plants will leave the system in the forecasting period.
Regarding the build margin, the scenario forecast states that in the period from 2007 to 2009 1994 MW of gas powered power plants, 1400 MW hydro power, and 692 MW of nuclear power will be installed.
In the Delphi Method, it is stated that in the period from 2008 to 2010 1875 MW of gas powered power plants, 1400 MW of hydro power and 692 MW of nuclear power will be

installed. The difference in this period between the two is primarily a small difference in the amount of installed gas power plant capacity. Furthermore the implementation is pushed one year beginning 2008 in the Delphi Forecast instead of 2007 in the Scenario Forecast. Regarding the rest of the period, no clear results were gained through the Delphi Forecast. It was however in the first round of the Delphi stated that future implementations would be even more focussed on gas power plants. This open statement fits very well with the Scenario Forecast.
The weighted operation and implementation of new power plants from the two forecasts are collected in the table below:

Year	**Technology**	**Capacity (MW)**	**Remarks**
2005			
2006			
2007	Gas	597 MW	
2008	Hydro, gas	700 MW, 800 MW	
2009	Nuclear, hydro, gas	346 MW, 700 MW, 400 MW	
2010	Nuclear, gas	346 MW, 138 MW	
2011	Gas	800 MW	Based on the Scenario Forcasting method, supported by the Delphi method
2012			
2013	Gas	800 MW	Based on the Scenario Forcasting method, supported by the Delphi method
2014			
2015	Gas	800 MW	Based on the Scenario Forcasting method, supported by the Delphi method

Table 6.7: The baseline scenario stemming from a combination of the Scenario Forecasting and Delphi method.

Concerning the additionality test, both methods pointed to, that solar power, geothermal and wind power was not to be implemented in the grid in the forecasting period. If this had not been the case, the most conservative answer would have been chosen.

6.9 Evaluation of case studies

The objective of the presented forecasting scenario method was to provide a method for establishing a sector baseline scenario as a basis for the calculations in the baseline emissions. The baseline scenario should furthermore include a sector additionality test.
Evaluating the method, the first question is therefore whether the method fulfils these general demands. Later, if the raised question is answered positively, it will be evaluated how well the method fulfils these tasks.

In the calculation of the baseline emission presented in the baseline methodology ACM0002, the baseline scenario has to provide information about the future operation and implementation of power plants in the interconnected electricity grid.
In the scenario forecasting method, the type of power plants that will be included in the future electricity grid is estimated and can therefore account for the baseline scenario. However, it was not addressed in the forecasts what type of power plants, only the energy fuelling the power plants was estimated. To be able to use this information in order to calculate the emissions from these power plants in the baseline emission, an assumption about the specific type of power plant has to be made. Drawing a parallel, in the ACM0002 it is assumed that the type of power plant resembles the newly introduced power plants also in type. Regarding the type, the same assumption can be made for the forecast presented in the case study, so that if it is estimated that a gas power plant will be introduced in the future, and the gas power plants that are already in the system is combined cycle power plants of a given standard, the future gas power plants will also resemble this type and standard. If on the other hand it is forecasted that power plants, which are not presently in the interconnected grid or which were introduced to the grid many years ago, are to enter the grid, it cannot be assumed that the type and standard of the power plants will resemble the existing type and standard in the grid as these are either not existing or very old. A parallel to analogous situations from other grids or a given technology standard can be used.
In this manner the scenario forecasting method can be used for establishing the baseline scenario necessary in the baseline methodology.

The second aspect that the scenario forecasting method has to provide is the additionality test. The additionality tool used in the ACM0002 is project specific meaning that it addresses a specific potential CDM project and states whether this is likely to be additional. The additionality test provided in the forecast above is on the contrary sector-specific, meaning that the test does not address the additionality of a specific project, but addresses what kind of projects that is additional in the sector. In this way the additionality test provided in the scenario forecasting method is not addressing whether a project will be made if is it registered as a CDM project, but only that some types of projects are not to be made, not considering the possibility for CDM registration. Whether these types of projects will be favourable as CDM project is therefore not considered, but is for the investor to decide. The method does nevertheless provide the essential aspect of the additionality question, which is to sort between projects that are likely to happen in the future and those who are not, not considering the possibility for CDM registration.
The scenario forecasting method therefore does provide a usable additionality test. It is however not as widely applicable as the additionality tool used in the ACM0002, which is used as a test for all potential CDM projects. The additionality test provided above can in the present setup only be used within the applicability conditions for the ACM0002.

6.9.1 Evaluation according to the criteria

As mentioned above it will following be addressed how well the scenario forecasting method performs the baseline scenario and the additionality test. The assessment will be based on the same criteria used to assess the ACM0002 in chapter 4.5. The criteria are:

- Accuracy;
- Conservatism;
- Transparency;
- Consistency;
- Wide applicability
- Practicability; and
- Cost-effectiveness

An explanation on the criteria can be found in chapter 4.3. The evaluation will be made in relation to the evaluation previously made of the ACM0002 in chapter 4.5.

6.9.1.1 Accuracy

Forecasts can, because of their future nature, not be verified before the end of the forecast period. In the present case it is therefore only the method that can be evaluated.
As stated in chapter 6.3, the Delphi method is especially applicable in complex dynamic environments, and the Scenario Forecasting method is capable of including multiple variables, making them appropriate for forecasting in the power sector. Combining the results have empirically shown to increase the accuracy of forecasts. It can therefore only be assumed that if the methods are applied in a proper way, the result of the combined forecast will on average be more accurate than the extrapolation method used in the ACM0002.
A recommendation in this connection is however that it is advisable to let two different groups carry out the two analyses, as it is difficult not be affected by the answers of the experts when carrying out the Scenario Forecasting method.

In relation to the application of the forecasting methods, there is however an aspect that probably would have increased the accuracy.
In the first round of the Delphi method there was a general agreement that future implementations after 2010 and throughout the forecasting period would be gas power plants, we were however not able to state when new power plants would be implemented and the probable size of these. This was both due to our limited experience with the method, but also because of practical limitations in the number of questions that we could ask and the number of rounds we could perform. It is however assumed that under optimal conditions these shortcomings could be managed. It is therefore not considered an issue that is an inherent limitation in the method, but merely a question of the performing.

6.9.1.2 Conservatism

Considering first the baseline scenario, the ACM0002 offers only one way of estimating this. Whether this can be considered conservative is dependent on the situation. But most important it can not be chosen conservative as there are no choices inherent in the method. The Delphi Forecasting method does similarly not contain the possibility to make a more conservative estimate of the baseline scenario, as it is simply calculated on the basis of the answers of the experts. One option, which was however not used here, could be to weight conservative answers from the questionnaires higher.

The scenario forecasting method is different in this regard as it offers the possibility to choose the most conservative scenario if two or more scenarios show to be equally possible. In the Argentinean case study this was not the case, and there were therefore no possibility to highlight this option.
In relation to the additionality test, the additionality tool in the ACM0002 and the Scenario Forecasting methods are very similar, as they offers the same possibilities for being more or less strict about how “additional” a project must be to be accepted. There is however a difference in the degree of conservatism in the methods. In the Scenario Forecasting it was chosen, that a project is only additional if it is assumed unlikely or very unlikely to be implemented, whereas the additionality tool in the ACM0002 only states that the project scenario has to be less attractive than the baseline situation.
In the Delphi Forecasting method, a conservative choice in relation to the additionality test can be made if it is decided that technologies are only additional if there have been no diverging statements among the experts.

6.9.1.3 Transparency

Transparency of the baseline scenario and additionality test relates to whether the included assumptions are justified and readily assessable.
Taking the Scenario Forecasting method, each event is a result of a cause-effect chain. Taking an example from the above categorisation of events, it was stated that it is very likely that a pipeline from the southern Argentina will be build in 2008. One of the arguments behind this statement is that:

- *The pipeline is highly needed and it can therefore be expected that it will be extensively used. An investment under these conditions is normally favourable.*

The first argument is based on the present and expected scarcity of gas. This is based on an official forecast of the gas demand, which can readily be verified, and an analysis of the gas supply and transport system (sources are available in appendix 8). The analysis of the gas supply covers several other aspects and is too comprehensive to discuss here. The capacity of the present transport system is likewise accessible official information as is the second statement above.
The scenario forecasting method is therefore transparent as the assumptions are justified and can be verified.
The Delphi method on the other hand is based on the judgements of experts. The assumptions they make are not justifiable and cannot be assessed in a transparent manner. However, if it is accepted that the baseline scenario and the additionality test can be based on expert judgements, it is not the judgements that need to be transparent, but the questions that are asked, the answers that are given and how these have been compiled. In the case study above, this information is provided. The Delphi method is therefore transparent if expert judgements can be accepted as a basis for the baseline scenario and additionality test.

6.9.1.4 Consistency

Consistency relates to whether the methods are systematic and objective.
The former addresses if the method systematically produces the forecast. In relation to the Scenario Forecasting method, it primarily identifies a list of key variables that are to be analysed in order to be able to establish a trend for the key variable and detect the interrelations of the key variables. The areas for what data needs to be gathered are hereby stated in a systematic way, but less regarding the level, i.e. how much should be known about the issues. Carrying out the analysis, this vague definition of the level of awareness that needs

to be gained, however, becomes clearer. For each question that is raised a reasonable burden of proof have to be established. It is however still considered being a problem of the method. How this could be improved was not identified. One solution might be to change the key variables into a detailed list of questions that should be answered. This would however on the other hand make the method less applicable, as the unique national setting of the power sector might not be comprised by well-defined questions.

For the Delphi Forecasting, some of the same critique can be mentioned. The creation of the questions demands a certain level of awareness about the relevant issues. It is however likewise difficult to state the areas and the precise level of awareness that must be gained to be able to ask the right questions.
Both methods do therefore not give a well defined level of awareness that should be established, which is the same critique that can be mentioned in relation to the additionality tool in the ACM0002.

The baseline scenario method in the ACM0002 is different in this sense, as it specifies exactly the area and level of awareness that needs to be gained.

The objectivity of the Scenario Forecasting method relates to whether the arguments for the events can be stated objectively. The events are considered to have some specific likelihood of happening, which is based on the weighting of arguments, as in the following example taken from the case study above:

- The lack of gas will encourage investors to look into hydro power.
  This <u>will</u> happen because:
    - *There is a large hydro potential in Argentina.*
    - *The technology has an acceptable price level.*
    - *Many investors are familiar with the technology.*

  This <u>will not</u> happen because:
    - *From a microeconomic perspective, hydro power still is more expensive than gas, which means that gas will be the preferred technology.*

Whether these arguments do actually lead to, that investments in hydro power is likely, is a matter of the judgement. Considering the size of the analysis, it can be argued that the objectivity of the result is even lowered due to the many judgements that are cumulating through the analysis.

The additionality test of the ACM0002 is functioning in the same way, except that the arguments are evaluated in turn as individual barriers and not collectively as in the example above. The baseline scenario methods in the ACM0002 on the other hand provide a fully objective way of stating the baseline scenario.

The Delphi Forecast is likewise based on judgements. It is however *expert* judgements and these are calibrated through taking an average of their answers. If this approach can be accepted it provides a fully objective forecast, as the answers of the experts are compiled in a systematic and objective manner.

Summing up, both the Scenario Forecasting method and the additionality tool in the ACM0002 are therefore not fully consistent, as they do not provide a fully systematic and objective way of producing the forecast.

Similarly is the Delphi Forecasting method not completely systematic in relation to the information that needs to be gathered either. The forecast is however compiled in an objective manner.
In contrast to these methods is the baseline scenario method in the ACM0002, which is fully consistent.

6.9.1.5 Applicability

The ACM0002 is stated to be applicable to renewable grid-connected electricity generating projects. As both the Scenario Forecasting and the Delphi Forecasting method uses the baseline emissions calculations in the ACM0002 applicability is the same, if the technologies addressed in the applicability conditions of the ACM0002 are included in the Scenario Forecasting method and the Delphi method.

6.9.1.6 Practicability

Obviously the forecast made through the case studies are more demanding than the baseline scenario method and the additionality tool of the ACM0002. Considering that this is a sector baseline approach, it is assumed that a more thorough analysis can be performed as several projects can use the same analysis. This evaluation will therefore be based on our practical experience in performing the methods and assessing whether these are assumed to be applicable in their potential context.

To apply the Scenario Forecasting method presented above was a demanding job and it took us approximately four months to do the research and reach a result on the scenario forecasting. Yet, it should be noted that during this period the method was also developed. We had some experience within the scenario methodology, which is comparable to the Scenario Forecasting method, from a former study in Ecuador and this was a great advantage in conducting the study. On the other hand our knowledge of the context and on the specific operation of power sectors was not very developed. Furthermore the study was to some extent impeded by language skills, meaning that the four months can most likely be shortened significantly under optimal conditions.

In broad terms we did not experience serious constrains in Argentina as for getting relevant data. Much information and data could be downloaded from the internet or was available through journals or other written evidence. Also the governmental entities had information on the internet.
Some analyses were even made on beforehand and readily applicable in the forecast. This was the case for the forecast of the electricity and gas demand.
Sometimes we could however not get completely updated information.
Our situation was significantly lightened due to expert guidance from Fundación Bariloche, meaning that coming from abroad without local contacts it would probably have been quite cumbersome to track down the needed information if not for some guidance.
Considering however that the Designated National Authority or similar institution carrying out the forecast is familiar with the host country of the CDM project, this is not considered a problem.

Our experiences in carrying out the case study point to, that the application of the Scenario Forecasting method is quite burdensome. It is however estimated that a local expert within the power sector would be able to apply it in a more efficient manner that we did. Yet, some months might be a realistic guess.

It was also found that transforming the gained knowledge of the system into a consistent scenario proved difficult, meaning that some experience within the method would be highly favourable.
Finally, the forecasting method sets relatively high demands for the availability of information.
If the open access to information and existing analyses as we experienced had not been accessible the Scenario Forecasting method could pose a problem. Such situation might be the case in less developed countries than Argentina.

The Delphi forecast was done over a period of 4 months. It is difficult to give an exact estimate of how time consuming the process was as other work was done in the same period. A rough estimate is, that we used collectively about one month. This should be seen in the light of the lack of results meaning that if a more complete Delphi should be carried out, longer time must be expected. The lack of results was mainly due to two aspects.
Firstly, a problem that we ran into was that some experts dropped out from first to second round and that we had long responding time on the second round. One reason is possibly our background being students and not professionals, but also that the Delphi was done on a voluntary basis. For this reason we moreover found it necessary to limit the number of questions because the experts were not compensated for their time spent.
It could based on this experience be said that a full size Delphi would probably be more likely to succeed if the experts were to be remunerated for their time spent and that it thereby also would be possible to follow a predetermined time schedule.
Secondly, the open format of the Delphi method left us with several options for design. As it was our first time conducting a Delphi forecast, there were several aspects that could have been improved. As an example we asked some questions that was not utilised in the forecast. Another issue was that it was generally difficult to find the right balance between open and closed questions, leading to the situation, that we had no information about when the expected gas power plants would be implemented.

The first round of the Delphi was carried out through open interviews, which was rather time consuming. In our case we however found that it was the better way to increase our knowledge and make sure we could cover the relevant aspects in order to reach a forecast. Further through performing of the scenario forecasting we successively built our level of understanding of the system, but a general lesson learned is that having a good understanding of the power sector analysed is crucial to be able to choose the right focus and questions in the Delphi.

When performing a Delphi, a broad network of experts is crucial. In finding and selecting the experts for the study we were fortunate that our contacts at Fundación Bariloche could give good assistance and provide the necessary contacts. Considering again that the Designated National Authority or similar institution carrying out the Delphi is well founded in the national context this is not considered a problem.

Based on the experience obtained through the case study, it was found that more questions should be included in the questionnaires and possible that more rounds should be conducted. This would probably increase the time consumption in carrying out the analysis. Furthermore it was found that the Delphi method is not easy to perform satisfactory, meaning that some expertise within the method would be favourable. Also a fair insight in the sector is needed to ask the right questions, indicating that some expert assistance on this matter would likewise be recommended. At the same time this would reduce the need for carrying out interviews as the first round, which was a quite time consuming process. Finally it should be mentioned that if a good network of experts can be established, the issue of gathering information is fully avoided, making the method suitable for a developing country context in this regard.

6.9.1.7 Cost-effectiveness

Considering that the combined forecasting method applied in the case study above must be considered much more demanding than the existing project-specific baseline scenario and additionality test in the ACM0002, this must be counterbalanced by the increased use of the sector specific baseline scenario and additionality test. If this is not the case, including a more complex analysis, will only aggravate the problem concerning high costs in applying the ACM0002 baseline methodology.

In small grids there will be only very few CDM projects in the power sector, it is therefore not considered possible to apply this combined forecasting method, whereas it might be possible within larger grids. This might imply, that the sector approach will be more attractive in larger sectors, whereas in smaller, the present ACM0002, however problematic this methodology seems, might prove to be the best alternative.

6.9.2 Conclusions

The critical points presented in relation to the ACM0002 are included on the left side of the table. The critique in relation to the ACM0002 that has been met is marked with a grey colour, whereas the continuing problems are written in black. On the right side of the table, new issues that has emerged, only relating to the combined forecasting method is presented.

Criteria	**Element in ACM0002 baseline methodology**				**Combined forecasting method**
	Additionality tool	**Baseline scenario**		**Baseline emissions**	
		Implementation of new power plants	**Operation of existing power plants**		
Accuracy		Using extrapolation will often not result in the most likely scenario	Using extrapolation for estimating the operation of power plants is inaccurate Assuming no shut down of operating power plants during forecasting period	Fifty-fifty weight of operation and build margin. Electricity production assumed to be constant	
Conservatism		No possibilities for choosing conservative baseline scenario			
Transparency					
Consistency	Additionality tool is by investors argued to be very subjective.				Trends in Scenario Forecasting method is based on judgements Level of necessary knowledge to perform the Scenario Forecasting method not fully defined
	Additionality and baseline scenario considered isolated, resulting in possible conflicts between the analyses.				
Applicability					
Practicability	Investors have to reveal their motives for investments. No explanations for how to establish alternatives.				More cumbersome than existing methods. Higher demand for expert assistance and information
	Additionality and baseline scenario considered isolated, making the analyses more cumbersome				
Cost-effectiveness	Baseline methodology in general considered costly by investors.				Depends on the number of CDM projects.
Constraints		Considerations regarding national circumstances are not included in the baseline scenario			Baseline scenario not made on a project-by-project level.

Table 6.8: The critique of the ACM0002 and the combined forecasting method. The combined forecasting method has mitigating the issues written in grey under the ACM0002 baseline methodology. The issues written in black are not affected by the scenario forecasting method. The points of critique written in the right side of the table under the combined forecasting method are new points of critique that are introduced by this method.

The proposed change from the ACM0002 baseline methodology towards a sector approach using the baseline emissions calculations from the ACM0002 shows in the above table not to be unproblematic. Several of the existing problems have been eliminated or mitigated, but new problems have at the same time arisen.

The problems in relation to consistency of the combined forecasting method, is difficult to mitigate. Judgements are an inherent part of the Scenario Forecasting method. An alleviating circumstance is however that in contrast to the additionality tool used in the ACM0002, the Scenario Forecast is assumed to be applied by a third party and not by the project proponent, making the incentives for biasing the analysis smaller.
Regarding the second problem, the level of knowledge that needs to be gathered in order to apply the methods might be systematised through further experience with both the Delphi and the Scenario Forecasting method.

The largest problem in relation to the proposed method seems to be the practicality. It was concluded above, that the combined forecasting method, and especially the Scenario Forecasting method, is much more demanding to apply than the existing baseline scenario method and additionality tool in the ACM0002.
A potential solution to this problem could be to reduce the scope of the Scenario Forecasting method. In the case study above, the forecast made through this method was mainly a result of the political plans, the least cost power technologies, experiences with the technologies in the Argentina, the institutional setup and the forecasted electricity demand curve. Forecasting on only this basis will obviously in some cases lead to more inaccurate results, but if it at the same time was combined with the results of a full Delphi analysis, this might be acceptable.

Another more drastic solution could be to only use one of the two proposed forecasting methods. This would probably compromise the average accuracy of the forecast, but more experience with both methods is needed to state the magnitude of this problem. It would however at the same time reduce the work load significantly. In this case, the Delphi method seems more promising as the input for the method can be assumed to always be available, whereas the information for the Scenario Forecasting method, in some developing countries might be problematic to assemble.

Whether the proposed combined forecasting method holds perspective for being used in the CDM context is heavily dependent on the final two problems stated in the table above. Accepting a more cumbersome analysis, when the existing ACM0002 is already accused for being too costly, depends on the flow of CDM projects. If many projects are to use the established forecast, a more cumbersome analysis can be accepted, whereas if the implementation of projects is not to gain speed, this proposal is doubtful. Also it is, as discussed in chapter 5.2.3, dependent on the political will to allow a sector-approach into the present project-by-project setup.
There is however no doubt that if the quantity of projects and the political will falls out to the benefit of the sector approach several of the existing complaints regarding the ACM0002 can be met by the above proposal.

7 Expanding the boundaries

During our process of improving the ACM0002 baseline methodology new relevant aspects have gradually appeared in line with our increased understanding of the issue.
To begin with the boundaries for the knowledge to include in the analysis of the ACM0002 was set through the list of criteria and constraints (see chapter 4.3). Following in the evaluation of the ACM0002, it was found that to overcome the problems facing the ACM0002, a sector approach had to be adopted. This change in setup implied that new issues had to be considered and following new knowledge and considerations was pertinent to the analysis of the baseline methodology.
The purpose of this chapter is to discuss the new understanding that has arisen on the basis of the above evaluation of the proposed baseline scenario method and additionality test and point to new knowledge or considerations that on this basis preferably should be considered in the design of the baseline methodology.

The issues that will be addressed are the following:

- Uncertainty;
- practicability; and
- sustainable development

7.1 Acknowledging uncertainty

We have in this study tried to mitigate some of the problems found in the present ACM0002. One of them being the uncritical use of extrapolation leading to a high risk of inaccurate estimation of the baseline emissions assigned to a CDM project.
No forecasting methods are however perfect as profound and partially irreducible uncertainties are inherent in all forecasting exercises.

To understand the prevalence and relevance of uncertainties in connection to baseline methodologies two concepts of uncertainty are introduced. Uncertainty is by Walker et al. (2003) defined as a three dimensional phenomenon, where one of these, the *nature of uncertainty*, is characterised by the two extremes.
1) Epistemic uncertainty, where the uncertainty is due to lack of knowledge. Such uncertainty can thereby be reduced by more research and empirical efforts.
2) Variability uncertainty, where the uncertainty is due to inherent variability, for example uncertainty related to social, economic and technological developments.

Looking at the questions on additionality and baseline scenario both assessments will include both types of uncertainty. The uncertainty can to some extent be reduced, but because of variability uncertainty it is not possible, even by the most sophisticated methods, to eradicate the uncertainty connected to the determination of the future or counterfactual situation. Concerning the baseline scenario there will be uncertainty to the number of emission reductions awarded to each project. The question however is much more critical when looking at the additionality test as this by regulating how many projects are allowed would seriously affect the environmental integrity of the CDM. This finding gives rise to a principal discussion on uncertainty and additionality.

In the thought example below for the sake of the argument a certain number of projects, say 50, have been assessed with an additionality tool that satisfies the Marrakech Accord's definition of additionality[32]. It is further assumed that through this additionality test, an equal number of projects are put in each category of likelihood to be implemented. In this case that would be 10.

Normally this additionality tool works by approving projects that are either unlikely or very unlikely to be implemented, whereas projects that are judged to be either possible, likely or very likely are rejected. This situation is show below:

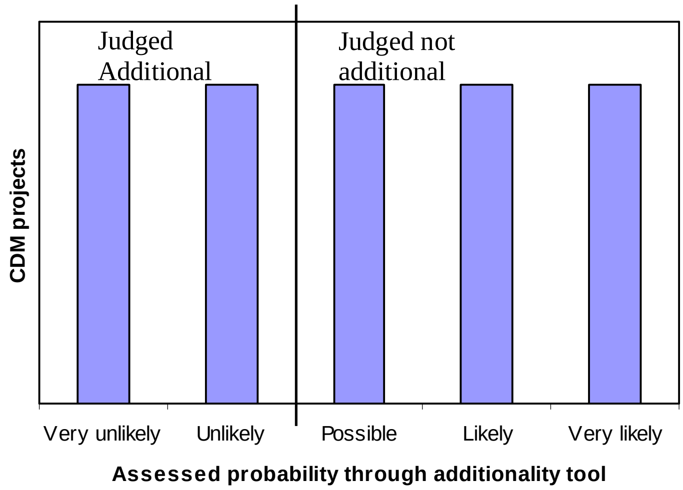

Figure 7.1: The hypothetical additionality tool approves projects that are assessed to be either very unlikely or likely to be implemented as additional, whereas the other projects are rejected.

In the sake of this thought experiment however all projects are now claimed "not additional", regardless of their category of likelihood. This means that even though projects are assessed to be both unlikely and very unlikely to be implemented, they are still in this thought example considered "not additional". It should now be assumed that none of these projects would be implemented as they are not to receive the benefits of being registered as a CDM project.

After the end of the assessed period, all the previously proposed CDM projects are reassessed and following picture emerges:

[32] According to the Marrakech Accord, a project is additionality if emissions are reduced below what would have occurred in the absence of the project [UNFCCC 2001]

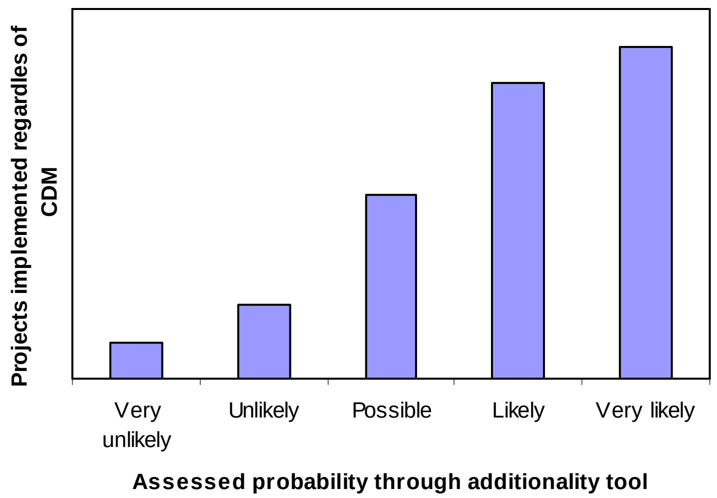

Figure 7.2: Despite of assessed to be very unlikely or unlikely some of the projects have been implemented.

Figure 7.2 shows that of the projects that were assessed to be in the categories very unlikely or unlikely, "surprisingly" some have been implemented, in this case about 3 in total, and similarly some of the projects assessed to be likely or very likely were not implemented. This means that if the projects in the categories unlikely or very unlikely in the first place had been implemented, 3 of these would have been claimed additional even though they where viable without the benefit of CDM.

From a technical point of view, in order to minimise the approval of non-additional projects (*false positive*) and the disapproval of additional ones (*false negative*), the additionality test can include more thorough investigations of the project and its surroundings. As already discussed assessing additionality is however governed by variability uncertainty meaning that the test can only be improved to a certain level, and can never become completely accurate.

Taking a possible example of this from the case study in Argentina, it was stated in the Scenario Forecasting method that wind mill projects are *unlikely* to take place and therefore additional. Still we know that some windmills have been implemented earlier indicating that it is not impossible even though the implemented wind mills were not registered CDM projects. A CDM wind mill project in Argentina might therefore be a *false positive*.

From an overall point of view the consequence of including false positive CDM projects is that the project will be credited CERs that are not a consequence of a real reduction, which will undermine the environmental integrity of the CDM.
Because of this, how to set additionality is key to the environmental integrity of the CDM.

An option could be to apply more conservative standards on assessing CDM projects. This would lower the quantity of wrongly approved projects, but would as a side effect and most importantly drastically increase the number of rejected, but in fact additional, projects. Thereby it would result in lost opportunities to invest in truly additional emission reductions in developing countries, which in turn would dampen the participation in the CDM from the private sector.
Relating again to the Argentinean sector baseline study hydro power was stated to being a non-additional technology. It is however very likely that some hydro projects in Argentina

would face barriers that could only be overcome by receiving the benefits of getting them registered as CDM projects *(false negatives)*.

This shows that the *nature of uncertainty,* here being variability uncertainty, is important to acknowledge in designing the baseline methodologies. An incorrect assessment of projects can therefore only to a limited degree be reduced, but is an inevitable consequence of how additionality is determined following the definition in the Marrakech Accords.
From the point of view of the designers of baseline methodologies in the EB it is probably not very prestigious to admit the fact of uncertainty and imperfect methods, and they do not seem to have communicated this potential problem to politicians.

That the experts are not able to create the perfect assessment tool on the methodological level should be acknowledged by policy makers. This brings the discussion on the design and effect of the baseline methodology up to the political level. It might be stated that in spite the inevitable presence of uncertainty decisions need to be made on additionality of CDM projects. We can of course accept that there is presently no handling of these risks. Another way would be to say that the question of additionality should be seen as a matter for political decision makers and not as an exercise of measuring of experts.

A recommendation would on this behalf be that the politician should decide on how big a flow they would have or accept. Such a decision could guide the strictness of the additionality test. One way of managing this would be to politically focus the applicability conditions on promising sectors, but this would of course take some lengthy political negotiations, because of different interests of different Parties to the Kyoto Protocol.

7.2 Baseline methodologies in a developing country context

Practicability of the proposed baseline methodology and additionality test was another important issue discussed earlier. It was handled from the perspective, that it was merely a question of design of the methods. As shall be discussed below, this might be a too narrow interpretation of dealing with practicability in relation to the methods.

In several cases the CDM projects will lead to the introduction and operation of new technology in the host countries. This raises issues that have been discussed for decades within the field of technology transfer and developmental aid. Experiences in this field have shown that the context or social setting in which a technology is going to be used is not trivial to the success of the transferred technology [Müller 2003a].

CDM projects introduce the issue of technology transfer on several levels. Most obvious the issue of technology transfer is introduced through the implementation of the "*hardware*" defined as the concrete technology implemented in the host country. In the power sector the hardware could for example be a wind mill or a hydro power plant.
Technology can however also be defined as "*software*" or "*know-how*", manifested through methods and conceptual tools. The assessments and methods constituting the baseline methodology can be said to be a "*software*" technology.

Müller (2003a) identify that technology transfer can consider the context or social setting in three different ways:

1. The technology is fully adopted to the social setting of the receiver.
2. The social setting of the receiver is fully adopted to the technology.
3. Both the technology and the social setting are changed or "moved" to fit each other at some point, which hardly can be predetermined.

He further argues that the social setting is important for the success of a technology and that the relationship between the social setting and a technology potentially gives rise to an imperfect fit [Müller 2003a].
An example can illustrate this point. If roads and gasoline stations do not exist in a country, cars will probably be a less successful technology at this location. Another example could be state regulations and market conditions making cars an unfavourable means of transportation. A technology whether hardware or software is not an isolated phenomenon, but is part of a process including interplay with the surroundings. These could be the social, economical or physical infrastructure at the location.

The imperfect fit between the technology and social setting can be related to the asymmetry between the receiver and the supplier of the technological knowledge. The technology supplier has complete knowledge about the technology, but most often incomplete knowledge about the social relations of the technology. The technology receiver has on the other hand often incomplete knowledge about the technology and is therefore incapable of accounting for all conditions that are essential for the effectiveness of the technology. Müller (2003b) therefore advocates for the third way of mutual adaptation of social setting and technology.

This knowledge offers a new perspective on the design of baseline methodologies.

The goal from the Executive Board of the CDM in relation to the baseline methodologies has been reaching a uniform standardisation in relation to tools and methods, so that these can be used all over the world and in every social setting. It has though been necessary to limit applicability condition according to distinct technologies or cohorts of technologies, which is mainly for technical reasons of emission calculations. The ACM0002 considered in this study has its applicability on renewable grid connected power technologies.

This universal standardisation thereby implies that the context or social setting of the host country is not considered in either design or use of the baseline methodology.

We must admit that fully understanding the guidelines, assumptions and how to follow the baseline methodologies presented by the Executive Board is truly an expert task. It is therefore a difficult job for the potential project developers to develop a CDM project and provide the assessment of additionality and baseline scenario needed. Cosbey (2005) from a survey among some developing countries found that the detailed level of understanding of the power sector that is assumed in the methodologies does often not exist in developing countries.

Less developed countries often have poor institutional infrastructure and the problem is exacerbated by a lack of human, financial, and technological resources. The reality is that many less developed countries face serious problems with scarce resources and they would tend to be focused on more basic and fundamental considerations of economic development. Building up the necessary institutional capacity for handling the CDM is thereby not a priority.

The design and usability of baseline methodologies as a standardised way of assessing CDM projects can be compared to the above example with the car. If there are no regulations, no institutions and no capacity in developing countries the exercise of assessing CDM projects would not function. Developing countries as *technology receivers* can be said to have incomplete knowledge about all the technicalities of the baseline methodologies and all the steps of the project cycle when developing a CDM project. They can therefore be incapable of making use of baseline methodologies and entering the overall scheme presented by the CDM.

This incapability would exclude many potential actors in developing countries that could have benefited from the incentives in the CDM and the possibility of technology transfer. Looking at the statistics indicates that it takes some capacity to get involved in the CDM. Four of the more advanced developing countries, Brazil, Mexico, India and China, as of August 2005 had absorbed 62 % of all 202 validated CDM projects[33] so far, whereas South Africa accounts for all 3 validated projects in all of Africa [Fenhann 2005b].

This opens up for the question if a one-size-fits-all baseline methodology can be applied. If a baseline methodology design does not define the user and take their capabilities into account it could exclude large groups.

As we in this study had a practical approach developing our sector baseline methodology in Argentina the design and choices were to a large extend a result of the context, i.e. the availability of information, our collaboration partner and willingness of experts to participate.

From our experience with collecting data and talking to experts within the power sector in Argentina we did not meet significant barriers to introducing a sector approach. The country has a high level of expertise and data are most often readily available. Further we presented the idea for Nazareno Castillo from the Argentinean Designated National Authority (DNA) and he was positive to the idea of doing sector baselines instead of project-by-project baselines for the power sector [Castillo 2005]. He however pointed out that they in the office did not with the existing setup have the resources to perform such a task.

If the suggestion of a combined Scenario Forecasting and Delphi method is however transferred to less developed countries it could pose a problem on data, expert capacity and general usability. This could be confirmed from an earlier study on the power sector in Ecuador, Forman & Jørgensen (2003), where it was experienced that getting updated and relevant information and data can constitute a problem in some countries.

If taking the point of departure in each country the sector approach could still be viable as it could be adjusted to different situations and capabilities. This would then argue for some sort of methodological pluralism in order to set baseline scenarios where capabilities might be low. Exactly how this could be manageable would be a field for further investigation with the inclusion of some of the less developed countries today not participating in the CDM.

Using the third way of Müller (2003a) as inspiration it could be stated that both baseline methodology and the social setting here understood as the capabilities in the developing countries could be changed to fit each other.

[33] Earlier in this study it was mentioned that there are 23 registered projects. The difference is that the validated projects are still not implemented but only approved to be so.

Argentina cannot be compared to sub-Saharan Africa and the same tools can probably not be used in so very different situations. One recommendation from the above would be to acknowledge that real world conditions are diverse. Recognising and taking this knowledge into account would be a huge challenge to future designers of CDM assessment tools.
On the other hand there is also a need to focus on the capabilities of the developing countries in handling the CDM and hereunder the technical difficult discipline of baseline methodologies. It also highlights the need for capacity development in many countries if baseline methodologies in one way or the other should succeed as an assessment tool.

7.3 Sustainable development

In the previous we have opened up for new insights important for the design of the baseline methodologies. Now we will however open up for the critical question on *why* to improve the baseline methodologies and thereby reflect on what we potentially marginalise by our present boundaries to the initial analysis.

We have in the study primarily had a focus on the key methodological challenge of dealing with the counterfactual situation concerning additionality and baseline scenario of the CDM project. These boundaries was adopted from workshops and discussions of the COP10 meeting in Buenos Aires and there is no doubt that the success of the CDM as a credit-based trading mechanism is dependent on a proper handling of awarding CERs in a consistent, fair and transparent way. This constituted the initial *why*.

Recalling that the dual objective of CDM projects is to assist developed countries in getting cost-effective, real and measurable emission reductions, while at the same time contributing to sustainable development in the host country, the focus above at the same time reflects how these two issues are managed in the present institutional setup.

Improving baseline methodologies to enhance the flow of projects is from a critical point of view only a way for optimising the process of delivering CERs for the benefit of investors and in the interest of the developed countries. Of course insuring the environmental integrity by improving accuracy and adjusting on additionality could be a main goal of improvement of the baseline methodologies, but the CDM will in principle only succeed if it does also adequately deliver the whole promised package of benefits.

As indicated in the Marrakech Accords the onus for approving CDM projects for their contribution to sustainable development lies with the host country. This is done through the Designated National Authority, which is responsible for the formation of sustainable development criteria reflecting the host country's situation.

It is logical that the issue of well-being and thereby sustainable development will be defined by those experiencing and living the conditions of the country. In relation to the CDM and the expectations of technology transfer and additional investment inputs a weakness is however that a competition between developing countries might arise. This would emerge with the goal of creating a favourable investment environment for CDM projects at the expense of forward looking criteria on sustainable development. In popular terms this is called a "*race to the bottom*" effect [Cosbey 2005], where the main focus of the CDM projects will be on emission reductions and only marginally on the sustainable development component. Far

from all developing countries can be expected to embark on such short term thinking, but the potential risk is enforced by the fact that the market mechanism will aim for the least-cost options also called the "*low hanging fruits*". These are often end-of-pipe-solutions such as landfill gas capture projects and HFC decomposition projects[34] without much to offer on sustainable development.
It is a huge challenge to merge a short term market thinking with a long term sustainable thinking as two very different logics lie behind.
If sustainability concerns for one reason or the other is systematically *marginalised* this could point towards changes and even taking some political decisions on which sectors can actually deliver both cost-effective CERs and a substantial sustainable development component.

It could be argued that the division of the dual objective is not logical from a developing country point of view. Bouille (2004) supports this by saying that "*the two aspects should be seen as two sides of the same coin*".

The developing countries however need to define clear criteria on what constitute sustainable development in CDM projects and in their countries, which is not always easy. This would somehow require different ideas of the future and some vision and long term policies and perspectives, something that many developing countries do not have.

Bouille & Dubrowsky (2004) in an interview put it in this critical way: "*The difference between developed and developing countries is that developed countries are doing planning*". Instead of single projects here and there most developing countries need a sectoral perspective and capacity to do some long term planning.
In the field of developmental studies this finding has been recognised for much more than a decade. The project approach where one road or one dairy is implemented without taking notice of the social and cultural setting has been abandoned in favour of a sector integrated approach based on participation, empowerment and capacity building [Wangel 2001]. Activities are of course still maintained on a project level, but they are integrated in an overall strategy and sector planning.

In this regards some possible synergies between sustainable development and the baseline methodologies can be seen and thereby viewing the dual objective as two sides of the same coin.

The project specific assessment of potential CDM projects in ACM0002 does not deliver any widely usable knowledge. The additionality tool focus on the investor and his barriers and extrapolation only deals with old trends in a simplified manner, so they cannot be turned into future trends.
The combined forecasting method presented in this report could on the other hand provide forward looking knowledge and form the base for exploring desirable and non-desirable pathways.
If entities in the developing country were responsible for analysis of the baseline scenario, they could then in an integrated manner look at additionality as to whether a potential CDM project is "normal practice" and potentially whether a project is additional in terms of sustainable development.

[34] HFC23 for instance is a by-product of the production of HCFC22, which is used as a refrigerant and as a feedstock for Teflon manufacture. It is normally vented to the atmosphere, where it is a powerful GHG, with 11,700 times the potency of CO_2. This accounts for the huge supply of CERs expected from such projects [Cosbey 2005].

It can, if included in the sustainable development considerations, be used to assess how, in this case the electricity sector, will most likely develop in the coming decade, and thereby provide a tool to assess whether potential CDM projects will contribute in a positive or negative manner to the foreseen development. In this way the baseline scenario can be used to assess what kind of projects will be beneficial for the country on the longer run, which is a key issue to sustainable development. The baseline scenario can therefore if integrated as a planning tool provide some guiding for a better assessment of the CDM projects regarding the sustainable development demands.

If the sector approach can in this way help build capacity on more long term planning developing countries would achieve a real and "*additional*" benefit of the CDM. Baseline methodologies could in this way be designed in an integral manner enhancing both of the objectives of the CDM.

To sum up, it was concluded in the discussion about baseline methodologies and uncertainty, that in relation to estimating the counterfactual situation an inevitable uncertainty exists, which cannot be eliminated on a methodological level.
In the discussion about baseline methodology in developing country context, it was suggested, that the practicality of the baseline methodologies will be constrained by the capacity of the developing countries.
Both the inherent uncertainty of the methodologies and the capacity of the developing countries to apply these are aspects that are not comprised by the design of the methodologies. These findings therefore point to, that in order to establish a functional baseline methodology these aspects must at the same time be considered. Both aspects are however not technical but are embedded in the political level and decisions surrounding the baseline methodologies and the CDM. Designing a functional baseline methodology thereby becomes not only a technical question, as it has largely been addressed in this study, but a political one.

Taking this conclusion a step further, it can be argued that design of the baseline methodology is generally comprised by a one-sided emphasis on the technical solutions. Context is in the present baseline methodologies only considered on a very superficial level as the methodologies are completely spatially standardised. Uncertainty and the implications for the crucial question on additionality kept on the methodological level despite a conflict on setting the standards for the screening of projects.
This point to, that there is a general misconception of the possibilities within the area of the technical solutions. The baseline methodologies seem to become the *technological fix* that in itself holds the key for a successful implementation of the CDM. However, the technical solution of the baseline methodologies is merely one of several options in the endeavour of creating a viable CDM wherein these must go hand-in-hand.

Regarding the discussion about sustainable development, it was argued, that by heading for a sector approach, sustainable development can to some extent become an integrated part of the baseline methodology. The two objectives are presently discussed in isolation, with the result that there is an overly focus on the emission reductions and only very limited on the CDM projects' contribution to sustainable development.

Another aspect that should be drawn into this discussion is the division between the baseline scenario and additionality test. In chapter 4.5 it was discussed that through the merging of these two concepts some of the present problems concerning the ACM0002 can potentially be overcome.

It can be argued on the basis of these two examples that the development of the ACM0002 has been performed in a *particularistic* way, disregarding potential synergies or improvements, which point towards a too narrow scope when addressing the relevant and necessary issues concerning the development of the ACM0002.

From these two discussions two key words regarding the development of the ACM0002 emerges. Primarily the overly confidence in the technology, where the ACM0002 becomes a *technological fix* to handle, in fact, non-technical questions, and secondly the *particularistic* development, which easily lead to missed improvements.
Implementing these two key words in the CDM debate between methodological developers and decision makers is together with the continual methodological development of great importance for the CDM.

8 EVALUATION OF THE PROBLEM SOLVING APPROACH

The improvement process of the ACM0002 baseline methodology was carried out on the basis of a number of choices. These choices, constituting frameworks, methodologies and methods, have been applied to the process with different level of success.
The choices and their application have therefore inevitably shaped the problem solving process.
The purpose of this chapter is to evaluate whether the choices made and the application of these are justifiable and whether they have contributed to a purposeful outcome of the study.

Throughout the process there are made a number of larger or small methodological choices. Instead of evaluating every one of these, some overall conclusions are drawn and discussed in relation to the application of the theoretical framework.

8.1 Evaluation of the epistemological framework

The systemic thinking approach can be applied in many ways. At one end of the spectre its principles are transformed into some steps that can be used in problem solving. At the other end of the spectre the understanding of the problematic situation is continually expanded to include larger and more remote aspects, in principle a process that can continue infinitely. In this form the systemic thinking approach becomes a philosophic discipline.
The application of systemic thinking as it has been used in this study lean against the problem solving oriented approach and can therefore be criticised for being to superficial, because it is heading to directly for the problem solving, whereas the opposite approach could be criticised for never commencing this phase, but only addressing the problem identification in an increasingly complex web of interrelations.

As it has been discussed in chapter 7 there are several issues that could preferably be included in the analysis of the baseline methodology, indicating that a more thorough analysis of interrelations could have contributed with useful knowledge before the problem solving phase.
One way of managing this would have been earlier to reflect critically on the boundaries with a chance of reformulating the problem field under investigation. On the other hand the adaptation of the systemic approach must be seen in relation to the objective and the resources available to perform the study. Our problem solving phase was set as a result of the timing of the problem solving and case study in Argentina, which had to be in the middle of the period of the study, whereas our understanding and practical knowledge of the issues relevant for the baseline methodology was continuously expanding.
It was seen as a necessary compromise to perform the analysis as presented.

As shown in chapter 4.4, a high degree of segmentation of the elements that constitute the ACM0002 can be observed. The baseline scenario and the additionality test, which in the ACM0002 are studied in isolation, is only one of the situations where a possible merging of isolated fields can be an advantage, as discussed in this study. Another example was

mentioned in chapter 7 concerning the division between the two goals of the CDM in relation to the design of the baseline methodologies.
On this basis it was argued that the "epistemological framework" used in the current official development of the baseline methodologies can in many ways be compared with the *mechanistic thinking* presented in chapter 2.1. It is a paradigm where it is believed that everything can be reduced to isolated elements, and a problematic situation can thereby be isolated from the whole by only considering the elements that are involved [Vidal 2004b]. Approaching the design of the baseline methodologies from this point of view, will however as seen in these examples give rise to suboptimal solutions. These suboptimal solutions are not improved simply because the relevant knowledge is not included in the design of the baseline methodologies.
The systemic thinking approach to problem solving focuses on expanding its view in order to take into account larger and larger numbers of interactions as an issue is being studied [Aronson 1996], thereby providing a more holistically oriented approach. The abovementioned cases therefore point to the suitability of the systemic thinking approach in this context, as it gives the basis for understanding the interdependency of phenomena, showing that more optimal solutions can be achieved by merging the isolated fields of research within baseline methodologies, considerations regarding sustainable development and political feasibility among others.

Talking politics an approach that could have stressed different and very interesting knowledge would have been taking a more *critical thinking* perspective. In the present study we did not embark in any detailed actor analysis, which might have deepened our understanding of why the bottom-up approach to assessing CDM projects was initially taken. Was it really just the best compromise or did some stakeholders want it for some reason. During the process we actually found out that it was partly a question of finding out who should pay the initial learning process but it also had a say that the developing countries feared that top-down determination of baselines could lead to an increased pressure on giving them binding commitments.

We experienced at the COP10 conference that the field of climate policy is filled with stakeholders trying to set the agenda. Who gets, what, when and how – are relevant questions, and these could have been key questions in a critical thinking analysis. In this sense looking into power relations with a critical thinking perspective could also have said something about why we have the standardised baseline methodologies and who will support a future change of the present set-up.
Combining the systemic thinking approach with a more critical thinking approach could in that sense have been an interesting exercise.

8.2 The application of the methodological framework

Being a process of improvement, where it is the usability of the result that is in focus and not the testing of a specific theory or method, it was seen necessary to adopt the process oriented approach (see chapter 2.2). This was characterised as multimethodology.
Multimethodology, however, is a broad term and was in this study interpreted very pragmatic, being an approach where the circumstances of the improvement process drove the methodological choices. Other interpretations focus on a more theoretical structure of the methodological choice depending on the type of task that the method should remedy. As an example Mingers (2004) creates a diagram based on the different type of activity that can be

undertaken on one axis, and the “dimension” in which these activities are undertaken on the other axis. By dimension is meant whether the action is relating to the social, personal or material “world”. This well-arranged diagram of possible actions and dimensions gives a good basis for seeing the different assignments that will occur in the course of a study and on this basis chose methods appropriate to these assignments. It therefore seems like a good approach if the task involves several actions and dimensions, making the complex methodological choices more clear.
It could be argued, that if such framework had been used, a higher level of methodological consideration could have been undertaken.

In relation to the application of the multimethodological approach the immediate risk is that even though the methodology opens up for an unorthodox use of methods and tools, the user will tend to be conservative, as it is easier to apply an already known method than to learn a new one.
With this in mind, returning to the choice of forecasting methods, the multivariate quantitative theory-based forecasting methods were rejected even though there were also some very positive aspects of the methods (See appendix 6). A potential use of these methods in this context could be analysed further to see whether they hold unforeseen possibilities.

The above discussions point to the difficulties in using a very practical approach to multimethodology as we have done in this study. There is a risk, that the lack of methodological overview in a practical situation will lead to the use of the method that are readily available or best known, not necessarily being the most appropriate in the situation. An example in this study could be the main use of a criteria analysis in defining problems for the ACM0002 in chapter 4.5, which might have been improved by using more participatory methods, as this might have reflected the opinions of the stakeholders more precisely. This aspect will also be addressed below in the evaluation of the “processual framework”.

The multimethodological approach as a methodological framework implies an open-minded methodological approach which can be seen as a method “including” approach rather than “excluding”. It is therefore difficult to perceive the multimethodological approach as being restrictive for the choice of method and thereby impeding the outcome of the study.
From another perspective, the multimethodology, being a “method including” approach, can in some cases be unnecessarily cumbersome if the diversity of methods is not used constructively in the study. However taking the choice of forecasting method as an example of the contrary, it was purposeful to investigate the practicability of the forecasting methodology in relation to baselines, and an exhaustive analysis of the applicability of different methods was therefore necessary. In this connection the multimethodology provided a necessary “platform” for choosing forecasting methods in its open approach. A more method oriented approach (see chapter 2.2) could lead to a more restrictive choice which would thereby not provide a discussion on suitable methods.

8.3 The application of the processual framework

As described in chapter 2.3, the process can be more or less linear or iterative, which will depend on the perceived complexity of the situation. Furthermore the process can be with more or less stakeholder involvement.
This study was performed in an iterative intuitive manner and with a limited stakeholder involvement.

The iterative and intuitive process was prominent in the methodological choices and applications. In theory the choice and application of methods are based on full knowledge about objective, contextual constraints, and about all applicable methods. This idealised perception does however not reflect this aspect correctly. Several of the methods used in the course of this study were chosen and undertaken in an ad hoc manner without looking into all possible alternatives. The real situation was often comprised by a complexity where choices only after the intervention became clear and possible to categorise within the frames of the methodological boxes.

The other aspect of the processual framework is the stakeholder involvement. As explained already in chapter 2.3 the situation with the large and very dispersed stakeholder group has made it difficult to include their concerns in structured ways.

This has resulted in the fact that there has been a general tendency in the study towards focusing on analytical work instead of stakeholder involvement. This fact was especially visible in the focusing chapter, where the focal point for improving the baseline methodology was the accuracy of the extrapolation method on the basis of expert opinions. By including a broader group of stakeholders, this focus could potentially have been changed, implying a radical alteration of the study.

This lack of stakeholder involvement is critical especially when dealing with such complex situations as this, where the usability of the proposed baseline methodology at the same time is heavily dependent on stakeholder acceptance.

A feasible solution to overcome this problem could have been, through our participation in the COP10, to interview more stakeholders than we did or to obtain some contacts that could have been requested later to give their point of views, suggestions and feedback by mail or other means of communication.

9 CONCLUSION AND OUTLOOK

The inspiration to this study emerged from the participation in the yearly Conference of the Parties to the UNFCCC, the COP10 meeting held 6-17 December 2004 in Buenos Aires, Argentina.
At this conference a highly debated issue concerned the design of the baseline methodologies used to quantify the emission reductions created through the implementation of CDM projects. These baseline methodologies were by some stakeholders claimed to impede the implementation of CDM projects, whereas others were of the opinion that they compromised the environmental integrity of the CDM.
It was within this conflicting field of opinions that it was decided that the aim of this study should be to contribute to the process of improvement of the existing baseline methodologies. To be able to get practical experiences with an alternative the specific methodology for grid connected renewable power technologies was chosen; the ACM0002.

The study has lead to three key findings:

The ACM0002 baseline methodology is faced with a multitude of interrelated problems, divided on all elements of the methodology, which are complicated to manage under the present project-by-project approach.

Through a thorough analysis of the ACM0002, it was among others found that the use of extrapolation in order to establish the baseline scenario will often lead to inaccurate results. In many cases, the complexity and dynamics of the power sector will cause the implementation of new power plants to diverge from the historical trend. Several national circumstances need to be included in the forecast to improve the accuracy. Extrapolation might be acceptable in certain situations, but must be justified through specific national conditions.
Moreover the additionality tool was found to be based on a very subjective foundation and deemed impractical for the project proponents, who have to reveal their own motives for investment and decision making in complying with the tool.
As a complicating matter, the application of the ACM0002 was furthermore considered rather costly to follow by the investor and could potentially impede the implementation of CDM projects.
The dilemma between environmental integrity and the difficulty in maintaining the investors' interests in the mechanism proved difficult to solve under the present project-by-project approach.
A sector approach was shown to hold the potentials for mitigating the above found problems. The *statements* and *policy discussion paper* of the *Greenland Dialogue* held in August 2005 on climate change issues could be a sign that a sector approach may be given more attention in the future.

A sector approach, that comply with the above stated problems seem probable, however more practical experience with the proposed sector approach is needed to streamline and evaluate the potentials of the baseline methodology.

A sector approach was designed on the basis of two systematically chosen forecasting methods; the Delphi method and the Scenario Forecasting method, which is a qualitative multivariate method comprising both scenario and forecasting principles.
These two forecasting methods were applied in a case study of the Argentinean power sector.

The Delphi method was carried out through two rounds. First round consisted of in-depth interviews with experts followed by a second round of a traditional Delphi questionnaire. The questions addressed both the expected future implementation of power plants as well as questions that should substantiate these opinions, later used as a consistency check for the forecast. The additionality test was based on the technologies that on average were not expected to enter the system within the forecasted period.
The Scenario Forecasting method focussed on analysing a broad list of key variables that were assumed to be generally applicable to power sectors.
On the basis of an interrelation between the trends of the key variables and the forecasted item a baseline scenario was established, comprising the most likely events. The additionality test was on the other hand based on the events that were estimated to be either unlikely or very unlikely to happen.
The results of the two forecasts were merged into one combined forecast for both the baseline scenario and the additionality test.

Through a comparative evaluation of these proposed forecasting methods and the ACM0002, it was found that several of the problematic conditions of the ACM0002 could be solved or mitigated. The most promising of these being; a presumable increase in the average accuracy of the baseline scenario; inclusion of national circumstances in the baseline scenario; possibilities for choosing a conservative baseline scenario; and less subjectivity in the additionality test.
However, new problems were also created, mainly in relation to the practicability of the method. Both methods were somewhat time-consuming to perform, and furthermore do set some higher demands for both expert assistance and availability of information than the ACM0002.
The large time consumption was proposed reduced through minimising the Scenario Forecasting method, but it is uncertain whether this is sufficient to streamline the forecasting methods. More experience is therefore needed on the applicability of this sector approach in the power sector to address its true potential.

The systemic approach has opened up for a more holistic understanding of the problems that the ACM0002 is facing and the possibilities for managing these.

The evolution of the additionality tool and baseline methodologies, among these the ACM0002, has been through parallel developments. It has by other words been a particularistic approach, where each element has been improved incrementally. By taking a holistic approach to the understanding of the ACM0002 and its context it was however shown that merging the isolated fields hold room for improvement of the methodology and importantly opened up for a way to unravel the complex intertwined net of identified problems. The systemic approach thereby in this study became a way to avoid the focus on suboptimal solutions by opening up for larger perspectives.

The process does however not stop by designing and improving the baseline methodologies. Several questions of which the baseline methodology is dependent lie in the political spheres and must be considered from this perspective.
The task of improvement should furthermore be considered in relation to the long term success of the CDM, which will depend on delivering both cheap emission reductions as well as sustainable development in the developing countries. Compromising one by improving the

other or hindering potential synergies between the common goals must be considered in any part of the continual improvement process.
These general conclusions from expanding the analysis on baseline methodologies make the basis for the following recommendations for future design and policy consideration:

- Acknowledge the limitations of the project-by-project approach established in the ACM0002 in the light of the potential benefits a sector approach holds for power generation CDM projects.

- Recognise that there is no perfect way experts can handle the inherent uncertainty in assessing CDM projects. Politicians need to take deliberate decisions on how to deal with this uncertainty and how the additionality test should function.

- Acknowledge that real world conditions of developing countries are diverse and does not necessarily fit to a one-size baseline methodology.

- Recognise the limits of rational thinking in handling the methodological development.

- Enhance capacity building for developing countries on behalf of both baseline methodology capabilities and on behalf of getting long term planning and definitions of criteria on sustainable development in place.

- Combine the dual objective in the CDM of providing emission reductions and sustainable development in a forward looking sector approach enabling developing countries to anticipate both likely and desirable future trends. This could possibly be done through a combined Scenario Forecast and Delphi Forecast or other planning tools.

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APPENDICES

APPENDIX 1 – MEETINGS ATTENDED AT THE COP10

In this appendix a list of meetings attended at the 10th Conference of the Parties (COP10) to the United Nations Framework Convention on Climate Change, 6-17 December 2004, in Buenos Aires, Argentina is presented.

CDM Executive Board: question and answer session
Date: 7 December 2004
Time: 13:00-15:00
Theme: The CDM Executive Board will report on its activities since COP 9 followed by a discussion with Parties and observers

Consolidated methodologies
Date: 07 December 2004
Time: 15:00 – 17:00 hrs

Speakers: Einar Telnes	DNV
Georg Børsting	CDM EB
Sonia Medina	Ecosecurities
Bruno Vanderborght	Holcim
Gautam Dutt	MGM International

Description: The first consolidated methodologies have been approved by the CDM Executive Board and can now be used by project developers. Will this now mean that projects within the relevant sectors will be able to more quickly get their projects approved? Looking at the development of other consolidated methodologies, what is required or what can be done to increase the drafting and publication of new consolidated methodologies?

Development and transfer of technologies
Date: 8 December 2004
Time: 18:00-20:00
Theme: Update on the ongoing work under the agenda item on development and transfer of technologies, including the outcome of the innovative financing workshop.

Using the CDM in electrification projects
Date: 10 December 2004
Time: 10:00 – 12:00

Speakers: Mandy Rambharos	Eskom
Assistia Semiawan	PLN
Sumie Nakayama	Jpower
Ikuo Nishimura (tbc)	TEPCO
Brian Dawson	UNDP
Fabian Gaioli	MGM International

Description: Speakers will present their opinions on the use of CDM within the electrification process in developing countries. Experience of various operators through out the world will be demonstrated, outlining when CDM can or cannot contribute to electrification projects.

Addressing emissions reductions: a sector-based approach
Date: 10 December 2004
Time: 13:00 – 15:00 hrs

Speakers: Laurent Corbier	WBCSD
Mahua Acharya	WBCSD
Marco Bedoya	CEMEX
Bruno Vanderborght	Holcim
Hiroshi Ozaki	Osaka Gas
Hirofumi Kazuno	KEPCO
Xuedu Lu	CDM EB

Description: The panel will assess the way additionality has been addressed in the CDM so far, relate
additionality to business practice and business applicability, and provide insights (or alternatives) to determining and demonstrating additionality.

Addressing additionality
Date: 10 December 2004
Time: 18:00 – 20:00 hrs

Speakers: Laurent Corbier	WBCSD
Bruno Vanderborght	Holcim
Fabian Gaioli	MGM International
Jeff Fielder	Natural Resources Defense Counsel
Mike Lazarus	CDM Meth. Panel & Tellus Institute
Einar Telnes	DNV

Description: This panel will assess the way additionality has been addressed in the CDM so far, relate
additionality to business practice and business applicability, and provide insights (or alternatives) to determining and demonstrating additionality.

Capacity development for the CDM
Date: 11 December 2004
Time: 10:30-12:30
Theme: The progress of Dutch-funded CDM capacity development project in 12 developing countries.
Presented will be potential projects in selected countries and guidebooks.

Three Years After Marrakech: Lessons Learned from CDM. IETA position at COP 10.
Date: 13 December 2004
Time: 10:00 – 12:00 hrs

Speakers: Robert Dornau	CarbonExpo
Mark Proegler	BP
Charles Cormier	Carbon Finance, World Bank
Einar Telnes	DNV
Georg Børsting	CDM EB
Karen Risse	International Paper
Laurent Segalen	European Carbon Fund
Frede Cappelen	Statoil
Jurgen Salay (tbc)	EC

Description: The panel will discuss IETA's position paper on the CDM which has analyzed the Clean
Development Mechanism and its record in delivering the mandate outlined in its defining documents – the Kyoto Protocol and the especially the 2001 Marrakech Accords.
In preparing this paper, IETA has followed a transparent process of consultation with its members, other business practitioners as well as other stakeholders, including a 24 question survey answered by 104 business participants in August 2004 and a series of workshops around the globe in September 2004.
IETA has been present all along for the last three years, has contributed to the debate, and will continue to provide the knowledge and experience it has in the future. IETA would be pleased to cooperate in any multi stakeholder process for a review of the CDM achievements leading to COP 11. This document must be seen as a contribution to stimulate discussion at COP 10 and in the work leading to COP 11.

Global Collaboration for addressing Energy Issues in Developing Countries – Future Perspectives for Technology Transfer.
Date: 13 December 2004
Time: 18:00 – 20:00 hrs
Speakers:

Mr. Chandrashekhar Dasgupta	Ambassador, India
Mr. Gao Feng	Ministry of Foreign Affairs, China
Mr. Hideo Fukushima	Ministry of Foreign Affairs, Japan
Prof. Hisashi Ishitani	Keio University, Japan
Mr. Andrei Marcu	International Emissions Trading Association
Prof. Akio Morishima	The Institute for Global Environmental Strategies, Japan
Dr. Harlan L. Watson	Department of State, U.S.A

Description: The leading negotiators and prominent scholars from China, India, Japan, and the US will discuss sustainable development of developing countries through addressing energy issues, and thereby, elucidate what cooperation between developed and developing countries should look like in the future. In the debate, technology transfer for energy efficiency and renewable energy, including CDM, will be focused.

Enabling, and then sustaining the CDM: now and beyond 2012
Date: 13 December 2004
Time: 15:00 – 17:00 hrs

Speakers: Laurent Corbier	WBCSD
Frank Joshua	Climate Investment Partnership
Einar Telnes	DNV
Dirk Forrester	Natsource
Fernando Almeida	Business Council for Sustainable Development, Brazil
Eduardo Dopazo	World Bank Carbon Finance Business
Brian Dawson	UNDP

Description: Now, with Russian ratification and entry into force of the Kyoto Protocol, industrialized countries face a huge shortfall in their Kyoto targets. As estimated, the CDM is expected to contribute only meagrely to this shortfall. How can the Mechanism be enabled to deliver more?
As negotiations for 2012 start to take form, further reductions are inevitable. How can the CDM be sustained over the longer-term? This panel will discuss what it may entail to not only enable the CDM in a stronger way, but also preserve the credibility and viability of such a market based instrument for the longer-term.

Long term view of the CDM
Date: 14 December 2004
Time: 10:00 – 12:00 hrs

Speakers: Hiroshi Yamagata	METI
Andrei Marcu	IETA
Jurgen Salay	European Commission
Xuedu Lu	Department of Rural and Social Development, Ministry of Science and Technology, China
Marcela Main	CONAMA, Chile
Cédric Philibert	IEA Energy and Environment Division
John Drexhage	IISD

Description:
1. Current CDM problems and request for the future from Industry's view
2. CO_2 emission projection and potential of decrease in developing countries
3. post-2012 CDM

Discussion(60 min)
1. Current CDM problems from developing country's view
2. What would be incentives for developing countries to reduce CO_2?
3. What should we do now and future?

Finance for carbon solutions: the CDM from the financial sector perspective
Date: 15 December 2004
Time: 18:00-20:00
Theme : UNEP Finance Initiative will launch its new CEO Briefing on the CDM, also highlighting what the financial sector can offer in terms of other carbon solutions. Understand the risks and opportunities for CDM projects as viewed by the financial sector.

Lessons learnt from CDM implementation in the ASEAN energy sector
Date: 16 December
Time: 13:00-15:00
Theme : This side event will feature the ASEAN energy CDM development. Government representative of the ASEAN countries and project team will present the experience with CDM implementation, and address regional aspect. Also, present the CDM opportunities in the ASEAN region to potential investors.

Generalisation of CDM Baseline Methodology
Date: 16 December 2004
Time: 18:00 – 20:00 hrs

Speakers: Johannes Heister	World Bank
Naoki Matsuo	Climate Change Experts
Kazuhito Yamada	Pacific Consultants
Yuji Mizuno	Pacific Consultants
Natsuki Tsukada	Jpower

Description: In depth discussion between experts on Baseline Methodologies.

APPENDIX 2 – LEGAL FRAMEWORK FOR THE BASELINE METHODOLOGIES

This appendix gives the background for establishing criteria and constraints emerging from the legal framework for the baseline methodologies.

The Kyoto Protocol states that the CDM projects will be implemented in a developing country termed the host country by a private or public entity and should meet the following eligible criteria:

- *The project must result in real, measurable and long term benefits related to the mitigation of climate change; and*
- *The emission reductions have to be additional to any that would occur in the absence of the of the CDM project activity.*

[UNFCCC 1997]

With the Marrakech Accords the broad terms of the Kyoto Protocol were clarified with a framework law that sets the basic rules, including what a baseline methodology should take account of.

The Marrakech Accords gives a more explicit formulation than the Kyoto Protocol of what is understood by additionality by saying that: *"A CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would have occurred in the absence of the registered CDM project activity.*" [UNFCCC 2001]

The baseline for a CDM project activity is defined as "*... the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases that would occur in the absence of the proposed project activity."* and *"A baseline shall be deemed to reasonably represent the anthropogenic emissions by sources that would occur in the absence of the proposed project activity…".* [UNFCCC 2001]

Further to this it states that a baseline shall be established:

- *In a transparent and conservative manner regarding the choice of approaches, assumptions, methodologies, parameters, data sources, key factors and additionality, and taking into account uncertainty;*
- *On a project-specific basis;*
- *Taking into account relevant national and/or sectoral policies and circumstances, such as sectoral reform initiatives, local fuel availability, power sector expansion plans, and the economic situation in the project sector.*

[UNFCCC 2001]

The approach taken by the baseline methodology for estimating the baseline scenario should be based on one of the following three options:

- *the existing actual or historical evolution of emissions, as applicable;*
- *emissions from a technology representing an economically attractive course of action; or*
- *the average of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 per cent of their category.*

[UNFCCC 2001]

The time frame for the baseline is set to either 10 years without possibilities for renewal or three times seven years, where the baseline has to be renewed and approved every seven years [UNFCCC 2001].

Pursuant to the Marrakech Accords guidelines[35] provided on baseline methodologies should be set in order to:

- *Promote consistency, transparency and predictability;*
- *Provide rigour to ensure that net reductions in anthropogenic emissions are real and measurable, and an accurate reflection of what has occurred within the project boundary;*
- *Ensure applicability in different geographical regions and to those project categories which are eligible in accordance with decision 17/CP.7 and relevant decisions of the COP/MOP.*

[UNFCCC 2001]

[35] More guidelines are included in the Marrakech Accords, but the here mentioned are the most decisive for the development of baseline methodologies [UNFCCC 2001].

APPENDIX 3 – APPROVED CONSOLIDATED BASELINE METHODOLOGY ACM0002

Approved consolidated baseline methodology ACM0002

"Consolidated baseline methodology for grid-connected electricity generation from renewable sources"

Sources

This consolidated baseline methodology is based on elements from the following proposed new methodologies:

- NM0001 rev: Vale do Rosario Bagasse Cogeneration (VRBC) project in Brazil whose Baseline study, Monitoring and Verification Plan and Project Design Document were prepared by Econergy International Corporation;
- NM0012-rev: Wigton Wind Farm Project in Jamaica whose Baseline study, Monitoring and Verification Plan and Project Design Document were prepared by Ecosecurities ltd;
- NM0023: El Gallo Hydroelectric Project, Mexico whose Baseline study, Monitoring and Verification Plan and Project Design Document were prepared by Prototype Carbon Fund (approved by the CDM Executive Board on 14 April 2004);
- NM0024-rev: Colombia: Jepirachi Windpower Project whose Baseline study, Monitoring and Verification Plan and Project Design Document were prepared by Prototype Carbon Fund;
- NM0030-rev: Haidergarh Bagasse Based Co-generation Power Project in India whose Baseline study, Monitoring and Verification Plan and Project Design Document was submitted by Haidergarh Chini Mills, a unit of Balrampur Chini Mills Limited;
- NM0036: Zafarana Wind Power Plant Project in the Arab Republic of Egypt whose Baseline study, Monitoring and Verification Plan and Project Design Document were prepared by Mitsubishi Securities;
- NM0043: Bayano Hydroelectric Expansion and Upgrade Project in Panama whose Baseline study, Monitoring and Verification Plan and Project Design Document were prepared by Econergy International Corporation;
- NM0055: Darajat Unit III Geothermal Project in Indonesia whose Baseline study, Monitoring and Verification Plan and Project Design Document were prepared by URS Corporation and Amoseas Indonesia Inc.

For more information regarding the proposal and its consideration by the Executive Board please refer to http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html.

Applicability

This methodology is applicable to grid-connected renewable power generation project activities under the following conditions:

- Applies to electricity capacity additions from:
  - Run-of-river hydro power plants; hydro power projects with existing reservoirs where the volume of the reservoir is not increased.
  - Wind sources;
  - Geothermal sources;
  - Solar sources;
  - Wave and tidal sources.

- This methodology is not applicable to project activities that involve switching from fossil fuels to renewable energy at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site;
- The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available; and
- Applies to grid connected electricity generation from landfill gas capture to the extent that it is combined with the approved "Consolidated baseline methodology for landfill gas project activities" (ACM0001).

This baseline methodology shall be used in conjunction with the approved monitoring methodology ACM0002 ("Consolidated monitoring methodology for grid-connected electricity generation from renewable sources").

Project activity

The project activity is grid-connected electricity generation from renewable energy sources. There are a number of different sizes and sub-types of this project activity (Run-of-river hydro power plants; hydro power projects with existing reservoirs where the volume of the reservoir is not increased, wind, geothermal, solar sources, tidal, wave).

Approach

"Existing actual or historical emissions, as applicable"

or

"Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment"

Additionality

The additionality of the project activity shall be demonstrated and assessed using the latest version of the ***"Tool for the demonstration and assessment of additionality"*** *agreed by the CDM Executive Board, which is available on the UNFCCC CDM web site*[1].

Project Boundary

1) Project participants shall account only the following **emission sources** for the project activity:

- For geothermal project activities, fugitive emissions of methane and carbon dioxide from non-condensable gases contained in geothermal steam and carbon dioxide emissions from combustion of fossil fuels required to operate the geothermal power plant.

For the baseline determination, project participants shall only account CO_2 emissions from electricity generation in fossil fuel fired power that is displaced due to the project activity.

2) 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.

For the purpose of determining the build margin (BM) and operating margin (OM) emission factor, as described below, a (regional) **project electricity system** is defined by the spatial extent of the power

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[1] Please refer to: < http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>

plants that can be dispatched without significant transmission constraints. Similarly, a **connected electricity system,** e.g. national or international, is defined as a (regional) electricity system that is connected by transmission lines to the project electricity system and in which power plants can be dispatched without significant transmission constraints. In determining the project electricity system, project participants should justify their assumptions.

Electricity transfers from connected electricity systems to the project electricity system are defined as **electricity imports** and electricity transfers to connected electricity systems are defined as **electricity exports**.

For the purpose of determining the Build Margin (BM) emission factor, as described below, the spatial extent is limited to the project electricity system, except where recent or likely future additions to transmission capacity enable significant increases in imported electricity. In such cases, the transmission capacity may be considered a build margin source, with the emission factor determined as for the OM imports below.

For the purpose of determining the Operating Margin (OM) emission factor, as described below, use one of the following options to determine the CO_2 emission factor(s) for net electricity imports ($COEF_{i,j,imports}$) from a connected electricity system within the same host country(ies):

(a) 0 tCO_2/MWh, or
(b) the emission factor(s) of the specific power plant(s) from which electricity is imported, if and only if the specific plants are clearly known, or
(c) the average emission rate of the exporting grid, if and only if net imports do not exceed 20% of total generation in the project electricity system, or
(d) the emission factor of the exporting grid, determined as described in steps 1,2 and 3 below, if net imports exceed 20% of the total generation in the project electricity system.

For imports from connected electricity system located in another country, the emission factor is 0 tons CO_2 per MWh.

Electricity exports should not be subtracted from electricity generation data used for calculating and monitoring the baseline emission rate.

Baseline

Which of the plausible alternatives scenarios, as listed in step 1 of the additionality text, is the most likely baseline scenario? Please provide thorough explanation to justify your choice, based on the factors (investment or other barriers) described in the additionality methodology. This methodology is applicable only if the most likely baseline scenario is electricity production from other sources feeding into the grid.

The baseline scenario is the following: electricity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources.

For project activities that modify or retrofit an existing electricity generation facility, the guidance provided by EB08 shall be taken into account.[2]

[2] "If a proposed CDM project activity seeks to retrofit or otherwise modify an existing facility, the baseline may refer to the characteristics (i.e. emissions) of the existing facility only to the extent that the project activity does not increase the output or lifetime of the existing facility. For any increase of output or lifetime of the facility which is due to the project activity, a different baseline shall apply." (EB08, Annex 1, http://cdm.unfccc.int/EB/Meetings/).

A baseline emission factor (EF_y) is calculated as a combined margin (*CM*), consisting of the combination of operating margin (*OM*) and build margin (*BM*) factors according to the following three steps. Calculations for this combined margin must be based on data from an official source (where available)[3] and made publicly available.

STEP 1. Calculate the Operating Margin emission factor(s) ($EF_{OM,y}$) based on one of the four following methods:

(a) Simple OM, or
(b) Simple adjusted OM, or
(c) Dispatch Data Analysis OM, or
(d) Average OM.

Each method is described below.

Dispatch data analysis should be the first methodological choice. Where this option is not selected project participants shall justify why and may use the simple OM, the simple adjusted OM or the average emission rate method taking into account the provisions outlined hereafter.

The Simple OM method (a) can only be used where low-cost/must run resources[4] constitute less than 50% of total grid generation in: 1) average of the five most recent years, or 2) based on long-term normals for hydroelectricity production.

The average emission rate method (d) can only be used

- where low-cost/must run resources constitute more than 50% of total grid generation and detailed data to apply option (b) is not available, and
- where detailed data to apply option (c) above is unavailable.

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[3] Plant emission factors used for the calculation of operating and build margin emission factors should be obtained in the following priority:

1. *acquired directly* from the dispatch center or power producers, if available; or
2. *calculated*, if data on fuel type, fuel emission factor, fuel input and power output can be obtained for each plant; if confidential data available from the relevant host Party authority are used the calculation carried out by the project participants shall be verified by the DOE and the CDM-PDD may only show the resultant carbon emission factor and the corresponding list of plants.
3. *calculated*, as above, but using estimates such as
   - default IPCC values from the *IPCC 1996 Revised Guidelines* and the *IPCC Good Practice Guidance* for net calorific values and carbon emission factors for fuels instead of plant-specific values (note that the *IPCC Good Practice Guidance* includes some updates from the *IPCC 1996 Revised Guidelines*);
   - technology provider's name plate power plant efficiency or the anticipated energy efficiency documented in official sources (instead of calculating it from fuel consumption and power output). This is likely to be a conservative estimate, because under actual operating conditions plants usually have lower efficiencies and higher emissions than name plate performance would imply;
   - conservative estimates of power plant efficiencies, based on expert judgments on the basis of the plant's technology, size and commissioning date; or
4. *calculated,* for the simple OM and the average OM, using aggregated generation and fuel consumption data, in cases where more disaggregated data is not available.

[4] Low operating cost and must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. If coal is obviously used as must-run, it should also be included in this list, i.e. excluded from the set of plants.

(a) *Simple OM.* The Simple OM emission factor ($EF_{OM,simple,y}$) is calculated as the generation-weighted average emissions per electricity unit (tCO_2/MWh) of all generating sources serving the system, not including low-operating cost and must-run power plants:

$$EF_{OM,simple,y} = \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}} \tag{1}$$

where

$F_{i,j,y}$ is the amount of fuel i (in a mass or volume unit) consumed by relevant power sources j in year(s) y,

j refers to the power sources delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports[5] to the grid,

$COEF_{i,j,y}$ 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 j and the percent oxidation of the fuel in year(s) y, and

$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source j.

The CO_2 emission coefficient $COEF_i$ is obtained as

$$COEF_i = NCV_i \cdot EF_{CO2,i} \cdot OXID_i \tag{2}$$

where:

NCV_i is the net calorific value (energy content) per mass or volume unit of a fuel i,

$OXID_i$ is the oxidation factor of the fuel (see page 1.29 in the 1996 Revised IPCC Guidelines for default values),

$EF_{CO2,i}$ is the CO_2 emission factor per unit of energy of the fuel i.

Where available, local values of NCV_i and $EF_{CO2,i}$ should be used. If no such values are available, country-specific values (see e.g. IPCC Good Practice Guidance) are preferable to IPCC world-wide default values.

The Simple OM emission factor can be calculated using either of the two following data vintages for years(s) y:

- A 3-year average, based on the most recent statistics available at the time of PDD submission, or
- The year in which project generation occurs, if $EF_{OM,y}$ is updated based on ex post monitoring.

(b) *Simple Adjusted OM.* This emission factor ($EF_{OM,simple\ adjusted,y}$) is a variation on the previous method, where the power sources (including imports) are separated in low-cost/must-run power sources (k) and other power sources (j):

$$EF_{OM,simple\ adjusted,y} = \left(1-\lambda_y\right) \cdot \frac{\sum_{i,j} F_{i,j,y} \cdot COEF_{i,j}}{\sum_{j} GEN_{j,y}} + \lambda_y \cdot \frac{\sum_{i,k} F_{i,k,y} \cdot COEF_{i,k}}{\sum_{k} GEN_{k,y}} \tag{3}$$

[5] As described above, an import from a connected electricity system should be considered as one power source j.

where $F_{i,k,y}$, $COEF_{i,k}$ and GEN_k are analogous to the variables described for the simple OM method above for plants k; the years(s) y can reflect either of the two vintages noted for simple OM above, and

$$\lambda_y\ (\%) = \frac{\text{Number of hours per year for which low - cost/must - run sources are on the margin}}{8760 \text{ hours per year}} \qquad (4)$$

where lambda (λ_y) should be calculated as follows (see figure below):

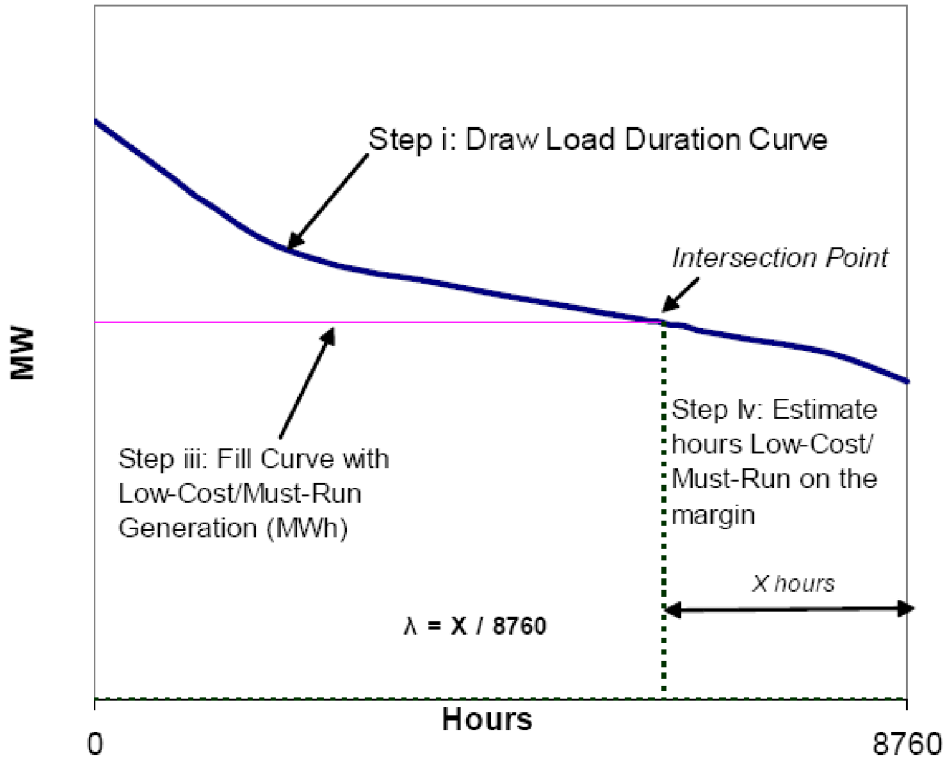
Step i) Plot a Load Duration Curve. Collect chronological load data (typically in MW) for each hour of a year, and sort load data from highest to lowest MW level. Plot MW against 8760 hours in the year, in descending order.

Step ii) Organize Data by Generating Sources. Collect data for, and calculate total annual generation (in MWh) from low-cost/must-run resources (i.e. $\sum_k GEN_{k,y}$).

Step iii) Fill Load Duration Curve. Plot a horizontal line across load duration curve such that the area under the curve (MW times hours) equals the total generation (in MWh) from low-cost/must-run resources (i.e. $\sum_k GEN_{k,y}$).

Step iv) Determine the "Number of hours per year for which low-cost/must-run sources are on the margin". First, locate the intersection of the horizontal line plotted in step (iii) and the load duration curve plotted in step (i). The number of hours (out of the total of 8760 hours) to the right of the intersection is the number of hours for which low-cost/must-run sources are on the margin. If the lines do not intersect, then one may conclude that low-cost/must-run sources do not appear on the margin and λ_y is equal to zero. Lambda (λ_y) is the calculated number of hours divided by 8760.

Figure 1: Illustration of Lambda Calculation for Simple Adjusted OM Method



Note: Step (ii) is not shown in the figure, it deals with organizing data by source.

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

$$EF_{OM,Dispatch\ Data,y} = \frac{E_{OM,y}}{EG_y} \tag{5}$$

where EG_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

$$E_{OM,y} = \sum_h EG_h \cdot EF_{DD,h} \tag{6}$$

where EG_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:

$$EF_{DD,h} = \frac{\sum_{i,n} F_{i,n,h} \cdot COEF_{i,n}}{\sum_n GEN_{n,h}} \tag{7}$$

where *F*, *COEF* and *GEN* are analogous to the variables described for the simple OM method above, but calculated on an hourly basis for the set of plants (*n*) falling within the top 10% of the system dispatch. To determine the set of plants (*n*), obtain from a national dispatch center: 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*, stack 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 ($\sum GEN_h$) comprises 10% of total generation from all plants during that hour (including imports to the extent they are dispatched).

(d) *Average OM.* The average Operating Margin (OM) emission factor ($EF_{OM,average,y}$) is calculated as the average emission rate of all power plants, using equation (1) above, but including low-operating cost and must-run power plants. Either of the two data vintages described for the simple OM (a) may be used.

STEP 2. Calculate the Build Margin emission factor ($EF_{BM,y}$) as the generation-weighted average emission factor (tCO_2/MWh) of a sample of power plants *m*, as follows:

$$EF_{BM,y} = \frac{\sum_{i,m} F_{i,m,y} \cdot COEF_{i,m}}{\sum_{m} GEN_{m,y}} \tag{8}$$

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

Project participants shall choose between one of the following two options:

Option 1. Calculate the Build Margin emission factor $EF_{BM,y}$ *ex ante* based on 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.

Project participants should use from these two options that sample group that comprises the larger annual generation.

Option 2. For the first crediting period, the Build Margin emission factor $EF_{BM,y}$ must be updated annually *ex post* for the year in which actual project generation and associated emissions reductions occur. For subsequent crediting periods, $EF_{BM,y}$ should be calculated *ex-ante*, as described in option 1 above. 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.

Project participants should use from these two options that sample group that comprises the larger annual generation.

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

STEP 3. Calculate the baseline emission factor EF_y as the weighted average of the Operating Margin emission factor ($EF_{OM,y}$) and the Build Margin emission factor ($EF_{BM,y}$):

$$EF_y = w_{OM} \cdot EF_{OM,y} + w_{BM} \cdot EF_{BM,y} \quad (9)$$

where the weights w_{OM} and w_{BM}, by default, are 50% (i.e., $w_{OM} = w_{BM} = 0.5$), and $EF_{OM,y}$ and $EF_{BM,y}$ are calculated as described in Steps 1 and 2 above and are expressed in tCO_2/MWh. Alternative weights can be used, as long as $w_{OM} + w_{BM} = 1$, and appropriate evidence justifying the alternative weights is presented. These justifying elements are to be assessed by the Executive Board.[6]

The weighted average applied by project participants should be fixed for a crediting period and may be revised at the renewal of the crediting period.

Leakage

The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction, fuel handling (extraction, processing, and transport), and land inundation (for hydroelectric projects – see applicability conditions above). Project participants do not need to consider these emission sources as leakage in applying this methodology. Project activities using this baseline methodology shall not claim any credit for the project on account of reducing these emissions below the level of the baseline scenario.

Emission Reductions

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

$$ER_y = BE_y - PE_y - L_y \quad (10)$$

where the baseline emissions (BE_y in tCO_2) are the product of the baseline emissions factor (EF_y in tCO_2/MWh) calculated in Step 3, times the electricity supplied by the project activity to the grid (EG_y in MWh), as follows:

$$BE_y = EG_y \cdot EF_y \quad (11)$$

For most renewable energy project activities, $PE_y = 0$. However, for geothermal project activities, project participants shall account the following emission sources[7], where applicable:

- Fugitive emissions of carbon dioxide and methane due to release of non-condensable gases from produced steam; and
- Carbon dioxide emissions resulting from combustion of fossil fuels related to the operation of the geothermal power plant.

[6] More analysis on other possible weightings may be necessary and this methodology could be revised based on this analysis. There might be a need to propose different weightings for different situations.
[7] Fugitive carbon dioxide and methane emissions due to well testing and well bleeding are not considered as they are negligible.

The data to be collected are listed in the associated monitoring methodology, AM00XX. Project emissions should be calculated as follows:

a) **Fugitive carbon dioxide and methane emissions due to release of non-condensable gases from the produced steam (PES_y):**

$$PES_y = \left(w_{Main,CO2} + w_{Main,CH4} \cdot GWP_{CH4}\right) \cdot M_{S,y} \quad (12)$$

where PES_y are the project emissions due to release of carbon dioxide and methane from the produced steam during the year y, $w_{Main,CO2}$ and $w_{Main,CH4}$ are the average mass fractions of carbon dioxide and methane in the produced steam, GWP_{CH4} is the global warming potential of methane and $M_{S,y}$ is the quantity of steam produced during the year y.

b) **Carbon dioxide emissions from fossil fuel combustion ($PEFF_y$)**

$$PEFF_y = \sum_i F_{i,y} \cdot COEF_i \quad (13)$$

where *PEFFy* are the project emissions from combustion of fossil fuels related to the operation of the geothermal power plant in tons of CO_2, $F_{i,y}$ is the fuel consumption of fuel type i during the year y and $COEF_i$ is the CO_2 emission factor coefficient of the fuel type i.

Thus, for geothermal project activities,

$$PE_y = PES_y + PEFF_y \quad (14)$$

Estimation of Emissions Reductions Prior to Validation

Project participants should prepare as part of the PDD an estimate of likely project emission reductions for the proposed crediting period. This estimate should, in principle, employ the same methodology as selected above (i.e. OM option 1a, 1b, 1c or 1d). Where the emission factor (EF_y) is determined ex-post during monitoring, project participants may use models or other tools to estimate the emission reductions prior to validation.

APPENDIX 4 – TOOL FOR THE DEMONSTRATION AND ASSESSMENT OF ADDITIONALITY

Tool for the demonstration and assessment of additionality

1. This document provides for a step-wise approach to demonstrate and assess additionality. These steps include:

- Identification of alternatives to the project activity;
- Investment analysis to determine that the proposed project activity is not the most economically or financially attractive;
- Barriers analysis;
- Common practice analysis; and
- Impact of registration of the proposed project activity as a CDM project activity.

Based on information about activities similar to the proposed project activity, the common practice analysis is to complement and reinforce the investment and barriers analysis. The steps are summarized in the flow-chart at the end of this document.

2. The document provides a general framework for demonstrating and assessing additionality and is to be applicable to a wide range of project types. Particular project types may require adjustments to this framework.

3. The use of this tool to assess and determine additionality does not replace the need for the baseline methodology to provide for a stepwise approach justifying the selection and determination of the most plausible baseline scenario alternatives. Project participants proposing new baseline methodologies shall ensure consistency between the determination of additionality of a project activity and the determination of a baseline scenario.

4. Project participants proposing new baseline methodologies may incorporate this consolidated tool in their proposal. Project participants may also propose other tools for the demonstration of additionality to the Executive Board for its consideration.

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

The Marrakesh Accords and decision 18/CP.9 provide guidance on the eligibility of a proposed CDM project activity which started before registration[1].

1. If project participants wish to have the crediting period starting prior to the registration of their project activity, they shall:

(a) Provide evidence that the starting date of the CDM project activity falls between 1 January 2000 and the date of the registration of a first CDM project activity, bearing in mind that only CDM project activities submitted for registration before 31 December 2005 may claim for a crediting period starting before the date of registration; and

(b) Provide evidence that the incentive from the CDM was seriously considered in the decision to proceed with the project activity. This evidence shall be based on (preferably

[1] For more information see decisions 17/CP.7 and 18/CP.9 (documents FCCC/CP/2001/13/Add.2, FCCC/CP/2003/6/Add.2) and the Glossary of CDM terms contained in the guidelines for completing the project design document (CDM-PDD) available on the UNFCCC CDM web site: unfccc.int/cdm.

official, legal and/or other corporate) documentation that was available to third parties at, or prior to, the start of the project activity.

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

(Note: In accordance with guidance by the Executive Board, consistency is to be ensured between "baseline scenario" and "baseline emissions"[2])

Define realistic and credible alternatives[3] to the project activity(s) that can be (part of) the baseline scenario through the following sub-steps:

Sub-step 1a. Define alternatives to the project activity:

1. Identify realistic and credible alternative(s) available to the project participants or similar project developers[4] that provide outputs or services comparable with the proposed CDM project activity[5]. These alternatives are to include:

- The proposed project activity not undertaken as a CDM project activity;
- All other plausible and credible alternatives to the project activity that deliver outputs and on services (e.g. electricity, heat or cement) with comparable quality, properties and application areas;
- If applicable, continuation of the current situation (no project activity or other alternatives undertaken).

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

2. The alternative(s) shall be in compliance with all applicable legal and regulatory requirements, even if these laws and regulations have objectives other than GHG reductions, e.g. to mitigate local air pollution.[6] (This sub-step does not consider national and local policies that do not have legally-binding status.[7]).

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[2] Please refer to paragraph 2 of Annex 3 of the report of the Executive Board at its ninth meeting, see: http://cdm.unfccc.int/EB/Meetings/009/eb09repa3.pdf.

[3] Reference to "alternatives" throughout this document denotes "alternative scenarios".

[4] For example, a coal-fired power station or hydropower may not be an alternative for an independent power producer investing in wind energy or for a sugar factory owner investing in a co-generation, but may be an alternative for a public utility. Alternatives are, therefore, related to technology and circumstances as well as to the investor.

[5] For example, the outputs of a cogeneration project could include heat for on-site use, electricity for on-site use, and excess electricity for export to the grid. In the case of a proposed landfill gas capture project, the service provided by the projects includes operation of a capped landfill.

[6] For example, an alternative consisting of an open, uncapped landfill would be non-complying in a country where this scenario would imply violations of safety or environmental regulations pertaining to landfills.

[7] This aspect may be modified based on forthcoming guidance from the Executive Board on national and sectoral policies.

3. If an alternative does not comply with all applicable legislation and regulations, then show that, based on an examination of current practice in the country or region in which the law or regulation applies, those applicable legal or regulatory requirements are systematically not enforced and that non-compliance with those requirements is widespread in the country. If this cannot be shown, then eliminate the alternative from further consideration;

4. If the proposed project activity is the only alternative amongst the ones considered by the project participants that is in compliance with all regulations with which there is general compliance, then the proposed CDM project activity is not additional.[8]

→ Proceed to Step 2 (Investment analysis) or Step 3 (Barrier analysis). (Project participants may also select to complete both steps 2 and 3.)

Step 2. Investment analysis

Determine whether the proposed project activity is the economically or financially less attractive than other alternatives without the revenue from the sale of certified emission reductions (CERs). To conduct the investment analysis, use the following sub-steps:

Sub-step 2a. Determine appropriate analysis method

1. Determine whether to apply simple cost analysis, investment comparison analysis or benchmark analysis (sub-step 2b). If the CDM project activity generates no financial or economic benefits other than CDM related income, then apply the simple cost analysis (Option I). Otherwise, use the investment comparison analysis (Option II) or the benchmark analysis (Option III).

Sub-step 2b. – Option I. Apply simple cost analysis

2. Document the costs associated with the CDM project activity and demonstrate that the activity produces no economic benefits other than CDM related income.

→ If it is concluded that the proposed CDM project activity is not financially attractive then proceed to Step 4 (Common practice analysis).

Sub-step 2b. – Option II. Apply investment comparison analysis

3. Identify the financial indicator, such as IRR[9], NPV, cost benefit ratio, or unit cost of service (e.g., levelized cost of electricity production in \$/kWh or levelized cost of delivered heat in \$/GJ) most suitable for the project type and decision-making context.

[8] This provision may be further elaborated depending on deliberation from the Board regarding requirements for the renewal of a crediting period.

[9] For the investment comparison analysis, IRRs can be calculated either as project IRRs or as equity IRRs. Project IRRs calculate a return based on project cash outflows and cash inflows only, irrespective the source of financing. Equity IRRs calculate a return to equity investors and therefore also consider amount and costs of available debt financing. The decision to proceed with an investment is based on returns to the investors, so equity IRR will be more appropriate in many cases. However, there will also be cases where a project IRR may be appropriate.

Sub-step 2b – Option III. Apply benchmark analysis

4. Identify the financial indicator, such as IRR[10], NPV, cost benefit ratio, or unit cost of service (e.g., levelized cost of electricity production in $/kWh or levelized cost of delivered heat in $/GJ) most suitable for the project type and decision context. Identify the relevant benchmark value, such as the required rate of return (RRR) on equity. The benchmark is to represent standard returns in the market, considering the specific risk of the project type, but not linked to the subjective profitability expectation or risk profile of a particular project developer. Benchmarks can be derived from:

- Government bond rates, increased by a suitable risk premium to reflect private investment and/or the project type, as substantiated by an independent (financial) expert;
- Estimates of the cost of financing and required return on capital (e.g. commercial lending rates and guarantees required for the country and the type of project activity concerned), based on bankers views and private equity investors/funds' required return on comparable projects;
- A company internal benchmark (weighted average capital cost of the company) if there is only one potential project developer (e.g. when the project activity upgrades an existing process). The project developers shall demonstrate that this benchmark has been consistently used in the past, i.e. that project activities under similar conditions developed by the same company used the same benchmark.

Sub-step 2c. Calculation and comparison of financial indicators (only applicable to options II and III):

5. Calculate the suitable financial indicator for the proposed CDM project activity and, in the case of Option II above, for the other alternatives. Include all relevant costs (including, for example, the investment cost, the operations and maintenance costs), and revenues (excluding CER revenues, but including subsidies/fiscal incentives[11] where applicable), and, as appropriate, non-market cost and benefits in the case of public investors.

6. Present the investment analysis in a transparent manner and provide all the relevant assumptions in the CDM-PDD, so that a reader can reproduce the analysis and obtain the same results. Clearly present critical techno-economic parameters and assumptions (such as capital costs, fuel prices, lifetimes, and discount rate or cost of capital). Justify and/or cite assumptions in a manner that can be validated by the DOE. In calculating the financial indicator, the project's risks can be included through the cash flow pattern, subject to project-specific expectations and assumptions (e.g. insurance premiums can be used in the calculation to reflect specific risk equivalents).

7. Assumptions and input data for the investment analysis shall not differ across the project activity and its alternatives, unless differences can be well substantiated.

[10] For the benchmark analysis, the IRR shall be calculated as project IRR. If there is only one potential project developer (e.g. when the project activity upgrades an existing process), the IRR shall be calculated as equity IRR.

[11] This provision may be further elaborated depending on deliberations by the Board on national and sectoral policies.

8. Present in the CDM-PDD submitted for validation a clear comparison of the financial indicator for the proposed CDM activity and:

(a) The alternatives, if Option II (investment comparison analysis) is used. If one of the other alternatives has the best indicator (e.g. highest IRR), then the CDM project activity can not be considered as the most financially attractive;

(b) The financial benchmark, if Option III (benchmark analysis) is used. If the CDM project activity has a less favourable indicator (e.g. lower IRR) than the benchmark, then the CDM project activity cannot be considered as financially attractive.

Sub-step 2d. Sensitivity analysis (only applicable to options II and III):

9. Include a sensitivity analysis that shows whether the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions. The investment analysis provides a valid argument in favour of additionality only if it consistently supports (for a realistic range of assumptions) the conclusion that the project activity is unlikely to be the most financially attractive (as per step 2c para 8a) or is unlikely to be financially attractive (as per step 2c para 8b).

→ If after the sensitivity analysis it is concluded that the proposed CDM project activity is unlikely to be the most financially attractive (as per step 2c para 8a) or is unlikely to be financially attractive (as per step 2c para 8b), then proceed to Step 3 (Barrier analysis) or Step 4 (Common practice analysis).

→ Otherwise, unless barrier analysis below is undertaken and indicates that the proposed project activity faces barriers that do not prevent the baseline scenario(s) from occurring, the project activity is considered not additional.

Step 3. Barrier analysis

If this step is used, determine whether the proposed project activity faces barriers that:

(a) Prevent the implementation of this type of proposed project activity; and

(b) Do not prevent the implementation of at least one of the alternatives.

Use the following sub-steps:

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

1. Establish that there are barriers that would prevent the implementation of the type of proposed project activity from being carried out if the project activity was not registered as a CDM activity. Such barriers may include, among others:

Investment barriers, other than the economic/financial barriers in Step 2 above, *inter alia*:

- Debt funding is not available for this type of innovative project activities.
- No access to international capital markets due to real or perceived risks associated with domestic or foreign direct investment in the country where the project activity is to be implemented.

Technological barriers, *inter alia*:

- Skilled and/or properly trained labour to operate and maintain the technology is not available and no education/training institution in the host country provides the needed skill, leading to equipment disrepair and malfunctioning;
- Lack of infrastructure for implementation of the technology.

Barriers due to prevailing practice, *inter alia*:

- The project activity is the "first of its kind": No project activity of this type is currently operational in the host country or region.

The identified barriers are only sufficient grounds for demonstration of additionality if they would prevent potential project proponents from carrying out the proposed project activity if it was not expected to be registered as a CDM activity.

2. Provide transparent and documented evidence, and offer conservative interpretations of this documented evidence, as to how it demonstrates the existence and significance of the identified barriers. Anecdotal evidence can be included, but alone is not sufficient proof of barriers. The type of evidence to be provided may include:

(a) Relevant legislation, regulatory information or industry norms;

(b) Relevant (sectoral) studies or surveys (e.g. market surveys, technology studies, etc) undertaken by universities, research institutions, industry associations, companies, bilateral/multilateral institutions, etc;

(c) Relevant statistical data from national or international statistics;

(d) Documentation of relevant market data (e.g. market prices, tariffs, rules);

(e) Written documentation from the company or institution developing or implementing the CDM project activity or the CDM project developer, such as minutes from Board meetings, correspondence, feasibility studies, financial or budgetary information, etc;

(f) Documents prepared by the project developer, contractors or project partners in the context of the proposed project activity or similar previous project implementations;

(g) Written documentation of independent expert judgements from industry, educational institutions (e.g. universities, technical schools, training centres), industry associations and others.

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

3. If the identified barriers also affect other alternatives, explain how they are affected less strongly than they affect the proposed CDM project activity. In other words, explain how the identified barriers are not preventing the implementation of at least one of the alternatives. Any alternative that would be prevented by the barriers identified in Sub-step 3a is not a viable alternative, and shall be eliminated from consideration. At least one viable alternative shall be identified.

→ ***If both Sub-steps 3a – 3b are satisfied, proceed to Step 4 (Common practice analysis)***

→ ***If one of the Sub-steps 3a – 3b is not satisfied, the project activity is not additional.***

Step 4. Common practice analysis

The above generic additionality tests shall be complemented with an analysis of the extent to which the proposed project type (e.g. technology or practice) has already diffused in the relevant sector and region. This test is a credibility check to complement the investment analysis (Step 2) or barrier analysis (Step 3). Identify and discuss the existing common practice through the following sub-steps:

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

1. Provide an analysis of any other activities implemented previously or currently underway that are similar to the proposed project activity. Projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing, etc. Other CDM project activities are not to be included in this analysis. Provide quantitative information where relevant.

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

2. If similar activities are widely observed and commonly carried out, it calls into question the claim that the proposed project activity is financially unattractive (as contended in Step 2) or faces barriers (as contended in Step 3). Therefore, if similar activities are identified above, then it is necessary to demonstrate why the existence of these activities does not contradict the claim that the proposed project activity is financially unattractive or subject to barriers. This can be done by comparing the proposed project activity to the other similar activities, and pointing out and explaining essential distinctions between them that explain why the similar activities enjoyed certain benefits that rendered it financially attractive (e.g., subsidies or other financial flows) or did not face the barriers to which the proposed project activity is subject.

3. Essential distinctions may include a serious change in circumstances under which the proposed CDM project activity will be implemented when compared to circumstances under which similar projects where carried out. For example, new barriers may have arisen, or promotional policies may have ended, leading to a situation in which the proposed CDM project activity would not be implemented without the incentive provided by the CDM. The change must be fundamental and verifiable.

→ If Sub-steps 4a and 4b are satisfied, i.e. similar activities cannot be observed or similar activities are observed, but essential distinctions between the project activity and similar activities can reasonably be explained, please go to step 5 (Impact of CDM registration).

→ If Sub-steps 4a and 4b are not satisfied, i.e. similar activities can be observed and essential distinctions between the project activity and similar activities cannot reasonably be explained, the proposed CDM project activity is not additional.

Step 5. Impact of CDM registration

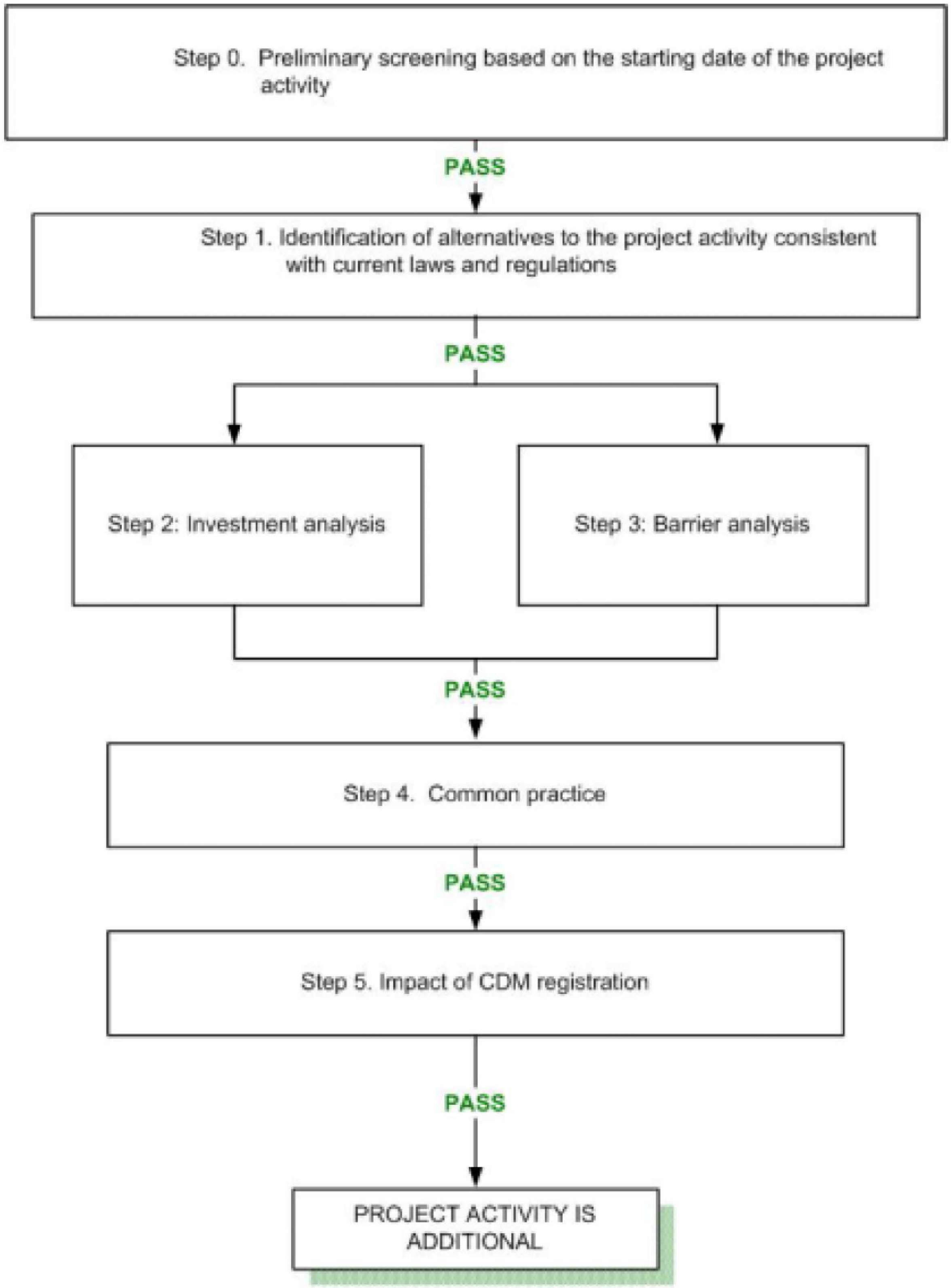
Explain how the approval and registration of the project activity as a CDM activity, and the attendant benefits and incentives derived from the project activity, will alleviate the economic and financial hurdles (Step 2) or other identified barriers (Step 3) and thus enable the project activity to be undertaken. The benefits and incentives can be of various types, such as:

- Anthropogenic greenhouse gas emission reductions;
- The financial benefit of the revenue obtained by selling CERs,
- Attracting new players who are not exposed to the same barriers, or can accept a lower IRR (for instance because they have access to cheaper capital),
- Attracting new players who bring the capacity to implement a new technology, and
- Reducing inflation /exchange rate risk affecting expected revenues and attractiveness for investors.

→ ***If Step 5 is satisfied, the proposed CDM project activity is not the baseline scenario.***

→ ***If Step 5 is not satisfied, the proposed CDM project activity is not additional.***

Flowchart: Additionality scheme



APPENDIX 5 – EXPLANATION OF THE WEIGHTING OF THE BUILD AND OPERATING MARGIN

In this appendix assumptions behind the fifty-fifty weighting of the operating and build margin in the baseline emissions calculations will be explained.

The emission factor calculated in the baseline emission is based on both the build and operating margin calculations that are equally weighted. The division is based on several assumptions: Firstly the electricity demand in the grid is assumed to rise continuously. Secondly it is assumed that the implementation of a new power plant becomes attractive, when the relationship between electricity supply and demand reaches a certain level. The situation is illustrated below:

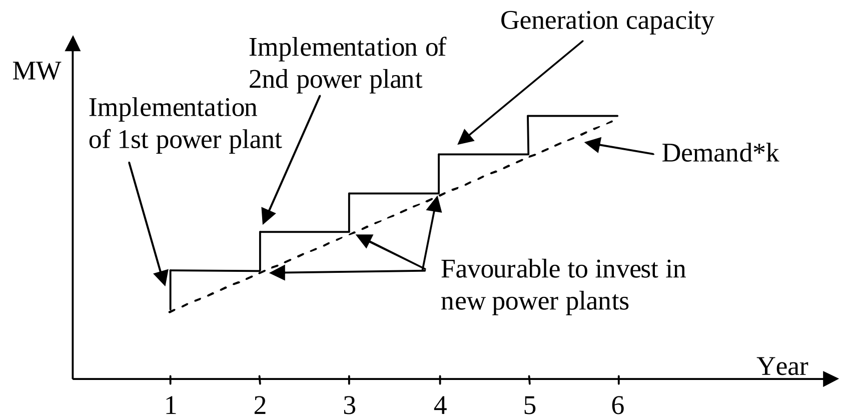


Figure 1.1: The assumptions behind the fifty-fifty weighting of the build and operating margin. The constant, k, that is multiplied the demand reflects the requirement for having a larger generation capacity than the average or peak demand to cope with variations and system drop-outs.

If the situation in figure 1.1 is now considered with and without the implementation of a CDM project, the scenario without the CDM project would represent the baseline scenario, and the other the project scenario.
According to the figure above, the baseline scenario would be:

Time	Event	Effect on operating margin	Effect on build margin
1st baseline period year	Implementation of 1st power plant	Displacement of the power plant operating at the margin	Displacement of the implementation of the 2nd power plant
2nd baseline period year	Implementation of 2nd power plant	Displacement of the power plant operating at the margin	Displacement of the implementation of the 3rd power plant
…			
Final baseline period year	Implementation of final power plant	Displacement of the power plant operating at the margin	Displacement of the implementation of the final+1 power plant.

Table 1.1: A hypothetical baseline scenario illustrating the implementation of power plant and their effect

The project scenario would on the other hand be (assuming that the CDM project corresponded to the size and characteristics of the other power plants implemented):

Time	Event	Effect on operating margin	Effect on build margin
1st baseline period year	Implementation of CDM project	Displacement of the power plant operating at the margin	Displacement of the implementation of the 1st power plant
2nd baseline period year	Implementation of 1st power plant	Displacement of the power plant operating at the margin	Displacement of the implementation of the 2nd power plant
…			
Final baseline period year	Implementation of final-1 power plant **and** final power plant, as CDM projects stops operating (in theory)	Displacement of the power plant operating at the margin	Displacement of the implementation of the final+1 power plant.

Table 1.2: A hypothetical project scenario. The influence of the implementation of a CDM project on the implementation of other power plants

Subtracting the baseline scenario and the project scenario thereby yields following result:

Time	Event	Effect on operating margin	Effect on build margin
1st baseline period year	Implementation of CDM project	None	Displacement of the implementation of the 1st power plant
2nd baseline period year			Displacement of the implementation of the 2nd power plant
…			…
Final baseline period year			None

Table 1.3: The difference between the baseline scenario and the project scenario from table 1.1 and 1.2

In theory the implementation of a CDM project therefore only affects the build margin. It is however in the first years credited according to the operating margin because it is argued that the first planned power plants will be build as planned, corresponding to the first half of the baseline period, thereby only affecting the ones to come in the later half of the baseline period.

APPENDIX 6 – CHOOSING FORECASTING METHODS

In this appendix the choice of forecasting methods will be made.

The choice between forecasting methods is based on the "methodology tree", which can be seen in figure 1.1 below. The methodology tree can be used to select suitable forecasting methods by considering what kind of information is available and what demands are set for the forecasting methods.

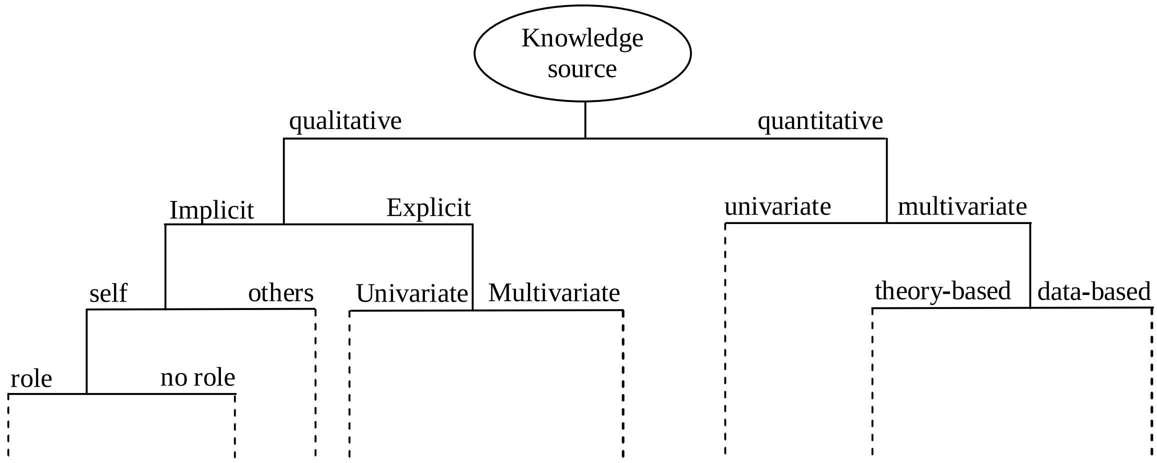


Figure 1.1: The "methodology tree". A classification of forecasting methods.

In the following each methodological branch in the methodology tree will be discussed, leading to a choice of method.

Qualitative or quantitative forecasts

As illustrated in the methodology tree the type of forecasts that can be made is dependent on first of all the "type" of information available. "Type" refers to whether the information is qualitative or quantitative. In qualitative forecasts the forecast is based on qualitative statements, for example an expert opinion. For the quantitatively based forecasting methods it is based on a mathematical statement about how the present correlates to with the future situation.

In relation to the electricity sector both types of information is normally present, which means that the knowledge source does therefore normally not represent a barrier regarding this division.

It can on this basis therefore not be determined whether qualitative or quantitative methods are the most suitable for the present purpose.

Quantitative forecasting methods

As a general principle Armstrong [Armstrong 2001], [Makridakis 1997] argues that quantitative methods should be used when sufficient quantitative information in available. In the following different quantitative forecasting methods will be identified and discussed regarding their need for information and their overall suitability according to the methodological demands for establishing a baseline scenario and additionality test.

Univariate or multivariate methods

Within the quantitative methodologies the first division in figure 1.1 is regarding the distinction whether the forecast should be based on univariate and multivariate knowledge. If the forecast is based on univariate knowledge, it is assumed that knowledge about the historical course of action of the forecasted item[36] alone is sufficient for determining its future path, whereas forecasts using multivariate knowledge assume that also factors presently affecting the forecasted item are important for its future development.

Quantitative univariate forecasting

Forecasting in this branch is made by extrapolation. Here it is assumed that the future of the forecasted item can be estimated from its own historical evolution. If this kind of information is scarce, data based on analogies from similar situations can be used or be established through experiments or surveys. This is however not necessary in this case, as the evolution of the electricity sector is normally well documented.

Extrapolation provides a cheap approach to establish a forecast which is easy to reproduce. It is generally more applicable when the forecasting period is short and there are few variations in the course of the studied phenomenon [Armstrong 2001].

As the forecasting period in this case is relatively long and the electricity sector is not especially stable over long time spans, the method is likely to give inaccurate results in the present case. This argument was substantiated in the analysis in chapter 4.5, where extrapolation methods for establishing the baseline scenario proved to be less accurate in several situations within the electricity sector. The univariate quantitative methods are therefore considered to be limited usable under these circumstances.

Quantitative multivariate forecasting

Quantitative multivariate forecasts encompass both theory- and data based methods.

In theory-based methods the idea is that established theories from for example the area of economic science are used to describe the quantitative cause-effect relationship between variables. In data-based methods statistical methods are applied on a large amount of data to find patterns for the development of the forecasted variable and project these into the future. The data-based methods are therefore not using theoretical cause-effect relations, but rely on experience.

Theory-based methods

Forecasting within the electricity sector using theory based methods has been done many times and some models are readily available[37].

Making models like these is a very time consuming exercise with a high demand of expert knowledge. If a model like these should be used to make baseline scenarios within the CDM mechanism, it should therefore be applicable to the electricity sector in all countries.

One problem with these models is however that the forecasted item is expected to react in the same way in different countries, for example by assuming that least cost alternatives are the chosen alternative, which will in some situations not be the case due to for example risks, knowledge and traditions [IEA 2003].

Another aspect is that the output of the model would not be transparent, as it would be very difficult to see the underlying assumptions. A very attractive feature about such model would however be that once it was made it could be applied to different contexts in a cheap and fast manner.

Taking these aspects into consideration, it was decided not to use this method in this study.

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[36] The forecasted item is the focal point of the forecast. In this case it is the implementation and operation of power plants in the Argentinean power sector.

[37] See for example the LEAP and MARKAL models (http://forums.seib.org/leap/, http://www.etsap.org/markal/main.html).

Data-based methods
For data-based methods, the abovementioned complex models are not needed, but are instead dependent on massive data availability and collection, powerful computers and algorithms [Thearling 1995]. The latter two can be expected to be available, whereas the first item represents a problem, as data availability and collection in developing countries in general are limited. It can therefore be a significant impediment for the use of these methods in this context. It was on this basis chosen not to use this method.

Qualitative forecasting methods
Following the qualitative branch the first division concerns whether the forecast is based on explicit or implicit information.
Forecasts based on implicit information uses the individual's knowledge, which can be based on all kinds of different information, but in the end, the forecast is based on the individual's judgement and implicit information.
Forecasting on explicit qualitative information is based on explicit analyses and qualitative cause-effect relationships between the present and future situation.
This information will normally be available, meaning that both methodological branches might comply with the demands for the forecasting method.

Division in the implicit qualitative branch: Self or others
In the "self" category, one is to forecast the behaviour of one self whereas the opposite category "others" one are to forecast on others behaviour.
Concerning the availability of information, the "others" category is the most promising, as there are a large amount of actors in the electricity sector and therefore to include them all in a forecasting procedure would be very difficult. Also it can be argues whether it is recommendable, as several of the actors keep their strategy close and are not likely to reveal it for the purpose of a forecasting. Getting others to speak of other actors probable behaviour is probably much more rewarding and is at the same time easier to accomplish in relation to obtain the information. This branch is therefore preferred.

Forecasts based on "other's" judgements
Within this category, collectively called "Expert Opinions", there are several different methodologies including "Delphi", "judgemental bootstrapping" and "analogies". Other methods in the same category exist, such as "prediction markets" and "game theory" which are however not considered relevant in this context[38] [Armstrong 2005].

The Delphi Method
The Delphi method is a forecasting method using judgements from anonymous experts, normally between 5 to 20. It normally consists of two or three rounds. In each round a questionnaire is filled and commented by each expert. Thereafter the answers are gathered and comments are used to support statements. Questions where agreement among the experts is found are left out from the next questionnaire and a narrowing of possible answers are made on the basis of comments. Gradually during the rounds consensus is established.
The Delphi method is a relatively open framework, based on some key principles: It involves several unbiased experts and uses structured questions which are summarised in an objective way.

[38] In prediction markets people's preferences and beliefs are used as a guide for what the future will bring. It is a useful method when information is widely dispersed and is mostly used in public cases, predicting events of common interest. In game theory it is assumed that all preferences, possibilities and consequences are know for all actors, which is not the case in this study [Armstrong 2005]. The two methods have therefore been considered irrelevant in this context.

The Delphi method can therefore be applied to all kinds of different questions and are especially favoured when data are poor or lacking. It is a method that is suitable in complex and dynamic situations. Furthermore it is relatively inexpensive to perform. On the downside, the Delphi method has shown to be overly effected by the current situation [Dale & English 1998], [Fowles 1978].

Analogies
When using analogies it is by experts examined how similar situations have turned out. It can be a useful approach if there are several very similar situations that can be used for comparison. In this case it can be a valid analysis, as it gives knowledge about real situations and does therefore not just present the beliefs of the experts. The risk is however that some important factors influencing the situation are overlooked [Dale & English 1998].
Using analogies to make forecasts for the electricity sector, some problems may arise, as the sector is very complex and has a quite unique setup. This makes it difficult to find some, in any, analogous cases where similar situations have taken place in other electricity sectors in other countries, if the goal is, as in this case to establish a forecast for the specific development of the sector, this method will be very difficult to use.

Judgemental bootstrapping
Judgemental bootstrapping is a method where the expert's (or group of experts') forecasts are modelled by examining previous predictions made. The model is based on the input that the expert uses and the resulting forecast. When modelled, the expert's rules can be applied more consistent that a person can, which makes it a useful method when comparing alternatives. In order to make the model, several stimulus cases have to be used to cover a reasonable broad spectrum of possible outcomes. It hereby follows that it is most useful if the historical data shows little variation.
The usefulness of the Judgemental bootstrapping method is therefore limited in relation to forecasts for the electricity sector. One example illustrating this problem could be the implementation new laws or new technology entering the market, which has historically proven to be able to change the investors' strategies significantly, thereby making the system very dynamic. An advantageous quality of the method is however the possibility for making several forecasts based on the created model, as the making of forecasts in relation to CDM projects will be a continuous process. [Dale & English 1998]

Division in the explicit qualitative branch
Going back to the explicit qualitative forecasting branch the division that occurs is whether the forecasting is based on multivariate or univariate information. As previously argued, the evolution of the electricity sector is dependent of several aspects, which means that a forecasting should be based on multivariate information.
As the sources for this information can be plenty it can be assumed that this information will be present. It is a methodological branch that is not well schematised and does encompass a broad variety of more or less structured approaches. It is therefore very open and flexible. This can however at the same time constitute a problem, if the forecasting method becomes less systematic [Armstrong 2001]. In chapter 4.5, it was argued that the extrapolation method often would prove inaccurate as it is a univariate forecasting method. It is therefore assumed that since the methods within this branch are multivariate it will more often lead to an accurate result, all things being equal.

Multivariate qualitative methodology
The multivariate qualitative forecasting methodology is as previously mentioned a very open and flexible approach. The method that will be used in this study is based on inspiration from several

forecasting proposals in the electricity sector[39]. It does furthermore draw on experiences from the scenario method and forecasting tradition[40]. As the method drawn on both scenario and forecasting techniques, it is named the *Scenario Forecasting* method

A common element for the above mentioned scenario and forecasting proposals is that they characterise certain important variables, denoted here as key variables, which are influential on the evolution of the sector. The forecast of the sector is based an analysis of the evolution of these key variables and their mutual interactions and interactions with the power sector. The evolution of the included variables can be based on different kinds of forecasting, but what characterises this methodology is that the mutual cause-effect relationships between the key variables and the development of the electricity sector are qualitative.
Diverse forms of information can be incorporated into the methodology as it can include different approaches for forecasting the key factors. This makes it an open and flexible approach that can be fitted in many different contexts. A risk is however that the forecast will be to subjective and opaque if not conducted in a stringent and systematic way.

Summary
Collectively there are two forecasting methods that seem promising in relation to establishing a baseline scenario and additionality test in the electricity sector. These are the Delphi method and a method within the open quantitative multivariate framework, denoted the Scenario Forecasting method.

[39] [CERUPT 2002], [Matsuo 2004], and [UNFCCC 2004]
[40] [Godet 1994] and [Graf 2002]

APPENDIX 7 – DEFINITION OF KEY VARIABLES FOR THE SCENARIO FORECASTING METHOD

In this appendix the key variables of which the evolution of the electricity sector is dependent. The method used is to analyse several articles and use expert opinions to find different suggestions for these key variables. By condensing these suggestions it is assumed that a reasonable comprehensive list can be established.

Below each of the articles will briefly be discussed together with the list of key variables presented in each of the articles:

The article “Operational Guidelines for Baseline Studies for grid connected electricity projects” [CERUPT 2002] takes its starting point in the electricity sector CDM-project baseline. To use the key variables mentioned in this article, it is assumed that the factors influencing a project in the sector are the same as the factors controlling the evolution of the sector. This is a reasonable assumption as the evolution of the sector is created from the implementation of projects.
It is argued that the key factors influencing the evolution of these projects can be divided into internal and external factors. The internal factors are influenced by for example the activity level within the project, and thereby controllable for the project proponent, whereas the external factors are independent of the project and incontrollable. The internal key factors address aspects which the project participants can influence, such as the operation of the power plant. These factors are not connected to the development of power sector as such and will therefore not be included.
The key variables presented in this article are:

1. legislation development;
2. sectoral reform projects;
3. economic growth, socio demographic factors, the economic situation in the electricity sector and resulting predicted power demand;
4. fuel prices and availability;
5. capital availability (investment barrier);
6. rate of return for different alternative projects;
7. available local technology, skills and knowledge, availability, best available technologies in the future;
8. social effects and local support; and
9. national expansion plan for the electricity sector

In the book: “CDM Methodologies Guidebook”, the issue is, among others, to establish a methodology for making baseline scenarios for the electricity sector. The methodological approach presented here is to establish a whole list of possible baseline scenarios, which one by one can be removed from the list of possible scenarios by comparing the scenarios with a comprehensive list of barriers. The methodology thereby works by indirectly choosing the most likely scenario, as barriers will exist for all the other scenario proposals. The barriers are therefore comparable to the key variables, as they are collectively determining the evolution of the sector.

In “The Methodology Guidebook”, Matsuo (2004) argues that in making a baseline scenario the following list of influential factors should be analysed if appropriate:

Physical Constraints, including:

10. Governmental approval:
    Can approval by the central/local government(s) be obtainable (in relatively shorter timeframe)?
11. Fuel supply:
    The current and/or future fuel supply system may constrain the construction of some type of power generation system.
12. Applicable technology-related constraint:
    Non-demonstrable technologies are difficult to be installed. In addition, chronological change (increase) of electricity demand may need step-wise installation of the power plants.
13. Availability of land and geographical condition:
    Is there any land area large enough and located near the water supply to be used for power generation?
14. Transmission line:
    Transmission line capacity—may be dependent on geographical location—may constrain the sales/purchase of the electricity to/from the grid.
15. Duration before implementation:
    Duration for governmental approval, environmental impact assessment (EIA), construction, etc.

Host Country Specific Conditions (Regulations,30 etc), including:

16. Safety regulations
    Methane concentration, etc.
17. Air quality regulations:
    SO2, etc.
18. Water quality regulations
19. Solid waste regulations and programmes
20. Energy policy, natural resources policy, and economy-related policies:
    Including efficient use of natural resources, stable power supply, and local economy promotion.

Other Barriers and Influential Factors in the Investment Decision Making, including:

21. Local people's behaviour:
    If strong opposition is found, such an option (such as large hydro) should be screened out.
22. Liberalization of the power market:
    This may influence whether and how the power station sells the electricity with competitive price to the external grid. Dependent on the type and other specifications of power generation.
23. Large heat demand:
    If large heat demand does not exist, CHP would not be feasible as the option.
24. Technology diffusion:
    If a technology penetration rate is less than [10%] by field survey or by statistics, such technology is regarded as 'new' in the country (evidence should be provided).
25. Technology operationality:
    Technology which needs very high control techniques may be difficult to be implemented in many cases.
26. Instability of the connected power grid:
    Instability of the generated electricity by the options and also instability of the grid, may limit the applicable option types.
27. Cultural modalities and additional investment:

For example, DSM programme may face cultural barriers.

28. Enough finance for governmental programmes:
Applicable for DSM and other programmes.

Finance and Risk Assessment, including:

29. Identification of financial supplier and investor (for baseline options)
30. Identification of largest risks
31. Who assures the risks?

Economic Analysis without CER Revenue, including:

32. Criteria for investment (including quantified threshold) and its reasons:
Demonstration is needed for its appropriateness (e.g., by showing past similar situations).

A few items have been let out from the above list because they were describing what to do and not factors to analyse.

The "Tool for the demonstration and assessment of additionality", [UNFCCC 2004] used in the existing baseline methodologies to prove additionality works by the same principle as the book presented above, as it establishes barriers that are to filter out projects that are not viable (if not for the project to be approved as a CDM project). The additionality tool hereby through these barriers screens out impossible scenarios, and thereby indirectly selects the most likely scenario. The barriers can therefore be compared with key variables. The barrier list presented in the additionality tool is however much more general as the tool is to function for all kinds of CDM projects thus giving the tool a much broader scope than just the electricity sector.

According to this article following list of factors should be analysed:

33. Current law and regulations:
Is a given alternative within all applicable and regulatory requirements?
34. Cost analysis:
Is the given alternative less attractive from an economical point of view than other alternatives?
35. Technology assessment:
Is it difficult to find trained labour to operate and maintain the system, and/or is the host country lacking infrastructure for the implementation of the technology?
36. Analysis of prevailing practice:
Is the project the "fist of its kind" in the host country or is it common practice?

The article "El Sistema Energético Argentino: su evolución reciente" [Bravo & Groisman 2003] can be used very directly, as it explicitly deals with the evolution of the electricity sector and defines a list of issues that has to be studied in this regard. As the title indicates, the article deals with the Argentinean sector.
List of key variables in the article "Operational Guidelines for Baseline Studies for grid connected electricity projects" CERUPT, 2002

The article presents following list of key variables:

37. The amount of energy resources available and their historical evolution
38. The socio-economic situation of the specific country
39. The international context

40. The energy policy and development goals
41. Actors
42. The technological evolution

The experts interviewed about the issue focused on the key variables listed below (interview with Bouille, D. and Dubrowsky, H., 2004):

43. Energy matrix evolution
44. Reserves of natural gas and hydro potential
45. Power structure
46. Energy policies
47. Legal framework
48. Risks
49. Stakeholder rationality
50. Institutional issues

Categorisation of the mentioned key variables
As it can be seen from the lists presented above, there are several repetitions. In the following these will therefore be compiled into a smaller condensed list of key variables:

- External context: International economic situation, energy prices and openness of domestic economy to the international market. Including following items from above:
  Partly 3, partly 4, partly 38, 39,

- Electricity system, comprising:
  - Demand: Domestic and external electricity (and heat, if relevant) demand, losses and peak demand. Including following items:
    Partly 3, 23, partly 38, partly 43

  - Supply: Electricity generation capacity, availability of this capacity, distribution of technology, transmission capacity of electricity grid, import of electricity and planned expansions of both grid and generation capacity. Including listed items:
    9, 14, partly 22, 24, 26, 36, partly 40, partly 43, 45

- Institutional setup: Authorities and entities connected to the electricity sector, operation, and electricity price setting. Including:
  2, 10, partly 22, 50

- Power sector policy: Legal and regulatory framework for the development of the power sector and political goals. Including:
  1, partly 33, 40, 46, 47

- Resources: Availability of resources. Including:
  Partly 4, 11, partly 30, 37, 44

- Status for technology: Use of technology in the country, future prospects for the technology, legal and social issues connected to technology, installation and production costs, infrastructure at the location of the technology, plant size, and lead time. Including:
  6, 7, 8, 10, 12, 13, 15, 16, 17, 18, 19, 20, 21, 24, partly 25, 27, 29, 32, partly 33, 34, partly 35, 36, 42

- Investments: Investors’ strategies. Including:
  5, partly 25, 28, 31, partly 35, 41, 49

Item 48 (Risks) is not included. The reason is that it is a very broad term and it is not specified for what and for whom. Some risk considerations are included elsewhere.

The relevance of each item will vary according to situation.

APPENDIX 8 – DATABASE ON KEY VARIABLES FOR THE SCENARIO FORECASTING METHOD

In this appendix a thorough analysis of each of the key variables, included in the Scenario Forecasting method, is given.

1 Key Variable: External Context

The purpose of this key variable is to analyse the external conditions for Argentina.
The international situation with respect to economy and energy price levels is very important for the domestic development. The openness of the Argentinean economy towards the rest of the world will give a picture of to what extent the international development will influence Argentina.

1.1 Information and Methods

This analysis uses forecasts made by the International Energy Agency regarding the energy prices and international economic development. The methods used to make the energy and economic forecasts were not mentioned in the reports.
The analysis of the openness of the Argentinean economy and its trends is based on reports from WTO and The Economist.

1.2 Analysis of External Context

The future Argentinean electricity demand and the implementation of new generation capacity are deeply intertwined with the international situation. The energy and thereby also the electricity demand are closely and positively related to the economic development [IEA 2004], which again is connected to the regional and global economic situation. It is therefore necessary to briefly discuss the likely future international economic development.
The type of new generation capacity installed in the Argentinean electricity system is partly dependent on the price of primary energy and thereby linked to the future energy price on oil, coal and gas.
Finally the level of globalisation of the Argentinean market is influencing the speed and the magnitude of the influences of the international fluctuations and trends on the Argentinean situation.
The themes that will therefore be touched upon in this chapter are the economical development, the development in the energy markets and globalisation processes.

1.2.1 International Macroeconomic Development

The international economic development measured in GDP-growth is expected to increase on a relatively steady pace at 3.4 % p.a. on a world level [IEA 2004]. Argentina and the countries in Latin America are expected to have an economic growth of 3.5 %, and Argentina's closest market relations – the countries in Latin America, the US, China and the EU [The Economist 2005] – are expected to have an increase in the yearly GDP at 3.3, 2.7, 5.7, and 2.2 respectively in the period 2005-2015 [IEA 2004].

1.2.2 Energy Prices

1.2.2.1 Oil

There are on an international level sufficient oil to supply the world consumption and the expected increase until at least 2030. With the sufficient investments the present high oil price is expected to fall back to 22 $ (in year 2000 prices) in 2006. The price is however expected to increase at a relatively constant rate, passing 24 US$ (in year 2000 prices) in 2015 due to the gradual increase in production costs [IEA 2004].

1.2.2.2 Natural Gas

Gas prices are highly regional due to the high transportation costs. The prices can therefore vary significantly from region to region. There is however a link to the international oil price which reflect the competition between gas and oil. Also the possibility to produce and transport LNG on a regional level is expected to contribute to the convergence of the natural gas prices. The natural gas prices on the North American, the Asian and the European market is expected to drop from the present high level to around 3.3 US$/MBtu in 2010 to approximately 3.4 US$/MBtu in 2015 (in year 2000 prices), with a little lower prices in Europe throughout the period [IEA 2004].

1.2.2.3 Steam Coal

Coal prices have like gas and oil experienced a high rise in price to more than 70 US$/ton in mid-2004. The price increase has been driven by production problems in some of the main international coal producing countries. It is however expected that the price will fall back at around 40 US$ (in year 2000 prices) in the period from 2006-2010. Hereafter a slow linear price increase is expected reaching 41 US$ in 2015 [IEA 2004].

1.2.3 Globalisation of the Argentinean Economy

Argentina is a member of MERCOSUR, which is a trade union consisting of Argentina, Brazil, Paraguay and Uruguay. The purpose of MERCOSUR is to establish a common market with free circulation of goods, services, and production factors among its member countries and to facilitate competitive integration into the world economy [WHO 2005].
MERCOSUR is not conceived as a finalised process but instead as a tool for making the member states able to participate actively in international markets. MERCOSUR is therefore a platform for connecting to the rest of the world and not for creating an isolated internal market. [WHO 2005]
This tendency can be seen in the signing of the Economic Cooperation Agreement (ECA) with Ancom, the MERCOSUR counterparts, which comprises Bolivia, Colombia, Ecuador, Peru and Venezuela. The ECA has the purpose of opening the markets in the respective countries. [WB 2004]
Also the EU and MERCOSUR are discussing the possibilities for entering into a free trade agreements between the two markets. The negotiations have however not yet led to any final agreements because of disagreements on exports of food from the MERCOSUR and export of machinery from the EU [WB 2004].
The agreement is however expected to be completed during 2005 [The Economist 2005] Under their own hemisphere the MERCOSUR countries are active participants in the Free Trade-Area of the Americas (FTAA), hereby trying to expand their free trade limits to also cover the North American continent. [The Economist 2004]

1.3 Summary

The international economic development as well as the economic development in Argentina is, as mentioned, expected to continue more or less in the same pace. This development is supported by the increased internationalisation of the Argentinean economy, which means that the Argentinean economy will tend to be positively correlated to the economic development of its trade partners. Regarding the energy prices, the oil and coal prices are expected to follow the course from before the present price rise, which means that no dramatic changes are expected. The gas price could be subject to a rising price due to the present low price level in relation to the international gas prices. The gas price is however presently to a large extent set politically. The stable oil and coal prices and a potentially large increase in the gas price can potentially have an influence on the preferred electricity generation technology. In the case of Argentina, the present national price level is very low, and the time period of the study relatively short, which means that this will probably be of minor significance.

2 Electricity System

The purpose of this and the following two chapters is to assess how the electricity supply needs to develop on the basis of the demand. It is the demand that drives the supply, which means that in order to study the needed supply, the electricity demand for the time period of the study has to be addressed primarily.

This chapter will give a short presentation of the Argentinean electricity system.

2.1 Description of the Electricity System

With a length of 3700 km. and a width of more than 1400 km. on the widest spot in an almost triangular shape Argentina has a surface area of 2.791.810 sq. km. (not including the areas on the Antarctic continent) [INDEC 2005a], [INDEC 2005b].
Argentina has a population of no more than 36,260,130 as of 2001, resulting in a density of 13.0 habitants/sq. km covering a great diversity in density from 59.4 and 45.0 in the Tucuman and Buenos Aires regions respectively to only 0.8 in the southern Santa Cruz region. [INDEC 2005c]
The electrification rate is estimated to be 94 % as of 2001 [Dubrowsky 2004] where only 0.8 % of the electricity demand is covered by isolated systems, which means that the electricity transmission and distribution network is extensively developed throughout the country [SDE 2004].
The main power grid is divided into two sub-systems:
The three regions farthest south; Tierra del Fuego, Santa Cruz and Chubut; constitutes the MEMSP[41] system, where only the two northern regions (Chubut and Santa Cruz) are interconnected.
The second system, the MEM[42] comprises the remaining part of the country and is thereby by far the largest regarding both electricity generation and demand.
The MEM and the MEMSP are centrally dispatched by CAMMESA (Compañía Administradora del Mercado Mayorista Eléctrico S.A.)
In 2003 the transmission line between the MEM and MEMSP was commenced, with the purpose of expanding the existing connection with a 500 kV connection, increasing the transmission capacity. When this line comes into operation in late 2005 [Mercado Eléctrico 2003a] the interconnected part of MEMSP will be considered an integrated part of the MEM [CAMMESA 2001]. In the following, the MEM will therefore be the common designation for the two systems if nothing else is mentioned.

The generators which are not dispatched by the CAMMESA and connected to the MEM network are referred to as the "Interconnected not MEM generators". These constitute 2.7 % of the generation capacity. [SDE 2004]
The installed capacity and the demand of both the MEM and the MEMSP systems can be seen in the figure below:

[41] Mercado Eléctrico Mayorista Sistema Patagonia or the Wholesale Electricity Market for the Patagonian System
[42] Mercado Eléctrico Mayorista or the Wholesale Electricity Market

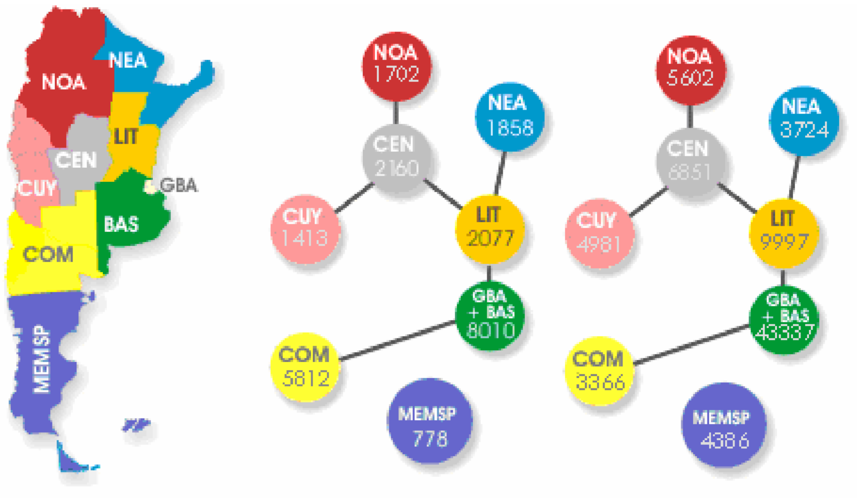

Figure 2.1: The interconnected MEM and the still in 2003 isolated MEMSP. The illustration on the left shows the installed capacity in MW [CNEA 2004]. The illustration on the right shows the demand in 2003 in GWh. [SDE 2004]

3 Key variable: Electricity Demand

Analysing the demand it is important to include both domestic and external demand, which can be defined as the total demand, the losses in the transmission and distribution network. Another important aspect is the peak demand. The electricity supply has to be build so that the peak-demand can be supplied, which means that some overcapacity in relation to the average demand has to be available to cover these fluctuations.

3.1 Information and Methods

The total electricity demand in Argentina in the period 2005 – 2015 is estimated on the basis of the official demand scenarios published by the Energy Secretariat (Secretaria de Energía) in their publication "Prospectiva" [SDE 2003a]. Tree different scenarios are proposed in this analysis; an average scenario, a maximum and a minimum. The numbers chosen in this report is the numbers corresponding to the average scenario
The latest edition was made in 2002. As the scenario presented in this edition is only valid until the year 2012, it is assumed that the evolution of the demand follows the same path in the period 2012-2015 as it does in 2012.
The method used to estimate the future internal electricity demand is a "neural network" approach [SDE 2003a].

The export rates are estimated using the contracted amounts. This will not give a picture of the average external demand, as not all the contracted capacity is exploited, but can be used to estimate the maximum demand for export.

The peak demand throughout the period was estimated to be concordant with the present peak/average demand ratio.

Transmission and distribution losses are estimated to be as they are today.

3.2 Analysis of the Demand

The method uses the future development of 8 "key-variables" in order to estimate the demand. These 8 key variables are:

- Population
- Level of employment
- Level of unemployment
- Steel production
- Cement consumption
- Aluminium production
- Production in the automotive industry
- A annual average of the international bank rate

As input to the calculation of the scenario, numbers for these key variables are necessary for the time frame of the scenario.

The national population in the period is based on data from The National Institute for Statistics and Census (Instituto Nacional de Estadísticas y Censos).
Regarding the employment and unemployment rates, the rates from 2001-1992 was used for the years 2003 – 2012; that is the rates for 2001 is estimated to correspond to the 2003 levels and the 1992 levels are equally set as the 2012 rates.
For the international bank rate, an average of the period from 1976 to 2001 was used, which corresponds well with the stable international economic development described in the "External context" key variable. For the remaining four key variables, prognoses based on extrapolation methods were used. [SDE 2003a]

On this basis the future internal demand is estimated to evolve as the following:

Year	Annual increase (%)
2004	3.7
2005	4.2
2006	4.61
2007	4.78
2008	4.95
2009	3.92
2010	2.88
2011	3.43
2012	3.98
2013	3.98
2014	3.98
2015	3.98

Table 3.1: The expected increase in electricity demand in the period 2004 to 2015. For odd years interpolation of original data is used. The increment in the period 2013-2015 is based on an extrapolation of the demand in 2012. [SDE 2003a]

By using the newest observed demand data from 2004 the total internal electricity demand for the period 2005-2015 can be calculated:

Year	Total demand (GWh)
2003*	82.244
2004	85.287
2005	88.831
2006	92.926
2007	97.368
2008	102.187
2009	106.188
2010	109.246
2011	112.993
2012	117.490
2013	122.167
2014	127.029
2015	132.085

Table 3.2: The total internal electricity demand in the period 2003 to 2015 in MEM including invoiced and dispersed demand. [SDE 2004], [SDE 2003a]
** Observed.*

Furthermore the losses in transmission and distribution have to be included. An average has been set for the MEM to around 12.5 %. [SDE 2003a]
The variation of the losses regarding location and consumption is not further considered here.

3.2.1 Peak Demand

In order to address the total installed capacity needed to supply the demand, the distribution of the demand on a daily and yearly basis has to be considered.
Based on the fluctuations of the electricity demand of a 5 ½ year period ending in March 2003, the peak demand at its maximum is around 15 % higher than the average demand for the period. There is a tendency that the average and peak demand curves are slightly converging, but they are never the less considered to be stable [SDE 2003a].

3.2.2 External Demand

The export of electricity is authorised by the Ministry of Federal Planning, Public Investment and Services (Ministerio de Planificación Federal, Inversión Pública y Servicios) as declared in the Law number 24,065 [MECON 2005]. Several authorisations have been given and contracts have been established with the neighbouring countries.
Between the two companies CEMSA and COSTANERA in Argentina and CIEN in Brazil a contract exists on exportation of 1000 MW until the year 2020. Later CEMSA has been granted two permissions to export another 2 times 50 MW together with an expansion of the existing contracts with CIEN in Brazil to export another 1000 MW. Two permissions summing up to a total of 1050 MW are also valid to 2020 and the last 50 MW until 2022.
The total export to Brazil is thereby summing up to 2100 MW.
From 2008 it is expected that another 1200 MW will likewise be exported to Brazil. [SDE 2003a]
It should be noted, however, that the exportation limits set by the above stated contracts are rarely used, and are made to supply the southern parts of Brazil in the case of drought. [Dubrowsky 2005]
Regarding export to Uruguay one contract exists between the Argentinean CEMSA and the Uruguayan UTE amounting to 138 MW. The contract was signed in 2003 and was only to be valid for 2 years. The contract is by the Energy Secretariat not expected to be prolonged [SDE 2003a]
The interchanges with Chile are different in the sense that they are only made as a possibility for Argentina and Chile to interchange eventual overproduction. Two connections exists; one in the central Chile, the SIC (El Sistema Interconectado Central) and one in the northern called the SING (El Sistema Interconectado Norte Grande). Originally the SING connection was made with the purpose of transmitting electricity from a gas power plant in the northern Argentina to the northern Chile and has no connection to the Argentinean transmission net. But with the planned expansion of the existing transmission lines (See the electricity supply chapter) the aforementioned power plant has been authorised to transmit to the Argentinean net. It is however considered that export will continue at a rate of around 300 MW [SDE 2003a].

3.3 Summary

The electricity demand until 2015 was estimated on the basis of an official forecast made the Energy Secretariat. The analysis included both domestic and external demand, which was as an average expected to increase 3.9 % yearly. The losses were found to be approximate 12.5 % as an average in the grid. The peak demand has in the latest years been around 15 % higher than the average consumption, and it was assumed to continue the present trend.
In the figure below the numbers have been summed up and show the estimated needed supply for the coming years:

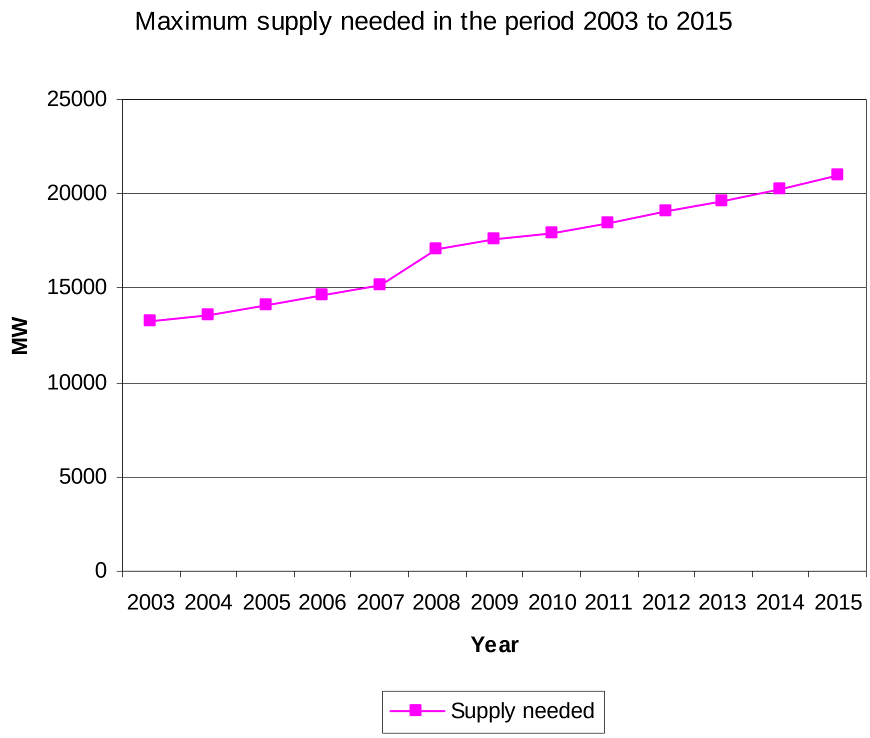

Figure 3.1: The maximum needed supply in the MEM system in the period 2003 to 2015.

4 Key Variable: Electricity Supply

The next step is to analyse the supply. Important factors here are the electricity generation capacities and the average availability of this capacity. The generation capacity is normally scattered around the country and not necessarily located appropriate according to the location of the demand. The distribution of the generation capacity and the transmission system are therefore important factors in relation to whether all the generation capacity can be used to cover the demand. Import of electricity from neighbouring countries is an important factor for determining the level of self-sufficiency on the electricity market. Import will therefore also be analysed.
This collectively gives a picture of whether and how much the electricity generation capacity has to evolve to cope with the demand.
The evolution of the supply side in terms of incorporation of technology will be touched upon in this chapter by including the planned new power plants and transmission lines. This will be compared to the discrepancy between supply and demand to see whether these solutions make up a sufficient development for the sector.

4.1 Information and Method

The information used in this analysis was gathered on the basis of literature studies and open interviews.
Two simulations was used; one of the present and coming dispatch chain divided on technology and one about the usage of the electricity transmission system until 2007 made by the CAMMESA. The methods used in order to make these simulations were not identified.

4.2 Analysis of the Supply Side

The electricity generation in the Argentinean interconnected electricity system (including the interconnected generators not dispatched by CAMMESA) is based on gas, hydro power, nuclear, a small percentage of oil products and coal and a negligible contribution of wind and geothermal power.
The table below shows the contribution of the generation capacity divided on fuel:

System	Fuel (%)							
	Gas	Hydro	Nuclear	Coal	Diesel	Wind	Geoth.	**Total**
MEM	53.9	38.9	4.4	2.8	0.1	0.0	0.0	**94.3**
MEMSP	35.2	64.8	0.0	0.0	0.0	0.0	0.0	**3.1**
INTERCON.	29.9	35.1	0.0	0.0	30.9	3.9	0.1	**2.7**
Total	**52.7**	**39.6**	**4.1**	**2.6**	**0.9**	**0.1**	**0.0**	**100.0**

Table 4.1: Generation capacity in each system divided on technology as of 2003. Geoth. is an abbreviation for geothermal power plant. INTERCON. is the interconnected generators that are not dispatched by the CAMMESA. In peak situations, some gas power plants use oil products, which is not reflected in the table. [SDE 2004]

The gas power plants are generally scattered throughout the country, except for the north-eastern Noreste Argentino (NEA) and western Litoral (LIT) and partly Comahue (COM) regions that are instead rich on hydro power plants. Gas power plants are especially prominent in the region of

Buenos Aires (BAS) as the region has no potential for hydropower. The two existing nuclear power plants, Atucha and Embalse are located in the Buenos Aires (BAS) and the central Centro (CEN) region respectively. The only existing coal power plant, San Nicolas, is located in the Buenos Aires region. For geographical overview, see figure 2.1 above. [SDE 2004], [CAMMESA 2004]

4.2.1 Availability of Generation Capacity

There is a difference between the installed capacity and the actual generation.
Some variation will always occur due to for example shut down because of maintenance. In relation to the thermal power plants (gas, diesel, and coal), the availability was from for the period 1997 to 2002 approximately 75.5 % of the installed capacity [SDE 2003b]. For the nuclear power plants the percentage is 85 % [SDE 2003a]. Regarding the hydro power, the availability can be deduced from the usage of the hydro plants, as the water is either used or stored. If it is stored, then taking an average for some years will even out this effect and will at the same time level out the yearly fluctuation of precipitation. In the period 2001-2003 the average usage and thereby availability of the hydropower was 48 % [SDE 2003b], [SDE2004]. Regarding wind an average of 35 % has been used [SDE 2004]. The geothermal power plant is presently out of order.

4.2.2 Import of Electricity

Import of electricity from neighbouring countries operate on market conditions, which means that if the countries live up to certain regulations about equal access to transmission capacity and certain other aspects, it is the price level and the transmission capacity that sets the limit for the import [WEC 2005].
This also means that the arrangement offers little security of demand, as it is uncertain whether extra generation capacity is available on other markets at the same time as the peak demand situation occurs on the Argentinean grid. Because of this uncertainty, this import potential is not included in the supply calculations.
One import agreement however exists between Brazil and Argentina, allowing Argentina to dispose of 500 MW from Brazil from 2004 [National Energy Plan 2004].

4.2.3 Transmission System

The transmission system comprises a net of 500 kV high voltage lines. The figure below shows the geographical distribution of the system:

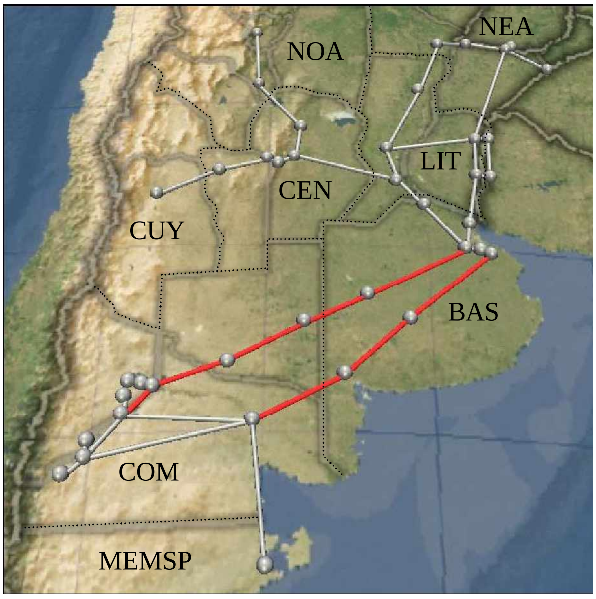

Figure 4.1: The main 500 kV transmission net. Interconnection between MEM and MEMSP is included [CAMMESA 2003a]. The two darker lines and the short line in the north-eastern corner of NEA are double lines [CAMMESA 2004].

As can be seen in figure 2.1 and from table 4.1 23.2 % of the generation capacity is located in the Comahue (COM) region which only has 4.1% of the total demand. There is therefore a large export of electricity from this region to Buenos Aires (BAS). The red colour on the transmission lines between these two regions indicates that the transmission size in these lines creates a bottleneck during peak load situations.
The rest of the net is not presently saturated. The table below shows the percentage of the time where more than 90 and more than 50 % of the total capacity is used in each direction:

Between the regions	CEN-LIT	LIT-NEA	LIT-BAS	CEN-CUY	COM-BAS	CEN-NOA	COM-MEMSP
Transmission capacity	1100	1875	2500	480*	4600	870*	1000**
Above 90 % (in %)	5	0	0	0	9	0	0
Above 50 % (in %)	38	12	5	8	42	0	0
Between the regions	LIT-CEN	NEA-LIT	BAS-LIT	CUY-CEN	BAS-COM	NOA-CEN	MEMSP-COM
Transmission capacity	850	1900	2050	480	n.a.	870	1000**
Above 90 % (in %)	3	0	8	3	n.a	0	0
Above 50 % (in %)	12	56	17	7	n.a	12	0

Table 4.2: The Transmission capacity between the regions. The table also shows how frequent more than 90 and 50 of the capacity is used. Data is based on simulation of the system for 2005. The transmission capacity numbers are maximum values when all systems are working. The transmission capacity numbers are in MW [CAMMESA 2003a], [Transener 2005], [CAMMESA 2001].
**Estimated to be the same in both directions*
***Based on expert opinion [Dubrowsky 2005]*

As it can be seen from the table it is only the COM-BAS and the CEN-LIT transmission lines that are used to or close to their transmission capacity whereas there is a scope for further growth in transmission for all the other lines. The situation saturation of the transmission lines is illustrated on the figure below:

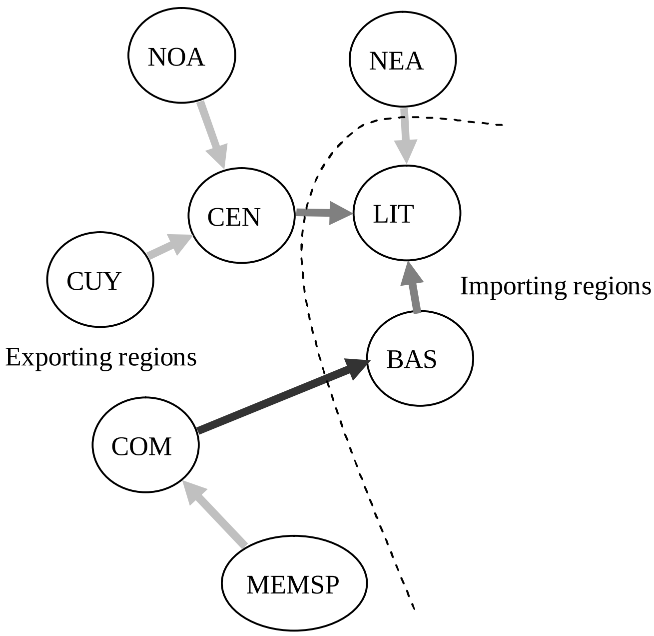

Figure 4.2: The colour of the arrow indicates the saturation and the arrow the direction of electricity. Black means that a bottleneck can occur during peak hours, dark grey that the line is used close to capacity limits and light grey that the current use is significantly lower than the capacity.

4.3.3 Power Plants and Transmission Lines under Construction and Planned

4.3.3.1 Transmission Lines

Several high voltage (500 kV) transmission lines are planned:

- The interconnection between MEM and MEMSP, expected to be operational in 2005. The interconnection is allowing the two systems to operate as one [CAMMESA 2001].
- Expansion of the existing high voltage line from the hydro power plant Yacyretá to Buenos Aires by another 500 kV, operating from 2007. [CAMMESA 2003a], [National Energy Plan 2004]
- Construction of a line between the Comahue (COM) region to Gran Mendoza in Cuyo (CUY) and ending in San Juan in the Central (CEN) region, operating from 2007 [CAMMESA 2003a], [National Energy Plan 2004]
- Construction of a line in the northern part of Argentina between Resistencia in the Noreste Argentino (NEA) to Cobos in Noroeste Argentino (NOA), ending in El Bracho likewise in the Noroeste Argentino (NOA) region, also planned to operate in 2007 [CAMMESA 2003a], [National Energy Plan 2004]. This transmission line will thereby incorporate the TermoAndes combined cycle power plant in Cobos, which is presently only connected to the Chilean net, to the rest of the Argentinean net. As mentioned in the chapter about demand, it is estimated that 300 MW of TermoAndes production will still be exported to Chile, while the rest of its capacity of 344 MW will be utilized in the MEM. [Energía y Negocios 2005]

4.3.3.2 Power Plants

The hydro power plant Yacyretá located on the border between Paraguay and Argentina is at the moment being expanded by elevating the damming two meters yielding an additional 360 MW of

installed potential [National Energy Plan 2004]. It is expected that within 2008 the dam will be elevated by altogether 5 meters increasing the yield from 1,700 MW to 3,100 MW installed potential. The expansion of the plant will be based on national investments. [National Energy Plan 2004]
The existing nuclear power plant Atucha, located around 200 km. from Buenos Aires is planned to be expanded with another reactor in 2009. The installed potential from the coming power plant, named Atucha II, is 692 MW and will be based on approximately two thirds national investments and one third private investments [National Energy Plan 2004].
In 2004 the Fond for Necessary Investments (Fondo para Inversiones Necesarias) was established with the purpose of increasing the supply of electricity. The fond is financed by existing investors on the marked and should result in the creation of a new combined cycle gas power plant near Rosario in the region of Litoral (LIT). The plant is expected to be operating in 2007 and will have an installed capacity of 850 MW (See also chapter on power sector policy) [Mercado Eléctrico 2003b].

Including the new power plant and the new transmission lines in figure 4.2 from above, following situation emerges:

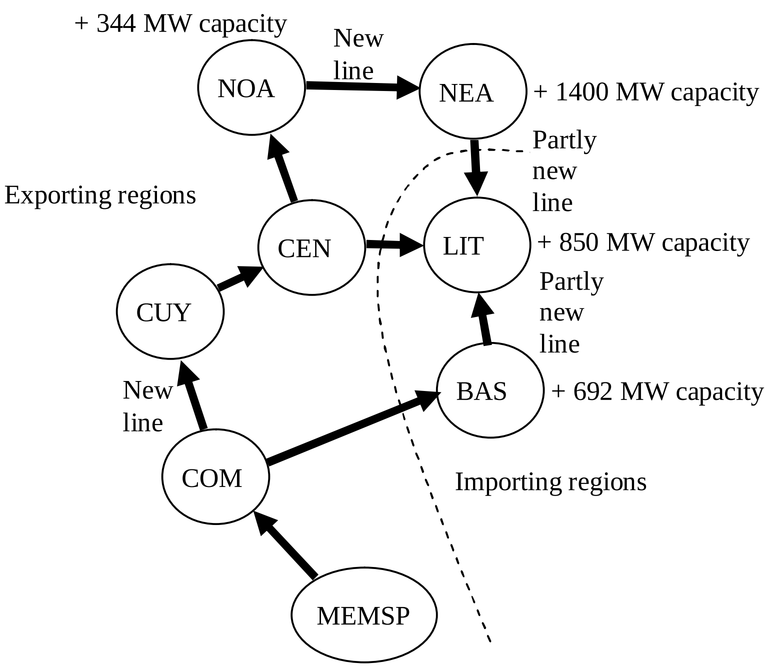

Figure 4.3: The transmission network including planned transmission lines and power plants. The arrows indicate the most likely direction of the electricity.

Figure 4.3 gives an idea about the significance of the inclusion of the planned transmission lines and power plants. The new transmission lines will help alleviate the present bottleneck situation between the Comahue (COM) and the Buenos Aires (BAS) regions as imported electricity to Buenos Aires (BAS) can go through COM-CUY and NOA-NEA. At the same time the planned new power plants will all be located in the importing regions and in Noreste Argentino (NEA), which has a high excess transmission capacity to Litoral (LIT) especially after the opening of a new line. The increased transmission capacity from the exporting to the importing regions, together with the inclusion of new power plants in the importing regions will substantially alleviate the existing bottlenecks. It is therefore assumed that the number and severity of bottleneck situations will be very low indicating that it can be assumed that all installed generation capacity can be used to cover the demand.

4.4 Summary

The above analysis showed the installed capacity was divided on fuel, showing that gas is the most used fuel in the country. Hereafter comes hydro and nuclear power.
The availability of the generation capacity was analysed showing that the thermal power plants in average are 75.5 % available. For hydro and nuclear power plants and wind power the corresponding numbers are 43, 85 and 35 % respectively. Finally the existing plans for the expansion of the generation capacity were listed.
Import of electricity from neighbouring countries operate at market conditions, which also means that since amounts are not contracted, the import arrangement does not offer significant security of supply. An exception is however the agreement with Brazil to dispose of 500 MW.
Regarding the transmission system, it was concluded that there presently exists a bottleneck between the Comahue (COM) and the Buenos Aires (BAS) regions during peak periods and also that the transmission between the Central (CEN) and the Litoral (LIT) regions can be close to maximum capacity likewise during peak periods.
The plans for carrying out several expansions to the existing transmission grid will however somewhat alleviate these bottleneck situations. At the same time the situation will be improved by the installation of the planned new power plants, where the largest share will be located in the eastern electricity importing regions (BAS and LIT) and regions with a surplus transmission capacity (NEA).
It is therefore assumed that there will be a very limited number of bottleneck situations when the new transmission lines enters into operation, which implies that all the available generation capacity can be used to cover the peak demand.

Comparing the available installed capacity, including contracted imports and the power plants that are planned to enter into the system, with the expected demand for the coming 10 years period (See "Electricity demand" chapter), following picture emerges:

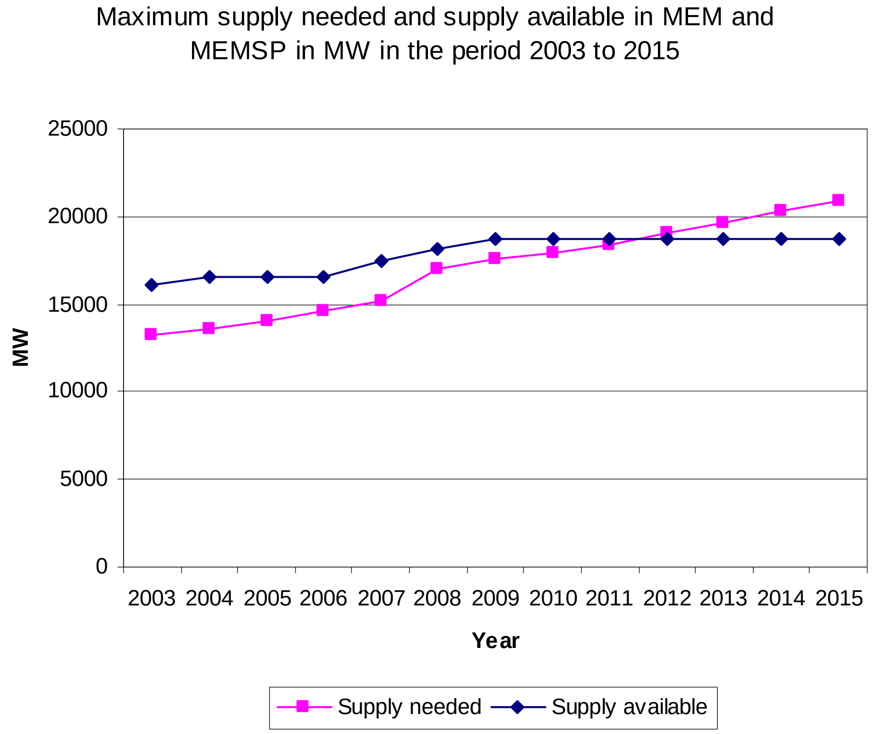

Figure 4.4: A comparison between the maximum needed supply including maximum export to Brazil and Uruguay, losses and peak demand in the MEM and the net available supply for the period, including the introduction of the planned power plants and the inclusion of some of the effect of the TermoAndes, that with the planned transmission lines will enter into the system with some of its capacity.

Based on figure 4.4 it can be seen that there is still a gap between the supply and demand that has to be filled. How this will happen will be analysed in the following chapters.

5 Key Variable: Institutional Setup

The purpose of this analysis is to give an overview of the institutional setup in the power sector and to draw up the regulatory frames for the sector, as these influences the future development of the sector.
The analysis therefore includes first of all the legal and regulatory framework, followed by a description of the authorities and entities connected to the sector. The operation and price setting will furthermore be discussed.

5.1 Information and Methods

The information used for this analysis is based on literature studies.
The analysis only considers the present situation, as possible future regulations and organisational changes cannot reasonably be forecasted.

5.2 Presentation of the Institutional Setup

5.2.1 Legal and Regulatory Framework

The basic regulatory framework for the power sector in Argentina is the Energy Act (Law Nº 24065) promulgated in 1992. The law introduced a new scheme of regulation and institutional set-up including a large-scale privatisation of state assets. In broad terms the state with this law gave up its role as administrator and planner to enter a new role as supervisor and regulator of the activities in the sector [CAMMESA 2005a].

The main goals of the restructuring as stated in the Energy Act are to encourage market competition in generation and demand, regulate toward fair and reasonable rates for transmission and distribution, protect users' rights adequately, foster efficient production, transport, distribution and use of energy, and encourage private investment in the sector to secure supply in the long run [MECON 2005].

To achieve better, cheaper and sufficient services through competition, the government has aimed at a vertical disintegration and a horizontal division of activities of the system especially for generation and distribution [Pistonesi 2000]. Production and services within the electrical sector are split into three business-units: generation, transmission and distribution. Within these activities the principle of incompatibility applies as no company may hold the largest stake in more than one activity at the same time [MECON 2005].

5.2.2 Political Authorities and Regulatory Entities

The legal and regulatory framework further establishes the functioning between the entities in the power sector, and figure 5.1 below show a schematic presentation.

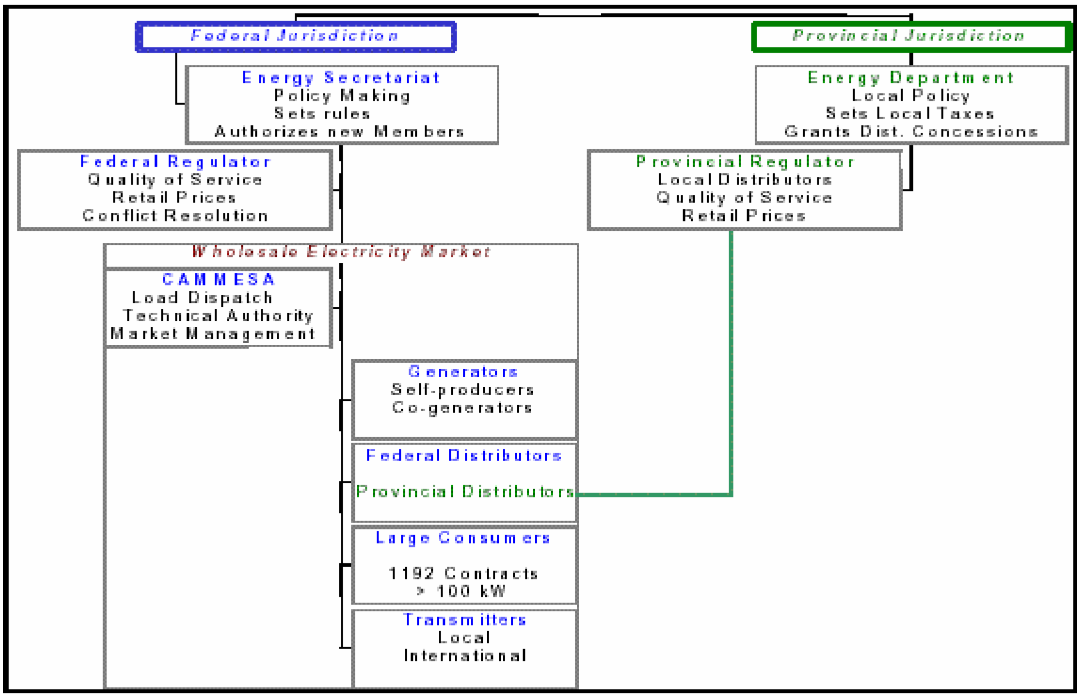

Figure 5.1: Institutional set up - schematic presentation of the entities in the power sector. [Guzowski 2001]

The *Energy Secretariat* subordinate to the *Ministry of Federal Planning, Public Investment and Services* is the supreme federal authority for application of the regulatory framework. In this context it has the responsibility to:

- Define and implement the energy policy.
- Lay down the normative regulation, which apply for the agents of the power sector.
- Authorise the entrance and exit of members of the Wholesale Electricity Market (MEM).
- Grant concessions on use of the hydroelectric resources in inter-provincial rivers, prior to agreement with the authorities of the provinces involved.
- Authorise the contracts of external electricity trade.

[MECON 2005], [Pistonesi 2000].

The Energy Secretariat does not formulate comprehensive power sector plans, but it releases a forecasting analysis to assess the natural resources available for use in the power sector and to secure adequate information about electricity demand and supply in short, medium and long term with the aim of anticipate problems with future supply.[43]

The Federal Regulator is called the *National Regulatory Entity for Electricity* (ENRE). This entity is in charge of the compliance of the Energy Act and the enactment of the contracts of concession granted by the national government[44], especially on quality of the technical service and business loans of the concessionaires.
Further to this its principal functions includes:

[43] The latest being [Prospectiva 2002].
[44] These concessions are within high voltage transmission, regional grid transmission and electricity distribution in the metropolitan area. The activity of distribution in each of the provinces is within the provincial jurisdictions.

- Determine the basis for and approve tariffs for the sector's transmission and distribution enterprises.
- Guard against monopolistic behaviour in the market.
- Control the environmental management of the agents of the sector subjects to the federal jurisdiction.
- Intervene and undertake the resolution of disputes in the sector.
- Protect the environment, consumer interests and organise public hearings to solve conflicts previous to making decisions.

[MECON 2005].

The *Wholesale Electricity Market Managing Company* (CAMMESA) is the cooperation in charge of managing the Wholesale Electricity Market (MEM) as well as the Wholesale Electricity Market for the Patagonian System (MEMSP). Both markets face the same regulation, but until they in the future will be fully integrated the prices differ in line with the specific supply and demand in each market.

CAMMESA was created in 1992 with the Energy Act and is an independent and non-profit corporate entity headed by the Energy Secretariat. It is owned equally by associations representing participants in the MEM with 20 % share to each and 20 % directly in state hands through the Energy Secretariat. There are four associations organised according to function: ATEERA (Transportation); ADEERA (Distribution); AGUEERA (Large electricity-users); and AGEERA (Generators).

CAMMESA has a technical task in the coordinated operation of the MEM according to established guidelines. The responsibilities of CAMMESA include:

- Real time operation of the MEM.
- Dispatching the electricity through least-cost principles.
- Administration of the MEM including seasonal and spot price setting.
- Accounting the economic transactions between the generators, the distributors, and the large users in the forward market.
- Executing the contracts between the above mentioned agents.
- Determine and assign reserve requirements.

CAMMESA is also responsible for functioning of the physical interconnected grid system (SADI) including the transmission and distribution lines. The operation of the system is planned for six-month seasonal periods with possible corrections every three months to meet the expected demand with reserves agreed between all parties [CAMMESA 2005a].

5.2.3 Agents in the Electricity Market

Since the power sector reform of 1992 with privatisation and implementation of a horizontal and vertical segmentation of the electricity market the number of agents have been numerous as is shown in the following table:

Agents	MEM	MEMSP	Total
Generators and Co-generators	34	4	**38**
Auto-generators	12	1	**13**
Transmission Companies	62	4	**66**
Distributors	63	3	**66**
Major Large Consumers (GUMAs) Min. demand of 1 MW	302	20	**322**
Minor Large Consumers (GUMEs) Min. demand of 30 Kw	1949	9	**1958**
Total	**2422**	**41**	**2463**

Table 5.1: Main agents in the Wholesale Electricity Market (MEM) and Wholesale Electricity Market for the Patagonian System (MEMSP). Source: [CAMMESA 2002], [CAMMESA 2003b].

For the unit of *generation*, the Energy Act declares this activity of national interest meaning that regulation is developed at the federal level. Regulation though permits free competition through free entrance and exit of generators.
Privatisation has led to more than thirty private generating companies as the majority of all former state assets are now in private hands and of these foreign investors hold major shares in many units. Among those still in state custody are the nuclear power plants (Embalse and Atucha I) and the bi-national hydropower plants (Yacyretá with Paraguay and Salto Grande with Uruguay).
Out of the total generation there is also a range of co-generators and auto-generators of private companies adding to the capacity.

As for *transmission,* it is declared a "public service" and a transmission company is defined as a company that through concession is responsible for transmission from the point of generation to the point of reception by large users or distributors [MECON 2005]. In short they connect all the nodes of the interconnected system.
The transmission companies have the obligation to give free access to their grids and this is a fundamental idea of the free market competition implemented in Argentina in 1992. On the other hand they are not obliged to invest in and extend the transmission grid. The free access permits any agent of the MEM, who is directly or indirectly connected to the grid, to buy its electricity from whomever offer to sell on the market. To assure horizontal division transmission companies are though not allowed buying or selling power.
The activity of transmission is subdivided into two systems. The High Voltage Transmission System, where the company *Transener SA* owns and operate the nearly 8800 km high voltage lines (500 kV) transporting electricity between regions plus some 5500 km of subsidiary networks. For the regional distribution system operating at 132/220 kV there are several transmission companies and they connect generators, distributors and large users within the same region [CAMMESA 2005a], [Arizu 2004].

The activity of *distribution* is the segment of the power sector that faces the greatest diversity of local circumstances. This because the process of institutional reorganisation and privatisation has been much slower on the provincial level, where most distribution companies are operating. The diversity is also due to the uneven composition and size of the local markets [Pistonesi, 2000]. Buenos Aires is by far the biggest consumer centre.
A distributor is a company that through a contract of concession is responsible for supplying to those end users that cannot independently be a member of the wholesale electricity market. Distribution is like transmission declared a "public service" and the distributors have the obligation

to supply with no discrimination within the established conditions of quality and prices. They should also meet all electricity demand required in the terms of the contract of concession [CAMMESA 2005a].

As the activities of transmission and distribution are both natural monopolies with the risk of being economically capitalised on, better efficiency is applied through regulation including fixed maximum tariffs and levels of quality. This on the other hand means that facing these restrictions the transmission and distribution companies can only increase their revenue through administrative optimisations.

5.2.4 Organisation and the Operation of the Wholesale Electricity Market

The MEM is the point of convergence of supply and demand. As illustrated in figure 5.2 the participating agents are the generators, the transmission companies, the distributors, the large consumers (more than 50 KW) and finally the marketers/retailers. These agents may choose between marketing directly their energy supply or demand, or act on the market through a company subscribed to either commercialisation of plants and services, or marketing of consumers aggregated demand [Pistonesi 2000].
On the market the services bought and sold include electricity, generation capacity, transmission services and ancillary services. As indicated the market consists of two segments: the spot market and the contract market.

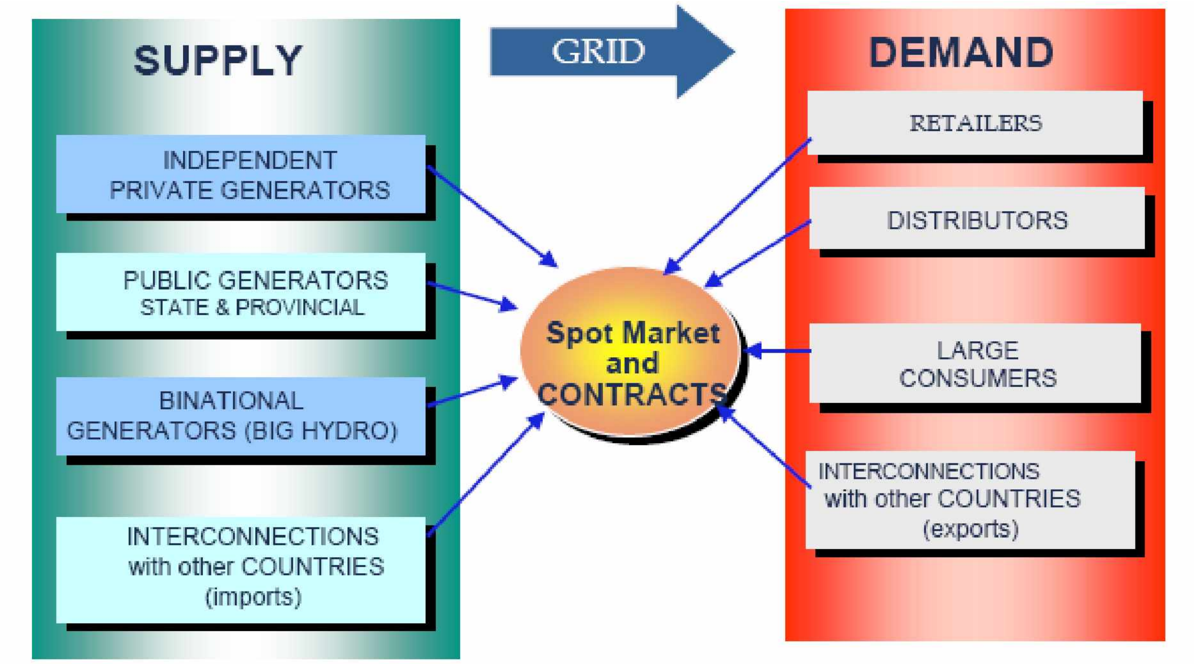

Figure 5.2: Market structure [Arizu 2004].

5.2.5 The Spot and Contract Market

The power suppliers can choose to sell their energy at the spot market at the hourly price determined according to market conditions. Generators use this option for the energy that is not contracted. CAMMESA in its calculation uses the costs and availability declared by participants in the MEM to perform a centralized load dispatch and to estimate hourly spot prices. Since the

dispatch does not consider the contracts signed by the different actors of the market, generation companies are obliged to buy or sell surplus power to or from the pool at spot prices.
The reference point for calculating the load dispatch is the Ezeiza node near Buenos Aires. Each power plant around the country is assigned a specific node within the interconnected system, and each one of those nodes has a specific factor that determine the final prices at which the plants will be remunerated [CAMMESA 2005a], [Pistonesi 2000].

The few retail companies allowed to import electricity, is paid the price offered at the border node where the electricity is imported to the national grid.

The power plants are dispatched according to economic dispatch order and are remunerated according to the short run marginal cost at the respective nodes of the grid taking into account transmission constraints. The spot price is additionally complemented by a charge for available capacity held by generators in the system.

The contracts market is restricted to the participants of the MEM. Here the distributors and large consumers can negotiate directly with the generators on prices and conditions for delivery of a given quantity and also on possible back up reserve. Normally the agreements would be on medium or long term. Within these contracts it should further be specified to what node the price refers and how the cost of transmission is dealt with [CAMMESA 2005a], [Pistonesi 2000].

5.3 Summary

Since 1992, there has been a large-scale privatisation of state assets in the power sector. In broad terms the state gave up its role as administrator and planner to enter a new role as supervisor and regulator of the activities in the sector. The privatisation process was commenced to encourage market competition.
In the Argentinean power sector there are some key institutions, which are:

- The energy secretariat, who formulates and implements policies, and grant permissions;
- the National Regulatory Entity for Electricity (ENRE) who enforces regulations; and
- the Wholesale Electricity Market Managing Company (CAMMESA) is managing the electricity market by dispatching the power plants and price setting as well as responsible for the transmission and distribution lines.

The electricity is either sold on contracts or on the spot marked. The price on the spot market is set by the market conditions on an hourly basis.
The dispatch is made according to economical dispatch based on short run marginal costs.

6 Key Variable: Power Sector Policy

The purpose of this chapter is to analyse the legal framework and the governmental policies for the development of the electricity sector.

6.1 Information and Methods

This chapter is based on laws and formulated political plans.
Besides from existing plans, the chapter does not consider a possible future development. The forecasting is therefore based on the existing and planned policies.

6.2 Analysis of Power Sector Policy

Taking a look at the future development for the power sector it is obvious that the government policies as well as the regulatory framework will have a significant influence.
With the enforcement of the Energy Act in 1992 the role of the State changed considerably with the reorganisation and privatisation of the power sector. After that the Argentinean government left the task of being and active power sector planner and stepped into the role of being a supervisor.
The reasons given to promote such restructuring, and which to a large extend determined its characteristics, were mainly the State's financial incapability to develop new capacity for power production and its "inefficiency" in carrying out this type of operation [IDEE 1999].
Regarding power generation the State is though still involved in the operation and planning of the nuclear plants and the bi-national hydro power projects.

As shown earlier in this liberalised open market context the State as the regulatory authority through the Energy Secretariat and ENRE[45] can still enforce some power and reduce the autonomy of plain business strategies. The State has the role of defining the energy policy and choosing the mechanisms for its implementation; it also regulates the inter-country trading of energy; and it is safeguarding the environment [IDEE 1999].

In theory the State should intervene as little as possible in the market and prices should result from market forces. However, with the severe economic and financial crises including a sharp contraction of economic output and a significant rise in the inflation the power sector was distorted like everything else in the Argentinean society.
The crisis escalated by the end of 2001 and in the beginning of 2002 the president with the Law 25,561[46] declared the country in a "state of emergency". The Argentinean government adopted several new economic measures as a result of the continuing political, social and economic crisis. These economic measures included abandoning the fixed dollar-to-peso exchange rate, conversion of U.S. dollar-denominated loans into pesos and placement of restrictions on the convertibility of the Argentinean peso.

The power sector suffered like many other industries from the devaluation of the peso and specifically from the regulations adopted during 2002 and 2003 in the energy sector, whereof some are mentioned below. The implemented "oppression" of prices on products and services effectively overturned the dollar based nature of the power sector. The cost structure was adversely affected as

[45] Ente Nacional Regulador de la Electricidad or National Regulatory Entity for Electricity.
[46] On the 6th of January 2002 the law of emergency and transformation "Ley 25.561 EMERGENCIA PUBLICA Y REFORMA DEL REGIMEN CAMBIARIO" was promulgated [MECON 2002].

many players in the power market had taken loans abroad and many of their inputs and technologies were imported.

Both the MEM and the distribution sector previously received payments that were linked to the dollar. First of all because of the Convertibility Law that pegged the peso at a 1:1 exchange rate with the dollar, and secondly because the price determination for electricity reflected the dollar-linked nature of the fuels used by the generating facilities.
[Economist 2004], [AES 2003].

The generators twice a year declared their costs of generation to the authorities taking into account their fuel costs. The overall energy prices were partly "oppressed" following natural gas as the dominant fuel. However, the regulators allowed the production cost for alternative fuels like coal and fuel oil to reflect international costs.
The government navigating in a stage of emergency was facing conflicting objectives and interests as they wanted to fight inflation and did not want to push costs to the impoverished population.

In order not to get higher electricity prices associated with the use of alternative fuels a regulation was altered so that the spot price would be set taking only into account fuel costs declared with natural gas. The outcome was that while generators received remuneration for producing with alterative fuels, the cost was not considered when setting the spot price.[47]
As an effect generation prices are reflecting an artificially low fuel price and consequently the real price received to the market for electricity generation has been significantly reduced since 2001

Furthermore during 2003 with the resolutions N° 240 14/08/03 and N° 984 22/12/03 caps were fixed to the MEM prices and rules were changed for remuneration and conditions for the available reserve capacity and corresponding fuel held by generators for sales to the MEM. The latter was done to try to secure a trustworthy and sufficient power supply during unstable times of gas supply and generation capacity.

For the distribution sector the companies under the former regulations were granted long-term concessions securing, directly or indirectly, that prices reflected the US consumer price index and producer price index. From the crisis on tariffs were converted to pesos and were frozen at the peso rate as of December 31, 2001.
The above gets evident in Law 25,561/2002 called "Public Emergency and Reforms of the Changing Regime" that also establishes the foundation for renegotiation of the concessions and contracts dealing with "public services". The procedures and a timeframe for the renegotiation of public utilities concessions were established in October 2003 with the Law 25,790. It stated an extension of the timeframe to run until December 31, 2004 [MECON 2004a]. By December 2004 with Law 25,972 this term of renegotiation was extended once more until December 31, 2005.

6.2.1 National Energy Plan

In 2004 the government presented its National Energy Plan from 2004-2008 containing a list of measures to overcome the critical situation in the energy sector. Part of the plan is founded on an agreement with natural gas and power producers to move the energy markets towards a "normalisation".

[47] This amendment to the spot price determination can be found in "Resolucion S.E. N^0 240" of August 2003 [SDE 2003c].

This normalisation will for the gas market in relation to the power sector include the creation of the *gas market of the power sector*[48] with the organisation and rules for it. This scheme include transparency of the dispatch, transparency of commercial transactions and information regarding relevant contracts, terms of negotiation on respectively the spot and contract market. In Decree 181/2004 additionally a scheme for the normalisation of wellhead gas prices is presented.
Also for the power sector a normalisation will imply an increase in prices. Further it will include an ongoing renegotiation of contracts of concessions for transportation and distribution of electricity and gas through the "*Unidad de Renegociación y Análisis de Contratos de Servicios Públicos*" – Unit for Renegotiation and Analysis of Public Service Contracts under the Ministry of Economy and Production, and Ministry of Federal Planning, Public Investments and Services.

The National Energy Plan is covering many parts of the energy sector and encompasses a list of measures and wishes for the present and medium term. These measures have been presented in the chapter about the supply side of the electricity system and include the expansion of the transmission lines and the implementation of several power plants such as the new nuclear power plant (Atucha II) and the elevation of the Yacyretá dam. Furthermore the National Energy Plan includes a revision of existing hydro power projects larger than 400 MW. Among those the large bi-national projects Garabí (with Brazil) and Corpus Christi (with Paraguay). This should be followed up by an identification of those which present the best technical and economical indicators, and selection of the three or four most profitable [SDE 2004b]. The plan also comprises a plan for a closer cooperation between Argentina and Brazil in power exchange in the case of interruptible power supply.

This outline of the national energy plan shows that the Energy Secretariat is looking into the future with some wishes for investments, but it does not touch much upon what is laid out in private hands like the important developments of oil and gas explorations and the power sector development as a whole including gas- and oil fired plants.
Therefore it does not seem as if there is any comprehensive and all-inclusive long term policy for the power sector. In doing this the government is obviously affected by the difficult economic situation where it first tries to solve the problem with the foreign debt and IMF [Bertero 2005].

Since the national energy plan was launched the government has in response to the lack of new power capacity additions on the supply side negotiated with power companies on building a gas power plant with joint financing of the Stabilisation Fund and private investors (See also "Electricity supply" chapter) [Bertero 2005].
Through Resolution 826/2004 the Energy Secretariat invited generators to partially contribute their existing and future credits of the MEM to fund new capacity to be installed by 2007 [SDE 2004b]. The benefit for the generators would be that the government committed itself to drive normalisation aiming at pre-crisis rules and eliminating all regulations fixing an artificially low price in the MEM. In December 2004 this agreement was set with the main part of the generators [IDE 1999]. The location of the new combined cycle power plant is not set, but a likely site would be near the CAMMESA headquarters outside Rosario.

[48] In Decree 180/2004 is outlined the creation of "Mercado Electrónico de Gas" – the gas market for the power sector [MECON 2004b].

6.3 Summary

With the enforcement of the Energy Act in 1992 the role of the State changed considerably with the reorganisation and privatisation of the power sector.
In theory the State should intervene as little as possible in the market and prices should result from market forces. However, with the severe economic and financial crises in 2001 including a sharp contraction of economic output and a significant rise in the inflation the power sector was distorted like everything else in the Argentinean society.
In the Argentinean environment of macroeconomic instability the urgency of stabilisation drained most of the political energy. The adaptation of the power sector to the new Argentinean context required systematic and rigorous fine tuning of regulation, but it was seen to be a difficult challenge to regulate with decrees and resolutions. Abandoning the fixed exchange rate and having revenues "oppressed" and frozen, and all prices to consumers fixed in pesos made it very difficult for the generators and distributors to cover their costs and invest in new capacity.
In combination, these circumstances created instability and significant uncertainties surrounding the performance of the power sector in Argentina. In the present situation there is still a lot of instability as generators and distributors have debts and costs they can hardly pay with the present low prices.

During 2004 the political and social situation in Argentina showed signs of stabilisation. The Argentinean peso appreciated against the dollar, and the economy started to recover.
Even though the political path forward is still with some uncertainty to how normalisation on prices will actually be put forward and how new capacity can be installed, the government has with the National Energy Plan and the additional legislation outlined the direction it will follow.

The process of normalising the regulations and electricity prices will continue to the end of 2005. The process has thereby been postponed from its original setup which will delay the plan of normalisation. Though the present stable government and economic situation will help and make normalisation possible in 2007 only a little later than stated in the National Energy Plan.
Development of the price level will tend to go from artificially low and partly subsidised towards more market constituted. More transparency will be experienced in the electricity sector as regulations are adjusted, but it will only be reached slowly by slowly. The normalisation will not only affect the electricity sector, but also the gas sector will experience similar changes, with higher prices and transparent regulations as a consequence.

An electricity crisis can have a detrimental effect on industry, and there are at the moment a lack of investments in the electricity sector. A fund has therefore been established with the purpose of financing a new gas power plant in 2007.

7 Key variable: Resources

As seen in the analyses of the electricity demand, it is expected to rise in the time frame of the forecast. The question of how this demand will be satisfied relies on the availability and attractiveness of different technical possibilities as well as the resources available to use the mentioned technologies. In this chapter the availability of energy resources will be analysed.
For some resources the availability is not an issue, as they can easily be transported. This is the case for oil, coal, and uranium. These will therefore in the following not be discussed. Other resources, such as gas, can be transported in pipelines or in tankers in pressurised or liquefied form. The two latter alternatives have, however, not been assessed as they are generally more expensive and are therefore not considered probable. Finally there are resources that are strictly bound to a given location. These are hydro, wind, solar and geothermal potential.

In the following, the availability of natural gas, hydro, wind, solar, and geothermal potentials for the electricity sector will therefore be addressed.

7.1 Natural gas

A wide used and promising technology in Argentina is the gas power plants. In this context the gas supply is important for the future investments in gas power plants, as the access is determining the possibility for expanding the electricity production from gas. In the following, the future gas demand, import and export rates will be discussed to give a picture of the availability of the gas in Argentina. Thereafter the gas sources both national and regional are discussed to show the possibility for the stated development in the gas demand to occur.
The access to gas is furthermore determined both by the location, the capacity and the expansion of the gas pipe lines which will be discussed in the following. Finally the possibility to attract the necessary investments to achieve the stated development of the gas system will be discussed.

7.1.1 Information and methods

The information used in this analysis is based on literature studies, including existing analyses, and open interviews with experts within the subject.
The included analyses mentioned are the forecast of the gas demand, the gas export, and gas reserves. The gas demand and export forecast is based on an analysis made by the Energy Secretariat. The methods used to make these forecasts are however not mentioned in the report [SDE 2002].
The peak demand until 2015 is extrapolated from the present peak demand/average demand ratio. Furthermore expert opinions in energy journals are used to assess the potential for investments in the sector.

7.1.2 Analysis of natural gas

7.1.2.1 Gas demand

The course of the gas demand gives the basis for discussing the future availability of gas. Since Argentina is a gas exporting country and is connected to its neighbouring countries through gas pipelines also the export trajectory is important for the total gas demand in Argentina.
The growth of the gas demand is expected to be relatively low in comparison with its neighbour countries because of the already high penetration of gas within all sectors of the society [IEA

2003a]. In the period from 2002-2012 the gas demand is expected to increase 3.4 % p.a. on average [SDE 2002]. This increase covers an increase in the demand from the electricity sector of 6.6 % p.a. and an average increase for the other sectors of 1.3 % p.a. Assuming that these demand trends are also valid for the years 2012 to 2015, the demand in 2015 will be 43,037 mcm[49]. In absolute values the demand from the gas power plants is going to increase from 7,959 mcm in 2002 to 15,123 mcm in 2012, reaching 18,335 mcm in 2015 [SDE 2002].

The purpose of this forecast is to evaluate the most consistent development of the electricity sector. It is therefore obvious that an increase in the number of gas power plants cannot be included as a basis for the forecast. The gas demand from the gas power plants can therefore only increase according to the maximum use of the existing and planned gas power plants.

The demand from the gas power plants in 2003 was 9982 mcm[50] [SDE 2002]. The utilization of the thermal power plants in 2003 was around 45 % of the total installed capacity on average. [CAMMESA 2003a] The maximum possible utilization of the installed capacity is 75.5 %[51]. This indicates that with the present gas power plants an increase of 168 %[52] is possible. Including the expected combined cycle gas power plant in Rosario[53] adds an 897 mcm potential increase[54] summing up to a total potential increase of 177 %[55] using 2003 as base year. The projected increase in demand from 2003 to 2015 is expected to be 184 %[56]. The maximal increase in demand from the power sector is therefore 177 % within the timeframe, corresponding to the projected increase until year 2014, thereafter levelling out in 2015 with an increase of the aforementioned 1.3 %.

7.1.2.1.1 Variation in demand

Argentina has a high seasonal variation in the gas demand. This is primarily due to the higher heating consumption in the residential sector during winter times. During these peak periods the gas transport systems operates at full capacity and at the same time the gas is substituted in the gas power plants with fuel oil [FB 2004]. The demand in these periods is estimated to be 5 to 10 mcm/day higher than the maximum transport capacity in 2005 [CAMMESA 2003a]. It is in the following assumed that the proportion between the peak and the average will stay constant throughout the analysed period.

7.1.2.1.2 Gas export

Argentina, Chile, Bolivia, Uruguay and Brazil is interconnected through an extensively build out high pressure gas transport system (see figure 7.2).

This is used mainly for gas export to Chile, Brazil and a smaller volume to Uruguay. [IEA 2003a] The gas export is expected to increase from 5,917 mcm in 2002 to 14,398 mcm in 2012, an increment on 9.3 % p.a. The amount reached in 2012 is the present allowed limit for the gas export and it is therefore assumed that the 2012 level remains constant throughout the studies period [SDE 2002]. The maximum export capacity of the existing pipelines is around 16,700 mcm/year [SDE 2002].

[49] Million cubic metres
[50] the demand for the gas power plants in 2003 is an interpolating of the demand projections of 2002 and 2004
[51] See “Electricity supply” chapter
[52] Dividing the potential usage with the actual consumption: 75.5/45
[53] See “Electricity supply” and “Power sector policies” chapters
[54] The mentioned gas power plant will have an installed capacity of 850 MW and an average availability of 75.5 %. The efficiency is estimated to be 58 % and one cubic metre of gas has the energy content of 9,300 Kcal corresponding to 38.91 MJ
[55] (1.68*9,982+897)/9,982
[56] 18,335/9,982

The figure below shows the peak and average demand in the period from 2003-2015 including export of gas:

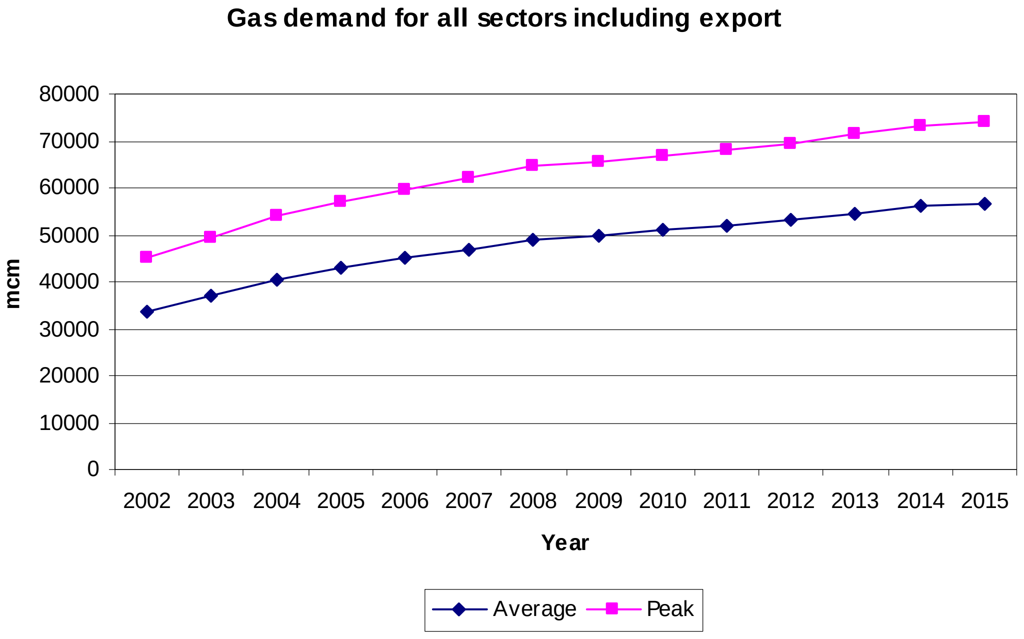

Figure 7.1: The Expected average and peak gas demand from 2002 to 2015, including export.

7.1.3 Natural gas supply

7.1.3.1 Gas reserves

There are 19 sedimentary basins in Argentina of which 10 is located entirely onshore, 6 in the coastline and 3 entirely offshore. [IEA 2003a] 5 hereof are currently in production (see figure 7.2). As of the beginning of January 2002 the proven reserves of these 5 basins correspond to an R/P ratio[57] of 19 years. The remaining 14 sedimentary basins are not explored and it is therefore not possible to address the potential gas production of these.
Presently the economic crisis has stopped all investments on this area but the government is planning to offer incentives, in the form of lower royalty and tax rates, to companies engaged in oil and gas exploration in high-risk areas, both onshore and offshore. On a longer term it is therefore possible that the R/P ratio will increase based on the unexplored basins. [IEA 2003a]

[57] The R/P ratio is an abbreviation for reserves/production ratio and is calculated on the basis of proven reserves and utilized production. [IEA 2003a]

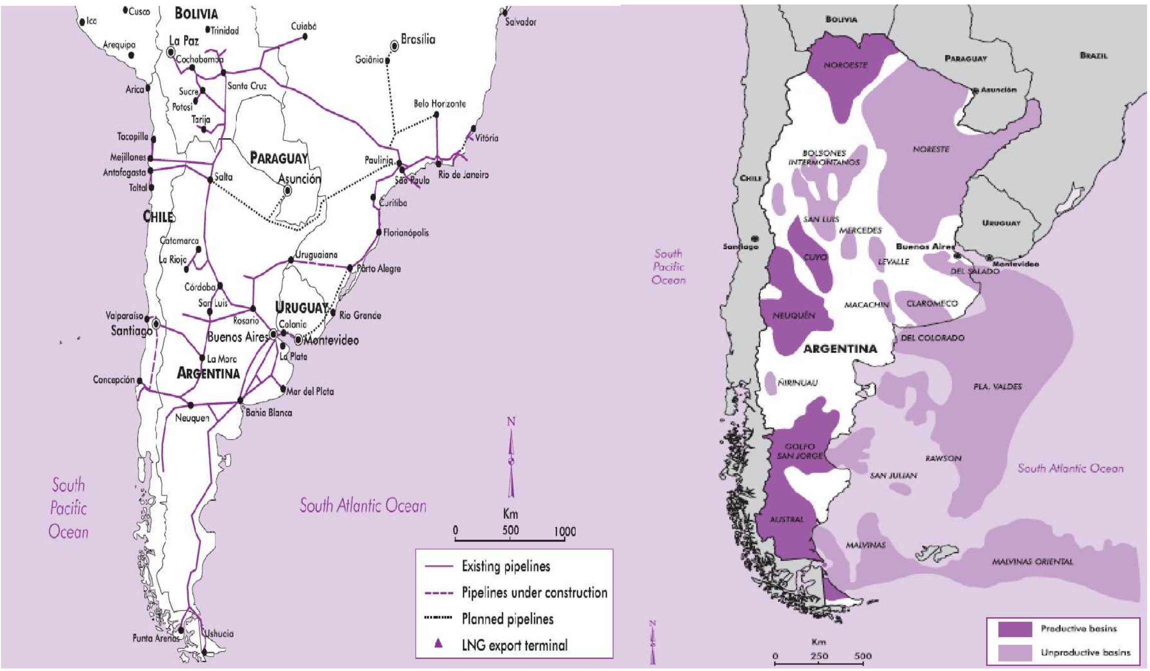

Figure 7.2: The high pressure gas transport system on the left. Productive and unproductive gas basins on the right. Dark basins are productive and light basins are unproductive [IEA 2003a]

A certain level of uncertainty is always connected to the exact size and the economical and technical feasibility to extract the gas reserves. To get a fuller picture of the actual size of the reserves also a share of the probable, possible and undiscovered gas reserves and resources should be included. Probable reserves are reserves that are not yet proven, but which are estimated to have a better than 50 % chance of being technically and commercially producible, whereas possible reserves cannot be regarded as probable, but which are estimated to have a significant nut less than 50 % chance of being technically and commercially producible [DTI 2005]. In relation to the undiscovered resources 14 of the 19 existing gas basins have still not been investigated. It is as mentioned above very difficult to quantify the potential occurrence of natural gas as well as the possibility to exploit it. Some rough estimates have however been made for Argentina and its neighbouring countries.

On a regional basis following picture emerges:

Country	**Proven reserves (bcm)**[58]	**Probable reserves (bcm)**	**Possible reserves (bcm)**	**Undiscovered resources (bcm)**	**Gross production* (bcm)**
Argentina	764	305	282	1,039	50.7
Chile	93	80		181	1.7**
Bolivia	775	706	704	708	7.2
Brazil	220	113		5,505	14.5

Table 7.1: A summary of the gas availability and production in Argentina and its neighbouring countries with gas reserves [IEA 2003a], [Enargas 2003].
** Gross production includes marketed production, re-injection, flaring, venting, and volume shrinkage*
***Marketed production*

[58] Billion cubic meters

7.1.3.2 Natural gas production

The natural gas production has been steadily growing. Since 1991 the gross production had more than doubled in 2003. In absolute numbers the production went from around 24 bcm/year[59] to 50.7 bcm/year, corresponding to 140 mcm/day. The marketed production was 101.5 mcm/day [Enargas 2003, annex 10]. Of the gross production around 56 % was produced in the Cuenca Neuquina, 19 % in the Cuenca Austral, 17 % in the Cuenca Noroeste, 8 % in the Cuenca San Jorge and 2 % in the Cuenca Cuyo (See figure 7.2 above for geografical explanation) [FB 2004]. With the present production levels the lowest R/P ratio of the mentioned basins has at least a 12 year horizon, which is however expected to increase when more probable reserves are incorporated in the available resources [FB 2004].

7.1.3.3 National gas transport system

The transport system has a throughput capacity of 124 mcm/day [SDE 2002]. The total transport was in 2003 37,041 mcm [Energas 2003] which corresponds to 82.6 % of the total throughput capacity. During peak situations the total transport capacity is used [FB 2004].
Since the restructuring and privatisation of the previously state-owned gas company “Gas del Estado”, there has been significant expansion of the transport networks because of government incentives and in order to follow the rising gas demands. The transport capacity rose by 66% between 1992 and 2002 [SDE 2002]. Despite the expansion, there are still a lack of capacity and bottlenecks, especially on the San Martin pipeline from Ushuaia to Buenos Aires, which is operating at full capacity.
After the economic crisis the expansion of the transport systems has been on hold because of lack of economic incentives to invest in the system. [FB 2004].
As an alternative to increasing the transport capacity, several aquifers and depleted gas fields are being studied with the purpose of storing gas and thereby levelling the peak demand [IEA 2003a].

7.1.3.4 Gas import

Regarding the gas import, a pipeline between Bolivia and Argentina allows the import of 6 mcm/day or 8 % of the national consumption in 2002 [SDE 2002]. The import has however been somewhat lower in 2002 and 2003 with an average of 0.276 and 0.249 mcm/day respectively [Energas 2003]. The import from Bolivia passes currently through the same pipeline as the production from the north-western basin (Cuenca Noroeste), which means that the potential import rates are controlled by the production in this basin. This alternative is presently more economically attractive. It is however expected that the production in the basin will decrease in the coming years which will be more than compensated by importation from Bolivia and that the import capacity will operate at full capacity within 2007 [FB 2004]. Further exploration of the Cuenca Noroeste seems unrealistic to happen within a foreseeable future because of the high investments needed and the abundance of Bolivian gas [FB 2004].

7.1.3.5 Planned expansions of the transport system

Some smaller increments in the transport system is planned to be finalised in 2006 and are already now initiated. These are:

- An amplification of the pipeline San Martin from the south, which will entail an increased transport capacity of 2.9 mcm/day;

[59] Billion cubic metres per year

- Amplification of the northern pipeline (Gasoducto Norte), which will bring about a increase in the transport capacity of 1.8 mcm/day; and finally
- Contractual confirmation of transport capacities will give about 1 mcm/day of extra capacity.
  [SDE 2005]

The figure below shows the demand projections, including existing and expected export, and the transport capacity, including the coming augmentations.

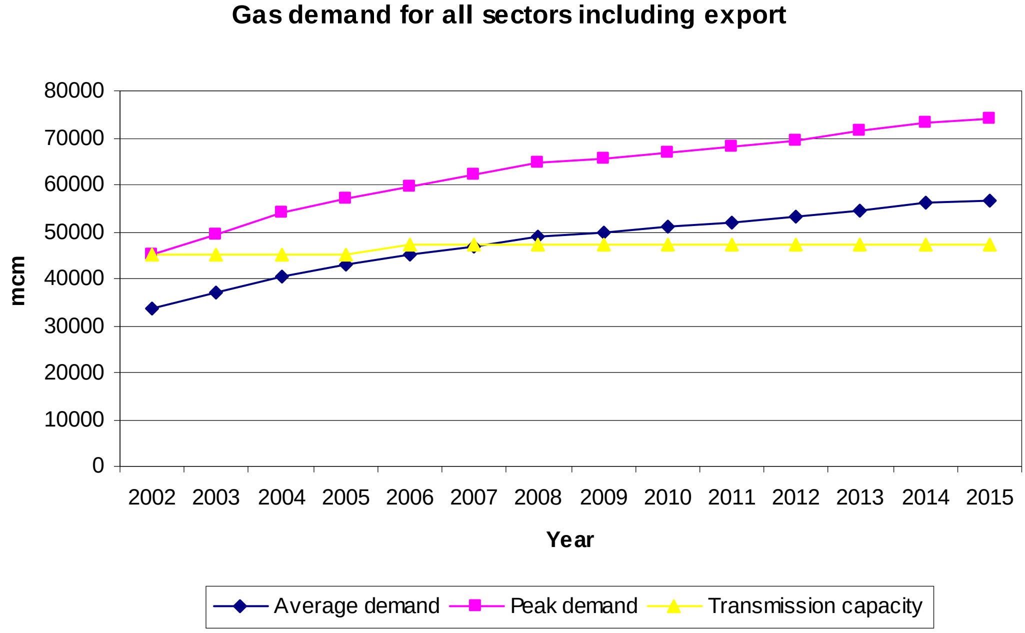

Figure 7.3: The average and peak gas demand in the period 2002-2015, including the transport capacity.

As it can be seen from figure 7.3 above there is a growing deficit in the production and transport system. The question is therefore how the demand is going to be satisfied after the intersection of the demand and transport capacity.

7.1.3.6 Availability of gas for the electricity sector

In the analysis of the electricity supply it was found that 52.7% of the generation capacity is dependent on gas. The electricity demand generally peaks during the summer, whereas the need for gas for residential heating peaks during wintertime, which creates a gas shortage during this period [CAMMESA 2003a].
The gas users are divided into "permanent" and "impermanent" users. The gas prices for the permanent users are higher and are used by users with no other alternative such as residential, transport and some industry. Most gas power plants are impermanent users, as the gas price is lower and most gas power plants can use both gas and fuel oil [Bertero 2005]. Shortage of gas during the winter occurred for the first time in 2004. This tendency is expected to continue and aggravate throughout 2007. During this 90 days shortage some of the thermal power plants are using more expensive liquid hydrocarbons resulting in higher marginal electricity prices. It is estimated in a worst case scenario that up to 50 % of the used hydrocarbons in this period will be liquid [CAMMESA 2003a]. Increasing the gas availability therefore is a key issue for the continual expansion of gas power plants.

7.1.3.7 Investments in the gas sector

During the 1990´s the gas sector underwent some far-reaching privatization reforms where private and foreign investments were allowed in al parts of the sector.
Several decrees stopped the state owned YPF's exclusive rights to exploration and production, removed price controls, eliminated restrictions on the oil and gas trade, and removed taxes and tariffs on exports. The objective of these decrees was to encourage investment in gas exploration and production and to create competition on the gas market. Similar actions were taken on the transport and distribution area were the company "Gas del Estado" monopolised the market [IEA 2003a]
Today YPF is nearly completely overtaken by the Spanish Repsol (Repsol was in 2000 holding 99 % of the shares) but several other international oil and gas companies have invested in the country [IEA 2003a] and the transport and distribution of gas is divided on several national and international companies [IEA 2003a].
As the market is highly liberalised and privatised the influence of the state is relatively marginalised. The development of the sector is therefore a question about the size of the private investments in production, transport and distribution. [Kozulj & Pistonesi 2004]
The size of the private investments in the gas sector is closely linked to the investment environment characterised by the market risks and the rate of return for the investments.
Furthermore some strategic considerations of the investor can play an important role.

Argentina is generally characterised as a high risk investment country. The once well working gas market has been restricted in setting the gas price since the beginning of the economic crisis as a means to control the inflation rate. The production, transport and distribution prices were fixed to the peso and after the economic crisis and devaluation of the peso, the prices in relation to the US dollar fell to one third [FB 2004], resulting in prices, in some cases, even below the production costs [IEA 2003a]. There is however a political will to normalise the market, meaning liberalising the price setting and make the regulatory framework more transparent, in order to make the market more attractive for the investors. It is expected that this normalisation will take effect within 2007 (See also "Power sector policy" chapter).

The general high risk level on the Argentinean marked and the opaque regulatory situation for the gas sector increases the investor's necessary rate of return, lowering the present possibilities for investments in the expansion of the transport system.
Investments in gas transport systems, operating with close to full capacity, which would be the case for a new pipeline leading from production sites to consumptions centres would under normal circumstances be regarded as a favourable investment [Bertero 2005].

7.1.3.7.1 Investment strategies

Possible investments in the gas transport system is most likely to be either in the construction of a pipeline from the south (The San Martin II) expanding the transport from the existing southern pipeline or the investments can be placed in the construction of a pipeline from Bolivia, crossing the north-eastern part of Argentina to Buenos Aires (Gasoducto Noreste Argentino).
The San Martin II will have a capacity of 16 mcm/day [National energy plan 2004]
The main question regarding the San Martin II pipeline is whether the project can find financing.

The situation for the Gasoducto Noreste Argentino is somewhat more complicated.

The Argentinean gas scene is characterised by multinational companies, such as Petrobras and Repsol-YPF among others. Their presence on several national markets in some cases changes their investment strategies, which seems to be the case in relation to the investments in the gas transport system.
The political situation in Bolivia is very unstable and there is a great fear among the population in Bolivia that they are not going to benefit from the exportation of the natural gas reserves, because of previous experiences with exportation of silver, grain rubber and tin that did not yield the expected outcome. It is therefore questionable whether Bolivia is interested under the present circumstances in engaging in the construction of a gas pipeline [Trebat & Edmar 2004]. But on the other hand the gas export from Bolivia is not restricted by the same price regulation as is the gas from Argentina, permitting a price level around 3 times higher and investments in Bolivia has from a political stance a high priority [Prensa Energetica 2004]. For the international players investments in the exportation from Bolivia is therefore presently much more attractive than an investment in the Argentinean transport system. The uncertainties regarding this solution are as mentioned the political instability in Bolivia and the Argentinean normalisation of the legislative framework covering the price setting of the gas. The present proposal for a pipeline from Bolivia has a transport capacity of 20 mcm/day, expandable to 30 mcm/day [Ormachea 2004], [National Energy Plan 2004].

7.1.4 Summary

The analysis of the gas demand showed that the gas demand is going to rise 3.6 % annually on average in the period from 2003 to 2015 including both national demand and increasing export rates. It was also concluded that the gas peak demand is expected to be 34 % higher than the average demand, assumed to be constant throughout the period. Regarding the occurrence of gas in Argentina it was shown that the R/P ratio is around 19 years as an average for the 5 producing basins. The gas occurrence in its neighbouring countries was shown to be scarce except for Bolivia which has about the same amount of gas at their disposal as Argentina and is presently exporting a smaller portion to Argentina.
The bottleneck regarding the future increase in demand was found to be in the transport system. The transport system is presently able to keep up with the average demand, but in peak demand periods, scarcity occurs. Especially the impermanent users as the gas power plants are affected by this lack of availability as they in this period have to use liquid fuels instead of gas at a larger expense. Investments in the gas sector is achieved through the initiative of the private sector, but the investment milieu is presently very unfavourable because of fixed low gas prices and opaque regulations. A normalisation of these conditions is expected by the government to occur in 2007. The two most likely extensions of the transport system is either a new gas pipeline from the southern gas basin or a new pipeline from Bolivia to the Buenos Aires region. Whereas the domestic solution is limited by the unfavourable investment environment, the pipeline from Bolivia is facing problems due to the politically unstable situation in the country.

After or during the expected normalisation in 2007, it is likely that investments will take place in new pipelines, most likely the domestic solution because of the political unrest in Bolivia. The latter project is however very attractive and when the riots end, it is very likely that it will be continued as it is politically encouraged in both countries. When this will happen is uncertain.

7.2 Hydro

Hydropower is another very important source of electricity in Argentina. This source is however contrary to natural gas abundant. Argentina has a large hydro power potential whereof a modest part is already utilized in the electricity generation. In 2003 33.7 TWh was produced by hydro power in Argentina corresponding to more than 40 % of the total electricity production [SDE 2004].
Argentina has a technically feasible hydro potential of around 130 TWh, which means that only around 26 % is utilised. [IEA 2005]
Considering this large potential it can be concluded that no scarcity will appear within a foreseeable future.

7.3 Wind

In the Patagonian province in the far south, Argentina has a huge wind potential, estimated to be one of the highest in the world. Also in the southern part of the Buenos Aires province large wind power potentials can be found. A preliminary estimate has been made, which indicate that the large land areas combined with the favourable wind conditions results in a total generation potential of 170 TWh/year. Presently 26 MW of installed capacity exists, resulting in a generation of 78 GWh in 2003 or 0.5 % of the total potential. [Dubrowsky 2004], [SDE 2003b]
On this basis it can be concluded that no problems regarding availability of wind will be an issue.

7.4 Solar power

Argentina also has a large potential for solar power, especially in the Mendoza and San Juan provinces as well as the northern Chacho and Formosa provinces where the radiation reaches around 5 kWh/day*m^2 which is comparable to northern parts of Africa [Dubrowsky 2004], [SOLAREC 2005]
Virtually nothing of this potential is currently used as only 26 kW of installed capacity is presently operating in Argentina, located in the northern province Jujuy [SDE 2004].

7.5 Geothermal power

The geothermal potential is difficult to estimate, but a worldwide exploration of the geothermal potentials suggests that the Argentinean conditions are not particularly favourable in this regard [IEA 2003b].
Only one small geothermal power plant presently exists in the province of Neuquen with an installed capacity of 0.6 MW. The plant is presently out of order. Some geothermal potential is however exploited especially in relation to spa therapeutic recreation centres, whereas only very few projects are dealing with domestic use. In total 25.7 MW of geothermal heat is used within these facilities. [Dubrowsky 2004]

8 Key variable: Technologies

The purpose of this analysis is to evaluate potential electricity generation technologies. To assess the attractiveness of a technology the important issues are:

- The present use of the technology in the country: The implementation and operation of a given technology require a certain level of knowledge. This can be a barrier for new technologies emerging in the system.
- Future prospects for the technology: Some technologies are presently undergoing rapid changes leading to lower installation and operation costs, whereas other technologies can be characterised as mature with little or no expected changes in technology. This has an influence on the future attractiveness.
- Legal and social issues connected to the technology: The possibility to implement a given technology is first of all a legal question. For several technologies, the social acceptance is also highly important.
- Installation and production cost: From a risk minimisation point of view it is favourable that the installation costs are as low as possible. The more of the costs are located in the operation, the higher the possibility to continuously manage the costs in the light of the existing electricity prices.
- Infrastructure at the location of the technology: For some technologies the electricity production is very large which sets demands for the local transmission capacity.
- Plant size: Regarding the size of the power plant several arguments can be stated, but economies of scale is definitely in favour of the large power plants. Bigger or higher quantum of a given technology is therefore generally aimed at [IEA 2003c]. As a nuance to this picture very large projects such as large hydro dams tend to be more vulnerable to market fluctuations than many smaller projects, as the many small projects can be gradually constructed in response to market conditions whereas the large hydro only can be build in one continuous process [IEA 2003c].
- Lead time: Long lead time is unfavourable for the investor, because of the uncertainty of the future electricity price and demand as well as the total cost of financing construction. The long lead time therefore enhances the risk that the investment milieu changes under the construction phase.

The technologies that will be assessed in this analysis are: Wind power, solar power, geothermal power, hydro power, coal, oil, nuclear and gas power plants, as they are the main power generation technologies.

For some of the mentioned technologies, not all listed items are relevant. These will therefore not be addressed.

8.1 Information and methods

The information used in this analysis is based on international surveys about price levels of different technologies and their probable future development. Studies regarding specific Argentinean subjects were based on literature studies and expert opinions.
In relation to coal, a least cost scenario analysis has been included.

8.2 Analysis of technologies

8.2.1 Gas

8.2.1.1 Use

Gas is extensively used for power production in Argentina, as 52.7 % of the installed generation capacity uses gas.

8.2.1.2 Installation and production costs, future prospects, plant size and lead time

Gas power plants can be divided into two different types of technology: Simple cycle and combined cycle. Simple cycle gas turbines is a technology where the combustion energy is converted to electricity through a turbine and the exhaust heat from the process in not utilised. In a combined cycle gas turbines the exhaust heat is used to raise steam and drive a steam turbine. Simple cycle gas turbines are because of their simplicity cheaper than combined cycle, but less efficient. The simple cycle gas turbines are therefore primarily used for peaking or mid-range duty as they are more expensive to operate because of their lower efficiency level, whereas combined cycle is more favoured as a base load technology. Gas power plants comes in all sizes, but larger plants are generally favoured regarding the installation costs per kW because of economies of scale [IEA 1999]
Installation costs for combined cycle gas turbines are around 400 to 800 US$/kW depending on size; larger plants are generally cheaper per installed kW. For simple cycle gas turbines the prices are a bit lower in the range between 600 to 350 US$/kW. Prices per produced kWh are around 4 to 6.5 US cents.
Low installation prices, high flexibility and short construction times have made both technologies very attractive.
Further lowering of prices and increasing efficiency levels are foreseen within the coming decades, as the technology still is relatively young.
[IEA 1999], [IEA 2005b]

8.2.1.3 Infrastructure

Generally the location of gas power plants is only restricted by the location of the gas transportation net, which is in the Argentinean situation extensively developed in many parts of the country. The gas transmission net is however in many cases working at full capacity, especially with regards to the pipeline from the southern Argentina (San Martin pipeline). The consequence is therefore that a new power plant will further limit the access of gas and thereby aggravate the existing gas shortage. However, this has shown not to be a decisive constrain, as a gas power plant is planned to be build in 2007 without having a guarantee for a better gas supply.
The location of the gas power plants is therefore with the present gas transmission capacity partly constrained by the location of gas wells with an excess production capacity. This is the case for the two producing southern basins. The construction of a new gas power plant in the location of these wells is however not possible because of the non-existing transmission lines. The location of the transmission lines or gas pipelines therefore is an issue for the gas power plants.

8.2.2 Hydro

8.2.2.1 Use

Argentina has a large number of hydro power plants, amounting to 39.5 % of the installed generation capacity.

8.2.2.2 Future Prospects

The use of hydro power has been known for centuries and was primarily used in a mechanical form. Later in 1827 the turbine was used to generate electricity for the first time, and was extensively used already in 1880. Since then the technology has been greatly improved, and hydro power plants can now have an efficiency of up to 90 % in relation to the theoretical limit [IEA 2003b]. Further significant technological improvements within the time horizon of this study is therefore not very likely.

8.2.2.3 Legal and social issues

Large hydro power plants imply great changes to the environment in which the dam plant is embedded. There has therefore been a great opposition against new large hydro power plants being build [Bouille et al. 2000].

8.2.2.4 Installation and operation costs

Argentinean studies suggest installation costs varying from 1000 - 1600 US$/kW depending on the head and size. In general terms, low head results in higher costs, and larger plants are cheaper per installed kW and per produced kWh [IEA 2005a], [IEA 2003b].
Prices per produced kWh vary greatly according to these parameters and a study suggests prices in the range between 4 to 24 US cents per kWh, with an average of around 7, depending on discount rate, country and the conditions for the project [IEA 2005b].

8.2.2.5 Plant size and lead time

Plant size comes in all sizes, from the very small micro hydro power plants to the enormous hydro dams like Yacyretá in northern Argentina.
Construction time is often in the range between 5 to 7 years [Bouille et al. 2000]

8.2.2.6 Infrastructure

The hydro potential is scattered throughout the country, and it is therefore difficult to assess whether the location of the transmission system presents a problem. One general condition is however that the hydro potential is low in the flatter Buenos Aires and Litoral regions, where the main electricity consumption is (See Electricity supply and demand chapters). Large hydro projects will therefore very easily lead to a need for expanding the transmission system.

8.2.3 Nuclear energy

8.2.3.1 Use

4.1 % of the installed generation capacity in Argentina stems from two nuclear power plants.

8.2.3.2 Future prospects, installation and production costs, plant size and lead time

Nuclear power is a mature technology [IEA 1999], which means that further improvements regarding the costs and efficiency level of the technology is expected to be limited in the future. A study suggests installation costs varying from 1000 to 2500 US$/kW and the construction period often as long as 6 years, which is 3 times longer than for example a normal gas power plants. Prices per kWh are however are relatively low, vary from 2.5 to 6.5 US cents with an average around 4. The lead time is quite long, around 6 years or longer. Research is ongoing allowing smaller plants, but presently they are very large. The technology is therefore generally impeded by high installation costs and long construction time [IEA 2005b].

8.2.3.3 Legal and social issues

The experiences with the new Atucha II nuclear power plant, which is expected to be fully operational in 2009, can be expected to have had a somewhat deterrent effect on the further expansion of nuclear power in Argentina. The Atucha II was commenced in 1981, and has been postponed several times, resulting in severely higher costs [TE 2005]. It can therefore be expected that a political opposition will be in a strong position to prevent an ongoing nuclear evolution in Argentina.

Nuclear power plants are because of security reasons only on governmental hands.

Nuclear power is to a larger extent than in Europe socially accepted and an expansion of the use of nuclear power in the electricity sector will therefore probably not be significantly limited by social opposition [Chorén 2004].

8.2.4 Coal

8.2.4.1 Use

Only one coal fires power plant is presently operating in the MEM. The plant is located in the Buenos Aires province and has a generation capacity of 650 MW or 2.6 % of the installed capacity. In 2003 its actual electricity generation amounted to 0.4 % of the total thermal electricity generation, decreasing from 2.3 % in 2000 [SDE 2004]. The decrease is due to more economically attractive electricity generation solutions, which means that the plant is only used under peak situations.

8.2.4.2 Future prospects

The future perspectives for coal power plants are not differing significantly from today. There is however a possibility to increase the efficiency level of around 5 % according to the present normally built coal power plants, which will also lower the operational costs marginally [Torrens & Stenzel 1997]

Whether this will be common practice within the next 10 years is nevertheless unknown.

8.2.4.3 Installation and production costs, plant size and lead time

The construction costs of coal power is varying around 1000 to 2000 US$/KW, and the operation costs are about 2 to 7 US cents/kWh, with an average around 4. An Argentinean study suggests prices around 6 US cents/kWh for this solution.

The plants are generally medium to large and the construction time is generally varying from 4 to 6 years. [IEA 2005b]

8.2.4.4 Other issues

Coal power was by all interviewed experts not believed to play any role in the electricity supply within a foreseeable future, apart from the San Nicolas power plant, which is expected to continue its production when other options are lacking [Chorén 2004].
This view is also consolidated by an Argentinean least-cost scenario analysis, where coal is only introduced in the case of severe gas scarcity [Bouille et al. 2000]

8.2.5 Oil

8.2.5.1 Use

As mentioned in the chapter "Electricity system: Supply", oil is hardly used among the power plants dispatched by CAMMESA apart from periods of gas scarcity. Among the co- and auto-producers diesel is widely used. This does however only constitutes 0.9 % of the generated electricity in the interconnected grid.

8.2.5.2 Installation and production costs

The information in the used analyses was relatively scarce on data for oil power plants, which means that prices locally may vary from the given numbers.
The installation costs were around 1300 US$/kW and the production costs around 8.5 US cents/kWh. [IEA 2005b]

8.2.5.3 Legal issues

The Argentinean law number 24065 of 1991 sets maximum limits for the emission from thermal power plants [Bouille et al. 2000]. These limits imply that the domestically produced crude oil cannot be used in the thermal power plants because of high sulphur contents. Instead more expensive liquid fuels have to be imported, which means that the production costs in Argentina probably are higher than above indicated.

8.2.6 Wind

8.2.6.1 Use, future prospects, installation and production costs, plant size and lead time

0.1 % of the installed generation capacity is based on wind power.
The price of wind power has fallen drastically since the late 1970's with about a factor 10. Most of this increase in efficiency has been due to optimisation in design and an increase in the generation capacity of each machine, which has increased by roughly a factor 100 in the aforementioned period. For the grid-connected systems, a cost around 1000-2600 US$ per installed kW can be expected. The cost in 2010 per installed kW is expected to drop around 17 to 24 %. Offshore wind parks are generally more expensive in installation than onshore wind parks. Some of this extra cost is however compensated by the generally higher wind levels at sea.
Prices per generated kWh can vary from 3 to 14 US cents, with an average about 6.
It is believed that the saving potential in relation to price levels suggested here on a long term view would be up to 40 % for offshore and 35 % for onshore wind parks.

An important aspect in relation to wind power is that on average only around 20 % of the installed potential is actually generated, whereas this percentage for e.g. nuclear power plants can be 85%. Existing wind parks in Argentina however shows that a capacity factor of 40 % can be reached [Dubrowsky 2004]. The average lifetime of wind power is around 25 years. Construction of the wind mills is normally achieved within 1 to 2 years.
Wind mills are normally made in wind mill parks, which mean that the "plant size" can be anything from a few MW to several hundreds.
[IEA 2003b], [IEA 2005b]

8.2.6.2 Infrastructure

With the incorporation of the new transmission line from Choele-Choel in the province of Rio Negro to Pico Truncado in the province of Santa Cruz (See chapter on Electricity supply), a fair share of the wind potential in Patagonia can be exploited.
Regarding the wind potential located in the Buenos Aires province, high voltage transmission lines (500 kV) are not in the vicinity of a potential wind power project. Lower voltage lines (132 kV) are locally present, which means that only smaller wind parks would be possible in this area without an extension of the grid. [Dubrowsky 2004], [CAMMESA 2004]

8.2.6.3 Legal issues

The law number 25019 of 1998 states that wind and solar power is in the national interest, and that no authorization is needed in order for the implementation of these technologies. Furthermore the law states that the generation of each KWh effectively produced by wind power which is made available to the MEM grid, will be remunerated by 1 centavo (around 0.33 US cents) in a period of 15 years.
The law number 25019 was followed by a provincial law number 4389 in the Chubut province creating an additional incentive of 0.5 centavos per generated KWh, thereby increasing the total remuneration to 1.5 centavos for each KWh produced in the Chubut province [MECON 1998].
Also in favour of the renewable energy in general is the *National Promotion System for the Use of Renewable Energy Sources for Electricity Production* (Regimen de Fomento Nacional para el Uso de Fuentes Renovables de Energía Destinada a la Producción de Energía Eléctrica) supported by the Senate, which states that within 2013 8% of the electricity should be generated by renewable energy sources. [MECON 2003], [Dubrowsky 2004]. It is believed that around one third of these 8 % will be wind power, and that more than half of this wind power will be connected to the grid [Legisa 2005]

8.2.7 Solar

8.2.7.1 Use

Presently only 26 kW of installed capacity grid connected solar power exists in the MEM, corresponding to around 0.0001 % of the total installed capacity.

8.2.7.2 Future prospects, installation and production costs, plant size and lead time

This category includes both the photovoltaic cells and the solar power plants converting the solar heat mechanically to electricity.
The costs for solar power vary widely according to location, type, and construction specifications. Grid connected vary in the price from 3000 to 10000 US$ per installed kW.

Prices per generated kWh vary according to location. A study [IEA 2005b] suggests prices between 10 to 190 US cents per kWh with an average of 60 cents.
An attractive feature about the photovoltaic cells is however that the generation falls within the peak hours of the day and can thereby help to lower the more expensive peak demand.
There is a great development within the photovoltaic cells. The present predominant technology that uses crystalline silicon is expected to stay dominant on the marked on the short term, whereas the thin-film solar cells are expected to be considerably less expensive on the medium and long term. [IEA 2003b]
The plant sizes are generally very small depending on type; photovoltaic "plants" are smaller whereas plants mechanically converting the solar heat somewhat bigger.
The lead time is short, around 1 year for photovoltaic cells and up to 3 for mechanical converters. [IEA 2005b]

8.2.7.3 Legal issues

Regarding the S-1221/03 bill [MECON 2003], as mentioned above, which has the purpose of implementing 8 % renewable energy to the electricity matrix within 2013, it is suggested that around one third of these 8 % will be solar power, though mainly for isolated systems [Legisa 2005].
Besides this bill and the general support to renewable energy sources, no special emphasis is put on electricity generation from solar power.

8.2.8 Geothermal

8.2.8.1 Use

A power plant with the capacity of 0.6 MW is connected to the MEM, which is presently out of order.

8.2.8.2 Future prospects, installation and production costs, plant size and lead time

Studies in the USA suggests that the cost per installed kW is between 1500 and 5000 US$ depending on plant size. Smaller plants (1-5 MW) are generally more expensive and vary in cost around 3000-5000 US$ whereas the cheaper spectrum is represented by the larger plants (>5 MW). The average plant life time is 30 years and the capacity factor is around 80%.
Investigations suggest implementation costs in the 3 to 15 US cents rage per kWh for a 1 MW plant [IEA 2003b], [IEA 2005b]
Some future achievements in order to improve the techno-economic performance are still possible but it is difficult to give an accurate estimate of the future price rage. It can however be concluded, that it is to a large degree a question about the suitability of the Argentinean resources that decides whether the investments in geothermal power plants are feasible in the future.
An advantage of the geothermal power plants is that the generation is not intermittent as other renewable energy sources such as wind and solar power that relies on the natural fluctuations. Geothermal plants can thereby add to the base load generation. A downside about the geothermal power plant is however that a fair share of the investments is used in the exploratory drilling which is a high-risk activity, and can cause the project to be cancelled, if unsuccessful [IEA 2003b].
The lead time is around 5-7 years [Ogoye 2003]

8.2.8.3 Legal issues

Except for the general support to renewable energy sources, no special emphasis is put on electricity generation from geothermal power.

8.3 Summary

The table below will give a condensed presentation of the above stated issues for the discussed technologies:

Technology	**Installation costs (US$/kW)**	**Price per kWh (US cents)**	**Lead time (years)**	**Inst. cap. (%)**	**Availability of resources**	**Issues regarding infrastructure**	**Legal and social issues**	**Future prospects**
Gas	350-800	4-6.5* (4**)	1-3	52.7	Medium-high, but low gas transmission capacity	Un restrained gas is only available far from demand centres.		Slightly lower costs are expected
Hydro	1000-1600	7	5-7	39.5	High	Main hydro potential is far from demand	Opposition against large hydro plants	
Nuclear	1000-2500	4 (6.5**)	6	4.1			Nuclear power is only on national hands. Expansion plans have been poorly managed.	
Coal	1000-2000	4 (6**)	4-6	2.6				Possible marginal decrease in production costs
Oil	1300	8.5***	?	0.9			Strict environmental regulations, resulting in higher production costs	
Wind	1000-2600	6	1-2	0.1	High		Remunerated by 1 to 1.5 centavo per produced kWh (~ 0.3-0.5 US cents)	Drop in prices on around 20 % during next decade
Solar	3000-10000	60	1	0	High		General political support	Price level is expected to drop significantly
Geothermal	1500-5000	4-15	5-7	0	Medium		General political support	Slightly lower costs are expected

Table 8.1: Prices, pros and cons for a number of different electricity generation technologies. Prices are based on international data, whereas the pros and cons are explicit for the Argentinean situation.
**The operation costs are probably lower in Argentina, as the prices indicated above are based on international fuel prices. The fuel constitutes a large part of the operational costs for gas power plants, and the gas in Argentina is below the international level.*

***According to Argentinean study [Bouille 2000].*
****Probably higher in Argentina because of legislation.*

9 Key variable: Investments

In the previous chapter the electricity generation technologies and resources available was analysed to assess which of these were the most attractive in the present situation. The purpose of this chapter is to analyse the possibility for investments in these technologies in the electricity sector.

Investments are bound to the investment environment, which will therefore primarily be described. Thereafter the main actors on the market will be analysed regarding their probable strategy.

9.1 Information and methods

The investment environment is analysed on the basis of a list of criterions established in an IEA (International Energy Agency) study, used to characterise the investment environment for investments in the power sector.
The main actors' strategies will be used as a general trend for the sector.

9.2 Analysis of investments

9.2.1 Investment environment and risks

In the period from 1991 to 2002 an amount of 8135 MW new capacity was installed and this was mainly reached through private investments. In comparison to the present situation only additional 541 MW has been added the last 2½ years [CAMMESA 2005b], [Bouille et al. 2004], [CNEA 2002].
Every year CAMMESA makes a forecast of the possible entries of new plants into the market. In 2003 CAMMESA had no plants listed to enter in the short term, but a list of 8 power plants with a total of 3750 MW expected to enter within 3 years time. Among those 8 plants was the state financed nuclear plant Atucha II [CNEA 2003]. One year later in 2004 CAMMESA still had no power plants on the short term entry list, but now the list of anticipated new power plants was reduced to only two or 948 MW of which Atucha II counted for 692 MW [CNEA 2004].

These trends show the almost complete halt in investment activity that has hit the power sector in Argentina following the 2002 crisis. The supply side of the market is hesitant even though demand is rapidly rising.
Analysing the investment environment will give a picture of the future situation.

The introduction of the Energy Act in 1992 and the following reform of the Argentine electricity and gas markets have led to major changes in the way decisions are taken in power sector investments. In the absence of explicit State intervention and management an understanding of the investors' strategies and perceptions is essential to make forecasts of the future development.

IEA has made a comprehensive study of power generation investments in electricity markets. From this study some crucial investment risks can be identified:

- Economy-wide factors that affect the demand for electricity or the availability of labour and capital.

- Factors under the control of the policy-makers, such as regulatory (economic and non-economic) and political risks, with possible implications for costs, financing conditions and on earnings.
- Factors under the control of the company, such as the size and diversity of its investment programme, the choice and diversity of generation technologies, control of costs during construction and operation.
- The price and volume risks in the electricity market.
- Fuel price and, to a lesser extent, availability risks.
- Financial risks arising from the financing of investment. They can to some extent be mitigated by the capital structure of the company.

[IEA 2003c]

Analysing the present situation in the Argentinean power sector in the light of these potential risks the investment environment can be characterised.

First of all being in the aftermath of the crisis and being a developing country a higher risk premium would automatically be put on investments in Argentina. The continuous growth rates in the economy and the agreements with the IMF about the foreign debt are though to some extend off-setting the high risk perception connected to investments Argentina.
Specifically surrounding the power sector present generators and investors experience a high risk concerning the factors under control of the policy-makers. As indicated in the "power sector policy" chapter, Argentina is in a stage of transformation. Renegotiation of contracts and concessions is causing a lot of uncertainty for power sector investors and companies, and the policy and regulatory development within the past years have not been stable and transparent.

Further there has been a clear tendency that the government has protected the customers from a radical price jump. This has in turn made it difficult for the generators to recover fixed costs and the market has thereby failed to deliver new capacity. The basic problem that prices are regulated and that they do not reflect long term investment costs for the generators make the market unattractive. When the legal framework and regulations is not transparent and reliable it constitutes a risk that is often crucial to investment decisions. How and when the government will counteract this instability is a high risk factor in the light of the previous slow political process.

The chapter about the gas resources further to this elucidated that especially the gas supply to the power sector is associated with an availability risk.

Summing up the Argentine power sector investment environment is not looking positive. The market intensively experiences many of the risks normally met in power investment decisions. The greater the business and financial risks, the higher the return that will be demanded, and the Argentine power market will hardly be able to deliver this return in the near future given the unstable price situation.

9.2.2 Trends within major energy companies

Before the 1992 liberalisation of the energy markets in Argentina, investment in the power sector was a relatively low business risk and often state ownership made access to debt capital relatively easy. The present situation has changed the nature of stakeholders responsible for investment. Investors are no longer directly accountable for guaranteeing adequate supply beyond their contractual obligations. Basically they will invest only if it is profitable.

The Argentinean power sector is comprised of many players on the scene and within power generation there are a long list of power companies and many stakeholders. Several of these stakeholders are big international energy companies with businesses worldwide, but no one of them has market dominance within generation.
In general all investors face the difficult investment environment with many risks outlined above. We do not distinguish between foreign private investment and national private investment, but given the exchange rate risk and the fact that prices are not remunerated in dollars will give international investors some thoughts of adding more capital in this market.

It is not possible to give a full analysis of all actors and investors' position and strategies, but to indicate a trend we have chosen to look at four of the big players on the energy market in Argentina, YPF-Repsol SA, Total Austral SA, Petrobras SA and the State.

Repsol YPF is among the ten largest international oil and gas companies in the world and the largest private energy company in Latin America in terms of assets. In 1999, the Spanish oil company Repsol merged with the formerly state owned Argentinean oil company Yacimientos Petroliferos Fiscales (YPF).
Repsol-YPF dominates the oil and gas sector in Argentina and accounted for more than 1/3 of total oil production. Production of natural gas amounted to 20.7 bcm (about 40 % of gross production) with a presence in all major basins in Argentina. Repsol-YPF is also heavily involved in distribution of gas e.g. through Gas Natural BAN, which cover 1.3 million costumers in the North of Buenos Aires.
Within power sector activities Repsol-YPF participate in several power plants and have a total capacity of 1,839 MW. These plants include Cetral Térmica Tucumán, Centrak Térmica San Miguel de Tucúman, Filo Morado and Central Dock Sud. The company also have gas fuelled auto-generation to cover own power needs [Repsol-YPF 2005a].
The overall strategy of Repsol-YPF is to grow stronger as a regional integrated energy supplier. They will focus regionally on market where they have already a good market share. In Argentina Repsol-YPF will seek to take advantage of the need for energy as the economy is growing and maiximize the value of downstream assets in an integrated manner. Providing gas to the growing Argentinean market is a key goal for Repsol-YPF [Repsol-YPF 2005b].

Total Austral S.A. in 2003 produced around 19 % of Argentina's natural gas having major shares in 5 producing fields. The upstream activities accounted all in all for 8.0 mcm/day natural gas, corresponding to 6 % of gross production.
Total Austral is part of the multinational energy Group *Total*, which is the fourth-largest oil and gas company in the world. It also has oil and gas activities in neighbouring Bolivia.
Further to this the Group owns interests in several natural gas transport companies in Argentina, Chile and Brazil. *Total's* interests include 19.2 % of Transportadora de Gas del Norte (TGN), which operates a gas transport network covering the northern half of Argentina; 56.5% in the companies that own the GasAndes pipeline connecting the TGN network to Santiago, Chile; 32.7 % of Transportadora de Gas del Mercosur (TGM), which operates a pipeline connecting the TGN network to the Brazilian border and other transport assets in the region. Collectively these different assets represents a total integrated network of approximately 9,000 kilometres serving the Argentine, Chilean and Brazilian markets from gas producing basins in Bolivia and Argentina.

Total has a strategy of pursuing all levels of the gas value chain and is therefore participating in electricity generation. In Argentina, *Total* owns 63.9% of Central Puerto SA and 70% of Hidroneuquen. Central Puerto SA owns and operates gas-fired power plants in Buenos Aires and in Neuquen, with the total capacity of 2,165 MW. Through its stake in Hidroneuquen, TOTAL owns

41.3% of Piedra del Aguila (HPDA) a 1,400 MW hydropower dam located in Neuquen. *Total* is also in transmission through a 70 % share in Transba SA, which is the concessionaire of the power transmission system in the Province of Buenos Aires.

Petrobras S.A. is a regional and global energy company based in Brazil. In Argentina *Petrobras* has considerable activities within both gas and the power sector. With the acquisition of Perez Companc, now Petrobras Energía S.A., *Petrobras* brought its average production up to nearly 19 mcm/day in Argentina. Today Petrobras is present in two of the major gas basins Neuquina and Austral.

Petrobras sold an average of 8.2 mcm/day of natural gas through short and medium-term contracts with companies and regional distributors as well as the supplying of the thermal power plants. Another large Petrobras company in Argentina is Transportadora de Gas del Sur (TGS), which owns 7400 kilometers of gas pipelines with a transportation capacity of 62 mcm/day or around 50 % of the total transmission capacity. The company also has a gas processing plant in Bahia Blanca, with a processing capacity of 42 mcm/day.

Petrobras' assets in the power sector in Argentina cover the entire production chain. In generation Petrobras Energía control 929 MW of thermal power capacity e.g. through shares in the thermal plant Genelba near Buenos Aires and is also involved in the hydro plant Futaleufu (472 MW) [AGEERA 2005]. In transmission *Petrobras* owns 49.99% of the operator of the national high voltage grid, Transener SA, and also 9.19 % in before mentioned Transba SA. In distribution *Petrobras* has 48.5 % shares in Edesur SA, which supply 18 % of the Argentinean electricity demand [Petrobras 2005].

Petrobras states that in the power sector its goal is to be a regional integrator that produce electricity mainly by own gas reserves and that its objective is to obtain a large regional expansion within the power sector [Petrobras 2005]. Further in its "Strategic Plan 2015" *Petrobras* outlines about Gas & Energy that it will "develop the natural gas industry, seeking to assure placement of *Petrobras*` natural gas, acting in an integrated manner with other Company units throughout the entire productive chain in Brazil and other Southern Cone countries." And it will "operate in the electric energy business so as to assure the natural gas market and oil products marketed by *Petrobras*." [Petrobras 2004].

Together these three multinational energy companies hold a significant share of the power generation capacity in Argentina and they signal a trend that has already been seen in many OECD countries. Growing risks in liberalised markets are hedged by merging companies and assets [IEA, 2003c]. The trend goes towards bigger units and more concentration.

Being the major gas producers, transporters and distributors and involved in power generation and distribution gives the companies an extreme advantage to manage price volatility in natural gas and electricity by either generating power or selling the gas whatever is more profitable. In this position they have a considerable advantage compared to other power generation companies.

The fact that *Total* and *Petrobras* also hold hydro plants assets could indicate that they spread their risks, but also the fact that they want to be major regional energy companies delivering all sorts of energy supply.

Looking at their assets and strategies there is no doubt that they will seek to strengthen their integrated downstream gas activities as they try to pursue all levels of the value chain. They all want to be dominant regional energy suppliers. Further this possibility of hedging risks and profiting from their gas market position will likely lead to more investment in gas-fired power generation in the future.

Although the electricity sector has been privatised, **the State** still owns parts or whole power plants. This is for example the case with both the nuclear power plants, which are because of security reasons on governmental hands. Also the two largest hydro power plants, Yacyretá and Salto Grande are bi-nationally owed. The State therefore still is a large player on the electricity market. Unlike the private investors, the State has some economic considerations at a more macroeconomic level than the private investors. From a macroeconomic perspective hydro power becomes more attractive, as hydro power is, contrary to for example gas power plants, build on-site. This means that hydro projects create new jobs, which at the same time means that less hardware have to be imported. Hydro projects can also create some secondary effects such as irrigation [SDE 2002]. Furthermore hydro power does not consume gas and does thereby not contribute to the increasing scarcity.
This strategy is confirmed by the National Energy Plan, in which the State plans to look into new hydro power projects. [SDE 2002], [National Energy Plan 2004]

9.3 Summary

With the privatisation experienced in Argentina the management of the power sector lies to a very large extent in the hands of private agents. From the above analysis of the investment environment and investor preferences it can be concluded that “normalisation” of the power sector as for regulatory safety, concessions, and prices are of crucial importance to further investment in capacity additions. In the present very risky investment environment it is unlikely that any private player will invest. This was also confirmed by interviews with many power sector experts in Argentina. The normalisation is however impeded by the tendency that the government has protected the customers from a radical price jump, which will be an inevitable consequence.
In the liberalised market one way to deal with the high risks in Argentina has been by oil and gas companies entering power generation. The strong interrelationship between energy industries was emphasised by looking at the position of the three biggest oil and gas companies in Argentina, Repsol-YPF, Total and Petrobras, whom all will be able to hedge the risks in the electricity market and profit from their participation both upstream and downstream in natural gas.
Their strategies are likely to indicate a common trend or even condition the remaining ones’ decisions as they deliver gas to the region. At the same time they have the regional basis to become investors in power generation when the investment environment betters.
The State is still a relatively large player on the electricity market. Unlike the private investors, the State has some economic considerations at a more macroeconomic level than the private investors. From a macroeconomic perspective hydro power becomes more attractive, as hydro power is, contrary to for example gas power plants, build on-site. This means that hydro projects create new jobs, which at the same time means that less have to be imported. Hydro projects can also create some important secondary effects such as irrigation.

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APPENDIX 9 – DELPHI INTERVIEW GUIDE AND INTERVIEWS

In this appendix the Delphi Interview Guide and interviews from the first round of the Delphi Forecast of the Argentinean power sector is presented.

The Guide is structured around the open question about the development of the power sector technologies. The specific questions following were used to get additional information whenever this was necessary or to confirm underlying trends in the power sector. They have therefore not been used in all interviews.

Important parts of 3 interviews have been transcribed and are presented together with a mail response to the first round open question. A number of experts would not have their interviews published and for the sake of anonymity no names are put on the transcribed ones.

Interview guide

Somos estudiantes de ingeniería civil de la Universidad Técnica de Dinamarca y estamos haciendo un parte de nuestra tesis principal acá, en colaboración con Fundación Bariloche.

Estamos haciendo un escenario para el sector eléctrico de Argentina. Trabajamos en el contexto mecanismo de desarrollo limpio (MDL) con una evaluación del método vigente del UNFCCC para hacer lineas de base.

El método Delphi usa opiniones sobre el desarrollo del sistema de los expertos en el ámbito del sector eléctrico. En este método hacemos dos turnos.
El primero donde, en nuestro caso, hacemos preguntas abiertas a través de entrevistas con aproximadamente 9 expertos. Después vamos a juntar las respuestas para establecer un escenario del sector. Todas las respuestas van a aparecer anónimas en el escenario.
El segundo turno vamos a mandar un cuestionario con preguntas mas especificas.

Preguntas para el Método Delphi:

- ¿Qué perspectivas hay a mediano plazo (10 años) para las diferentes tecnologías en el sector eléctrico (Gas, hidroeléctrico, nuclear, petróleo, carbón y nuevas fuentes renovables)?

- ¿Por qué cree usted que el desarrollo va a estar así?
- ¿Qué influye este desarrollo?
- ¿Es posible decir exactamente qué centrales o ampliaciones de centrales se va a construir?
- ¿Qué centrales va a cerrar en el periodo?

Inversores

¿Cuáles son los factores más importantes para los inversores?

¿Qué son las perspectivas para estos aspectos dentro 10 años?
¿Qué son los aspectos mas importante para los inversores en el sector gas?
¿Qué son las perspectivas para estos aspectos dentro 10 años?
¿Van a invertir suficiente en equipo nuevo para sustentar el abastecimiento de electricidad?

Aspectos economicos

¿Qué son las influencias mas importante de la devaluación en el sector eléctrico?

El rol del Estado y el marco regulatorio

¿Además de la ley 24065 qué son las leyes mas importantes para el comportamiento del sector eléctrico?
¿Qué métodos tiene el Estado para regular las inversiones, mantenimiento y ampliación del sistema eléctrico en relación al sector privado?
¿Hay alguna posibilidad que el Estado vaya a aumentar su influencia en el sector eléctrico otra vez?
¿Qué rol tiene ENARSA y que rol va a tener en el futuro como actor en el sector eléctrico?
¿Hay planes políticos para renovar el marco institucional del sector eléctrico?
¿Cómo se puede describir el político en el ambito del energía y electricidad antes 2002?
¿Y despues?

Precio del electricidad

¿Cómo esta fijado el precio de la electricidad? Qué elementos esta incluido en el precio? Leimos que el precio es muy bajo en comparación de los costos. Que son las perspectivas para esto desarrollo?
¿Cómo funciona el Fondo de estabilisación?

Ampliación de la red eléctrica

¿Qué tan importante es la reserva del sistema eléctrico?
¿Puede funcionar como un "parachoques" para abastecer el crecimiento de la demanda?
¿Hasta que año?
¿Qué significa la ampliación de la red eléctrica para el sistema eléctrico?
¿Para la eficiencia y la operación de las centrales?
¿Qué son las perspectivas para las interconexiones en el norte (Cobos- Resistencia), y en el oeste (Chocon Oeste – Los Reyunos)?
¿Quién van a invertir?
¿Qué significa esas interconexiones para el abastecimiento de la electricidad y la operación/ampliación de las centrales?

Gas natural

¿Es probable que la ampliación de la red troncal de gas natural sea suficiente para el abastecimiento de las centrales de gas existente y el aumento de gas probable en el sector eléctrico a mediano plazo?
¿Es probable que el precio del gas suba a mediano plazo?
¿Hay una correlación entre el precio del gas y el precio de la electricidad?

¿Con la falta de inversiones en el sector eléctrico, es posible que Argentina necesite importar electricidad de sus vecinos para suministrar el crecimiento de la demanda?
¿Cómo esta fijado el precio del gas?
¿Qué elementos esta incluido en el precio?

Importción / Exportación

¿Con la falta de inversiones en el sector eléctrico, es posible que Argentina necesite importar electricidad de su vecinos para suministrar el crecimiento de la demanda?
¿En su opinión qué será el tamaño de la importación y exportación a corto y mediano plazo?
¿Cómo influye el importación/exportación el funcionamiento del sistema eléctrico?

Interconexiones

¿Qué son las perspectivas para las interconexiones en el norte (Cobos- Resistencia), y en el oeste (Chocon Oeste – Los Reyunos)?
¿Quién van a invertir?
¿Qué significa esas interconexiones para el abastacimiento de la electricidad y la operación/ampliación de las centrales?

Signature explanation for the interviews:

marks questions from the interviewer.
When no # is given it is the expert talking.
Dots like "…." signifies a small break.
A question mark (?) in the middle of a sentence signifies bad recording, which was impossible to transcribe.

Interview A

[A] has a map with the different power sector technologies on the table.

[Start of the interview after the introduction and the open question]:

Ahora primer punto.
Cómo ...va a estar la situación en el futuro en 10 años.

Un experto puede decir. Pero aca hay unos actores tan diversos participando de las disiciones. Bueno, las dicisiones politicas, las tiene la Secretaria de Energía…pero en hecho del sector de hidrocarburo...la producción esta liberada significa que el gas no aparece...nadie obliga que se aparezca .....por lo tanto...se supone que el gas no deberia ...hacer (¿) su participación.....por que nosotros tenemos que (¿) hacer gas de crecientes...

Ahora, tambien se dice que la mejor...las exportaciones a Chile se cortan...si las exportaciones a Chile se cortan esto puede crecer. (She is probably pointing at the gas share of the map!).

019
<u># ¿Pero tambien si se realisa este ampliación del **gasoducto de Bolivia**? #</u>

Pero Bolivia tiene su complicación politica...entonces, si se amplia ...esto puede crecer.

Por que el nuclear va a cargar...hay una central, **Atucha II**, que posiblemente entra en este periodo...etonces esto cree un poquito...
La elevación de la cota de **Yacerita**...puede modificar...

<u># ¿Y algo mas?</u>

Garabi. Ahora esta apereciendo ....hidroelectrica con Brazil y aparece con bastante fuerza. Como que interesadas inversores....

029
<u># ¿Hay...?</u>

Aparecemente...
El funcionamiento mas grande...(¿) ambiental (¿)...parece que se va a superando. Pero creo que modifica el proyecto ...no se exactamente... Podriamos chequear que potencia...
Creo que no va a modificar mucho en 10 años....

[Looking at the map again!].

Creo esto un poquito, y esto un poquito...

Y gas no vamos a poder ... es insostenible....estamos exportando gas.....y concrando (¿) fuel? ...
Creo que va a estar **algun instalación aditional de gas**. Ya (¿) y **dos que el gobierno va a colocar con los generadores**.
Entonces yo creo que este..(...) (¿) la structura de generación.

045

¿Y con carbón?

Carbón...no la veo...

Y petróleo que es fuel oil...Fuel un poquito va a crecer por que...esta importado de Bolivia, pero muy poquito...digamos...
Nuevos centrales quemando fuel, dudo que se incorpora....No creo que se incorpora.
Por que es mas cara y por que es fuel importado.

¿Pero hay centrales hoy que solomente quema...?

Solo fuel no. Son duales.

Hay 0.1 por ciento del abastacemiento que es de diesel en el MEM.

Tiene diesel ...
Pero tambien tienen centrales termicas grandes que quema gas o fuel.

058
Si en la ventana...durante el invierno.

Durante invierno y ahora con la crisis de gas ....se importó...

¿Ahorita?

Creo que hay alguin que esta quemando...me pareció que esta en CAMMESA.
Pero en dos maneras es una cosa estructural....yo para mi esto no.

063
¿Qué pasa con el **central de carbón**?

La San Nicolas...

¿Si....continua o cerra o...?

Yo no creo que la cierran. Por que hay un contrato con Rio Turbio....y Rio Turbio esta cerrada ahora por una acidente grave ...pero creo que le van a reabrir por que tiene un impacto local importante.
No por que el carbón...por un cuestion...digamos un dicisión politica de todo esto pueblo no (¿)aparezca(¿) ...**Pero no creo que va a estar mas generación** ....que esta en el central San Nicolas...la otro esta en Bahia Blanca, pero creo que no quema carbón.

076
¿No va a ampliar....?

Ampliar...yo creo que turbo vapor esta mas cara que un TG o ciclo combinado por kW instalado.
Creo que seria un dicisión estrategica y no pensando en hidro electrica y no pensando en el carbón que esta aca...en el sur.
No se, no se....

Nosotros una vez decimos en un escenario que presentamos para Bio-batel.
En donde, si todo esto esta dejaba a la dicisión del mercado. Ibamos a terminar con un indebilidad total del resto y quemando carbón solamente que lo que tenemos. ...pero es una locura....un situación muy dramatica, asi que no hay otra cosa....Hay que invertir tambien.

091
<u># ¿Entonces solo va a continuar por causas politicas?</u>

Yo creo que si.

<u># ¿Y con los **centrales nucleares**?</u>

Yo creo que **nuevas no**. **Creo que van a terminar Atucha II.**

¿Crees...no es seguramente?

Bueno no... digamos....es la unica que...puede hacerse....es cara...terminar la tambien....estan todavia peleando quien la va a terminar ...que sea los franceses o sea....Es una cosa cara.
No creo que haya fondos para instalar nuevos.

101
<u># ¿Entonces solo esto...?</u>

Solo esto...

<u># ¿Hidro?</u>

Hidro...asi bien aparece...**Garabi**...y aparece **elevar la cota de Yacyretá**.

104
<u># ¿Qué es la situación con Garabi ahora...dices que hay inversores...?</u>
...
Habría...es lo unico que les dijo...habría.
...

<u># Si, un poquito, pero muy general ....</u>

No hay tanto.

<u># Tenia mucho interese en hidro generalmente y por eso creo que estaba muy pro hidro.</u>

No, no...hojo Brazil...no queriendo .....abandonar la alternativa....golpe..........quemar gas de Bolivia...todo térmico...

Finalmente hidro es lo que garantiza el abastacemiento ...si tiene una crisis...
Y todvia no podria mandar a nosotros....

Se van a ampliar la linea ....esto si es importante...

121

¿Qué son las perspectivas para la ampliación...?
...
Pero en esto momento .....capacidad para 500 ...
Necesitan mas....hay dos contratos de 500....ellos tienen mucho mas para...mandar a nosotros....realmente para nosotros seria...

¿Quién va a realizar este ampliación? Qué son los posibilidades?

No se.... a quien le favorece....

Interview B

[Start of the interview after the introduction]:

The first opening question is: If we look at the technologies in the market there are different possibilities…you have almost all of them on the market.

Yes, we have a very broad range of technologies in generation.

How do you see the future in a ten year perspective…and we choose this because that is what they do in the UNFCCC framework…they have this horizon …

014
Lets just take them from one end. The renewable energy sources, is there any future and how does it look?

Well, first of all I would like to talk about the big numbers. We had about 6000 MW installed in the last 5 years…or from 1998 to 2001…of combined cycle power plants. Natural gas fuel, ok.

022
That was our change, we used to have a dual oil gas steam power plants and now we are based absolutely on combined cycle power plants. But then we don't have gas anymore. … So we are beginning to have problems with availability of natural gas…as for production and transportation of gas. We have two problems…

029
Transportation of gas has always been a problem in winters.
The system is regulatory and economically designed to have…a certain limit for the availability of gas for power plants…..but now we are facing a new scenario, that is lack of production of gas…also due to devaluation …lack of incentives for exploration of new reservoirs…
Macroeconomic issues….so we are in the middle of a microeconomic system…and we have to experience this kind of problem…

043
We used to be with overcapacity and now from 2007-2008 we will lack capacity.

We don’t have any plans that will be under construction …or under planning from now and until 2007. There are no plans.

048
But there is this governmentally planned ??

Yes, but this is in the stage of a project…It is not defined where it would be. Maybe here… But they have not found the financing or the provider…many problems could occur.

053
One of the most difficult problems to solve is from where the gas will come to fuel that new equipment…because Bolivia was suppose to be the provider…and they have political problems…very difficult to solve. Ethnic problems and social problems…
And from the south of Argentina there is…Carina...far south…in Tierra del Fuego…there is an off-shore not developed reservoir.

064
But it has to…it needs time and money to …
I talked to some of the specialists in the field. They need three years or so…to be sure that they can fuel 15 mill cubic meters per day. That is what is needed.
071
And then you need 1500 km of pipeline…
So nothing is easy in this country…
If you asked me this question in 1996 I would have said, well, we would be developing our next future in **combined cycle power** plants…that is very efficient equipment…and very efficient capacity. And that was true.

078
And today I would say…well, any thermal power plant of huge amount that will be installed…surely will be combined cycle plants…because we need 600 MW per year…so that will continue.
But it should combine with other resources.
That is we have **Yacyretá**, that is a hydro power plant…but the plant is so constructed…
086
...the machines are ok. The only thing we have to do is to rise 7 meter the… flood some areas and we have 700 mill of water…I think it will be finished…
The only thing we need to do is some natural dams…

095
So finance is there?
Finance and politics…
I think more politics than finance…because the main problem is arranging with Paraguay. The value of the flooded land. Then it is a political issue and economical also…because the paraguayans want to value their land as if it was Manhattan.

105
Is that because they don’t really need it?
Yes, they are with an overcapacity.
They have rights for half of the generation of Itaipu…that is 6300 MW for them and they have 500 MW demand, so they dont…

And it is not a very clean government…(…)
114
Financing I don't think it is the greatest problem…but that is…talking not as an expert, but as someone who reads the newspaper.
But the main problem is to get to an arrangement between Paraguay, Argentina and the World Bank.

But since we are facing a shortage of energy I think this will be solved. So you have 700 MW of hydro…of an increase in the capacity of Yacyretá…I think it would happen.

122
The same I think will happen with **Atucha II**.
Atucha II I remember when I began working as an engineer in energetic…was suppose to be done in 5 years…in 1987 I began…we are in 2005 and also …it is 5 years long…

128
But since the cost of natural gas…transport , production…and financing of natural gas development…is very, very expensive…
And characteristics of our new government. That is more State oriented…for intervention and so. Nuclear plants are State…

134
So I think Atucha also will be developed…but in 2012 or something like that.
I don't think it will be in 2009 or 2010…
They say in 2008, but I think 3 or 4 years later, but finally, eventually I think they will finish it…

139
What about more plans for nuclear?

I don't think so….because Atucha II is a project that…it costs more to shut it down than to follow it…but again getting to that issue …and where… I think it is impossible…another …because it requires so much political power and I don't think it is the best option also. The world is not going in that way.
So…I think this will be finished because it is there and …it is a need now…also …the past years it was not necessary, because we had all this plants coming on…and because gas was cheap. Now gas and liquid fuels are getting higher prices…so it is real an option to finish Atucha II…but not to begin a new one. I don't think.

155
What I think …may be some projects with Brazil, **Garabi**, will be developed. And it is necessary to develop a balanced way…between solid fuels, liquid fuels, natural gas and hydro plants…
I think we should go that way…

161
Is that because the system runs better or because of national independence…?

No, I think the system will run better that way…besides we are not…I see us as an appendix of Brazil. Brazil has 55000 MW demand, we have 10000, so …everything is times five.
Brazil has 95 % of their energy as hydro plants…so they have a large amount of capacity…and they need some firm energy.

170
I think and hope that in the future the integration between the two countries …in our last years report we encouraged that ….a new line from Yacyretá to Buenos Aires should be made in order to get benefit of good hydro years in Brazil. A typical reserve analysis…when we have gas.

178
There are many pipelines …many extra **high voltage lines** as projects. I don't know which of them will be true or not…we try to define an order from our view a dispatch point of view…..was first of all the line from Yacyretá to Buenos Aires.

189
And all the rest are lines that may help in a very long time to close the grid…and to get better the quality of service and reliability…because when you close rings you get a stronger system, but it will not help in this phase. That is when you are facing shortage of energy, we should add lines that give you more energy.
Quality is another issue. It is when you have enough generation capacity….

195
Comahue has many hydro plants. That is where I used to work.
And we used to have a strong limit, strong restriction of energy from Comahue to Buenos Aires. Two things: A fourth line from Comahue to Buenos Aires helped and the growth of local demand helped to have little restrictions, so there is another line planned from Comahue to Cushu(??) other side of the Andes… But it wont help to get much more energy into the market. ….Just reliability and particularly we know we have a certain risk that the nuclear plant that is in Cordoba if it has a serious problem, that might happen with a nuclear plant, they will have a problem with reliability and quality in the Northern… the area Cordoba, Mendoza and the North, this NOA. …that is "What if"…if Embalse fails we will have problems.

212
So it is not making so much more efficiency…?

No,…

Does it mean anything to the dispatch of those plants lying in the far West ??

Yes, it helps to reduce a little the losses and it helps a little in reliability, because when the line drops…you have another way to keep it up. But it is not a big solution for anything. It is just a good line to insure that Cushu has better quality and to insure that Cordoba has quality. And maybe to export to Chile, but if we have problems in exporting gas, more difficult to exporting energy.

225
So that was a scenario the line from Cushu(?) to Comahue and the line from NOA, Tucuman to Yacyretá …it was under the scenario of Argentina as a big exporter…that is 1998.

228
So, now you see it more as ideological plans?

It has not economically sense in the short term. In the long term you need to build interconnections because you create opportunities. Then you can install new generators…but and now I am speaking as a citizen. If I don't have enough money to pay for the generators to generate energy that I need to consume today…or pay the installing of new generator to cope with the demand of the next few years it doesn't seem logical to spent money in what I will need in ten years. But also politics influence and they are seen as regional victories of governors. They can go and say we have been interconnected. We have a new connection in Mendoza, so the governor will have a victory.

241
But what about…**Transener** is private now and if they don't see any advantages in closing the ring?

No, they see advantages, because for Transener it is a win-win, because they operate with less problems…they construct, maybe they build the lines, so they get money… and then they operate the lines…a stronger transmission system it is less conflictive for Transener than a weaker one, because if they stress the transmission system and then one line fails. Then everyone will see that we have a restriction and that Transener should hurry up in building…in solving the problem…if there is more reserve politically(?)…And they have build lines, so…it is a good business for them.

253
The regulative part is happy with Transener, because they will have less stress over the system…and the unregulative part is happy because maybe they win the bit and they build the line. So for Transener it is a win-win.

256
But who is going to build the connections to Brazil?

To Brazil…maybe it will be Transener…I don't know…

Petrobras is behind Transener, no?

Yes, today Petrobras is behind Transener…I think they have…because they have bought Techint…the energy part of Techint…Pericompan(?), which is one of the biggest national conglomerate. As Techint or as Macril(?)…They used to build…and oil …they used to owe as I remember it now…Genelba, that is a power plant in Ezeiza and Pichipulafue(?) that is a plant near (?)….a hydro power plant. Part of TGS or TGN I don't know which of them, Gazafortas(?) and Transener.

270
And when they bought, that was in the Duhalde government, 2002, when Petrobras bought Pericompan (??), it was suppose to sell Transener. Because it was seen as a strategic…
I read the other day that maybe they will be selling it and maybe a buyer that is Minding(?)…a local company.
But still it hasn't happened. So Petrobras and Transener are related today. But I don't think…they are just running a business.

280
They know they have to sell it…it was a political…between governments. In the short term or the long term it will be sold.

282

Returning to the different technologies…we have talked about most of them, but how do you see the **investments**. You have probably made some analysis. You say that you see no future plans or no solid plans for new power plants at the moment?

That's what I said. We don't see any plants that are being build, but surely we will have **a couple of 800 MW combined cycle plants**…and maybe some open cycle plants…to shorten the time of construction…

From private hands?

From private hands. I don't think thermal plants would be build by the State. Yes, I think they will strongly support hydro plants…I imagine **Garabi** will begin again to…because it is both an interest for Argentina and Brazil...

294
…and within 10 years, is that possible?

Yes, yes...5 years, 6 years of construction.

And then I think the distribution of generation….
I hope that to solve…in certain areas, we are talking about little amounts of generation…instead of building new lines of regional transmission, 152 kV…instead of building new lines that are with little use, I think we should be constructing **local generation**. It is locally with a shortage of energy, because it helps to solve electrical problems….In long lines we have voltage problems in the end in the line…and then it can be gas turbines or motors…

Ok, with fuel oil?

I think we should run them on natural gas…but if they are dual it is better, because then we can use them in winter and summer. And in summer we should have gas available for that type of energy and they can help also under hydro dry years.

311
So…it is a good way to lower the cost of investments….that is not the market oriented solution, but I think it has sense, that is if you don't have capacity….don't waste your money in long lines to insure reliability…put local generation, maybe it can also be run by transmission companies. Because they solve mostly the regional problems…or by distribution companies…but it is against the model.

But from what I have seen in every part of the world that problem is not easy to solve through market signals.

320
So…and in our system that is so wide…you have long, long distances…so that kind of problems can be addressed that way….and should, I think.
That will help a little to certain areas…..you can put open cycle, TGTs or motors to solve electrical problems….and then to be back-up for the…as a reserve for the market…

325
And you think the gas will be provided?

For that kind of models, yes, ….this kind of problems we have in the North West…that is very near the gas wells…so I think that is a good place and then we have problems in the summer in the coast, because of the tourism. But in summer we have gas…If price is ok, we will have gas.

The price is regulated, so there are no new investments before the price goes up…or?

You are talking about **gas price**?

Yes!

Last year there was a pact (?) …we began with 0.4 dollars for million Btu(?) …gas price, only product…and many increases from last year to now…to July 2005 we are landing on one dollars per million Btu…that is still cheap in the global market.

338
And Bolivia wants more?

Bolivia wants two dollars or….now it was 1.4, but Argentina is exporting at 1.4, so there is a regional negotiation between Brazil, Bolivia, Argentina and Chile.
And the price will be…but …the negotiation might end there ….
But Bolivia is under political problems…so it is not easy…to set a price for the whole region…

344
You never think the gas price will go so high that gas will not be the best solution?

I don't think, because it is also related with **alternative fuels pricing**….
That is just a guess, but it is difficult to get back to 11 dollars per barrel. I don't know if it will be 50 forever, but maybe 30…but 11 not any more.
So with 30 dollars per barrel, we can pay 3 dollars per million Btu…4… and it will still be cheaper than fuel, so …and from and environmental point of view and from the operational …gas is very easy to operate…you just turn on the machine…..so you don't have to worry about shit…
The efficiency of the plants also….they have less problems... So I think the gas for the thermal generation will be the solution.

356
No **coal** ?

No, coal, no. …We have only one plant available, San Nicolas, that can function with coal. It is ok, but noone will build a coal plant. We don't have brown coal like in Australia that it is like water…infinite amount of coal. And we had last year problems with Rio Turbio, the mine, so I don't think coal … is not going to be the …
and liquid fuels it is very difficult to maintain a long term…[Interruption]

370
Is it possible to listen to this presentation or is it not public?

No, it is still not…it is in the directors of CAMMESA.
(…)

377
This year we have to evaluate the amount of MW to adapt the system by 2007….so it is a very political report.
(…)
So we have presented an energetic part. And then tomorrow it is the electrical part. Which new lines are necessary and all that, but it is still not approved by the directors…the board of CAMMESA and when it is approved (…)

394
Well, we who operate the system see every day what happens when we don't have gas available….

<u># Will any of the **old plants** leave the system or do you need them to be there as back up?</u>

I think what will happen…the old, old plants cannot be because it is the same…you cannot dismantle…a steam power plant from 1960 or 1980. It has no economic sense…just what may happen…and that is a problem that may happen with old plants is that a major figure may have an impact on the access of a generator…or the turbine or …and maybe they don't fix it.

414
As I said, I imagine this, it is not easy to dismantle a plant… just gas turbines maybe.

That happened up in Phoenix. It was four 40 MW power plants …and they dismantled them and …California crisis and …

But we had a problem in the south in Commodore Rivaria… it was 3 years shut down and then we sell it now and it began to work again.
I don't imagine…. not a steam power plants nor a combined cycle.
And government would not let it anyway.
Anyway it is very expensive to dismantle a combined cycle plant….it is about 50 million dollars…and noone does that.

424
<u># I am just thinking that if they want to be a reserve they need to maintain them…or they will never get dispatched?</u>

They are all amortised the plants, so they get paid even though they are not dispatched. They get a capacity payment. So if they are available they get money…enough to cover the vital costs and maybe to maintain the plant…
And they have the people also… they have a problem if they …old plants have people… they have maintenance and equipment and people so with the money they receive they seem to maintain the plants …under an operation not very stressed.
The problem may occur that since we lack capacity we begin to use them more frequently and then the maintenance they receive is not enough to attend that kind of stress. And then it can break and …if it is a major break maybe it will not be economically viable to repair it. So I think that will happen…

438
Some plants will have huge problems and will not run anymore, because it will not be economically feasible.

439

I heard from one part that maybe some of the old plants are cheaper to maintain than the new ones…because the new ones have to pay in dollars for the equipment coming from abroad... and the old ones can more or less sustain.

Yes, but the resolution number 8, 2002…included in the variable costs, the variable cost for operation and maintenance and it was done in a moment where the dollars came out and reached the 4 pesos per dollars. So in pesos they are receiving about 9 pesos per MWh, that is 3 dollars per MWh…for maintenance and operation and that is a fair number for the combined cycle…It is more expensive to maintain them, but the are receiving the money to do it and they are running…and so maybe an old plant can make a little bit of profit of that number…so I think they are receiving just enough to maintain the plant…if they don't have a big problem they are making money with that. The main problem is financing the availability of fuel and they have a risk there, because if they buy fuel…because we have regulation to…where cut prices are acknowledged for each kind of fuel…

So if you buy fuel at 200 dollars per ton and then the fuel goes down…we recognise only maybe 180 …and with this big fuel cost that is a risk…so last year there was an agreement between Venezuela and Argentina…and they are just operating the fuel not managing it. So I think that is the main risk they have economically …that is managing the fuel and …if they have to buy fuel they have a risk.
Because if they do bad business they can loose all the revenue of the year.

461
Finally just about the renewables. How do you see them entering the market if they do so? They are expensive, but are they governmentally subsidised?

I think the windmills in the South…there are many MW now... and I think it will have a strong support from the government…but I don't know if they have money…support is ok, but money… Because the installation cost is very expensive, but we have got… everything is getting more expensive…if we are lucky they are getting more even …and …

But with the new line?

But that line is economic absurd absolutely…I don't know how it will operate. Because they don't have load nor generation so 400 km of nothing…

Will it be unstable?

So long that it should be compensated…so that is a political act…

474
… and Aluar needs it?

Not badly, …if a project in Aluar in the South is ok, it will be a good one…but if not.
…and if it is so interesting to Aluar, they should be building it.

I think they put like 30 % in it?

Yes, but that is maybe because I am explaining myself badly. The line between Choele-choele and Puerto Madryn is perfect. It integrates the system, it is an integration line, not very important in terms of energy…but it is a good line.

The line between Puerto Madryn to Pico Troncado is absolutely absurd. No people are living there. It is very political and very expensive line. But of course in 20 years maybe you have 1000 MW of wind mills installed around there and you can bring them to the market, but that is in a long time…it is not in a 10 year outlook.

483
<u># But there are no government incentives or economic incentives to build wind mills?</u>

Yes, they have…I don't know the number…it is about 13 dollars per kW installed or something like that. But don't take it as a fact (…). That is a specifically regulation. We (CAMMESA) have to do something….trans section…but I don't remember well how it was the mechanism.

Each MW that is generated by wind power has a benefit and we calculate it and send the number to the ENRE and ….I don't know how we finished it, but …
They have an economic incentive…I don't know if it is clear…for the investors…If it is defined…it is in pesos surely. So, it has certain risks…

And the other kind of renewables…hydro…

494
<u># And there is still a big unused potential?</u>

Yes, yes…….from the optimal point of view the integration between Argentina and Brazil would be…the optimum. A social optimum…

<u># And that will happen within 10 years?</u>

Not as strong as a global optimum, but it will be (important) for us to solve the regional problem… Also the governments of Brazil and Argentina are more alike today. In a way the same so…that helps in a certain way…I don't know if it is good or bad.
That is how I see it now.

I think also to solve our problems more than investment in capacity we should invest in rational use of energy. We don't waste a lot. We are not America, but it can help. It is so easy to save and I think it should be done with market signals and prices.

506
<u># Are there any plans at the moment?</u>

Last year there was a programme, but I think it was not effective. Effectiveness of saving plans depends more on political issues than technical. The perfect plan to save energy if it has not a good political drive it helps nothing. But a bad plan with an encouragement from the government will help. The best way for me…is the price…but in a moment where all the companies are under political stress, because they are not well-seen by the community. It doesn't help to install the price issue on the savings, because it is difficult …

514
But prices will go up?

Prices will go up. Today or tomorrow they will go up.

You mean that they are negotiating now or …?

We are talking …all what is commercial and industrial activities...the prices for the product…the energy (electricity) have gone up…and they are reflecting the costs…more or less.

516
With the new rise?

Just for the wholesale price. The distribution and transmission it is still under negotiation…that is the added value distribution and transmission…
So, one day or another prices for residential consumers will rise. … I here in Santa Fe pay 3 times what Buenos Aires pay. I as a residential consumer…because here we have a State company…that the prices are political prices…related more with the needs to maintain the company and to get money for the government. It can be well used or bad used but there…what we see here in Rosario…for the same product we are paying 3 times of in Buenos Aires, Capital… So it is a political problem to say that the energy is not cheap….that it is expensive…because in Buenos Aires it is not expensive.

527
Generators claim it is too low the price…?

Yes, the price is low…it should be raised, because if not the ….costs are not covered. It is as simple as that.

…and that will happen in 2 years…3 years?

It is planned to be liberalised …adapted in 2007. But we will see. I don't think it will happen.

But it will go slowly up or they don't want to touch it…?

At one moment they have to …because a certain part of the community….that cannot pay much more. Because they cannot pay….they cannot eat. They don't have work…so that should be subsidised…social tariffs or something like that…and then the other part of the residential demand…it is capable to pay the real cost of energy…so I think they will slowly…but

535
They didn't do anything this year…?

No, because this year we have elections…maybe 2006. In 2005 only the industrial and commercial consumers will receive (a raise?)…but the residential will not receive…in 2006 maybe.

539
That is interesting, because I had not thought about the …

First it was the debt and now the election…but they will have to raise the price because if not, noone will generate…it is impossible. And the government has not got the knowledge to manage again companies. It is very difficult.
It is not like other parts of the society where …when you choose topic today saying we will manage everything and create a company…at the end of the day the demand will be there…and you will not be able to solve it.
So, going back to savings I think savings should be the complement of investments … And it is very important from the social point of view. The optic of the society…what optic the society should have for the use of energy.
It doesn't matter if it is cheap or not. What is important is that it is an infinite resource, and I think it is easier…it is easier to change the bulbs than to invest in new plants.

551
And it can be used for this kind of government…leftist. And it fits in the kind of …but they should be aware of the importance of ...anyway people want comfort…comfort and it should be cheap. So it is not possible to have the two things…cheap energy and comfort…you should forget about.

So, Brazil made an incredible work when they had their crisis…the lowered 20 % their demand.

It was a combination of capacity installed by industrials…and commercial reduce and very strong tariffs if you consumed more…and Fernando Rodriuge Cardozo (?), that was the President and the minister, were everywhere in the media. And it was like a competition of which State saved more. So, it was a very proactive way to solve the problem. I haven't seen any place in the world…that can make…all this kind of rational consumers and 2 % is a big success.
So it is marginal, but in this case it was 20%…incredible. And also I remember Rio Janeiro half lights everywhere.
All the hotels began to have this intelligent light and then you have to, to turn on the light of your room...you have to put your card and then you go out and then you insure that air-conditioner and lights go off. It is a very intelligent way.
So, when you add many, many of them and I think it creates consciousness. And that is very important.

So that is my view. I think we got around.

<u># Yes, I think we covered all the issues I had on the table.
I thank you very much for your time and knowledge, not least, because it has really been a good insight.</u>

<u>Interview C</u>

[Start of the interview after the introduction]:

028
<u># El pregunta que es un pregunta muy grande y muy abierta es:
¿En tu opinion personal qué son las perspectivas en el medio plaza dentro 10 años para las tecnologías para hacer electricidad aqui en Argentina?</u>

Todos las technologias en general …..

036
En general la Argentina en lo que respecta de la energía **eólica** y la energía **solar**.
Solar hay muy poco . .. se utiliza no para generación electrica, pero en usos en comunidades muy elajadas…langt væk (?)… que utiliza paneles solares para carga bateria por ejemplo.
La energía **eólica** no entramos en el balance intenacional por que estamos menos de 100 MW de potencia instalada.
Hay centrales eólicas en todo el pais pero estamos menos de 100 MW.

(Solar hay muy
Energis eólica y energía solar.)

047
Pero hay una central que tiene autorisación de la secretaria energía que esta en …..Bario o vario o algo BLANCA
…que tiene 170 MW y esa central …. Le va a construir muy rapidamente…..pero ha un problema economica hubo…y esta un poco en stand-by.

Pero esa seria lo que (…) pasar a figurar en el contexto internacional.

056
<u># ¿Entonces te parace que las perspectivas para los alternativos son……?</u>

059
Una central **nuclear** mas…**Atucha II**. Esta practicamente decidido a terminarla. Tiene un caracteristica muy particular Atucha II. Es lo mismo que el Atucha I. Son los unicos reactores en el mundo de tankes de pression (…) natural
Es el primer …..de Siemens….Atucha

067
Tiene una seguridad muy grande ….por que era el prototipo que pusieron para salir a el mercado internacional. (…)
Canadienses (…) perdimos
La unica central en el mundo (...) que tiene tanke de pression…es nuestra.

074
<u># ¿Hay planes para otros **centrales nucleares**?</u>

En pricipio no…por ahora no.

<u># ¿Por qué no hay inversiones?</u>

Son muy competitivas ahora los centrales nucleares…por que tenemos …cerado el ciclos combustible nuclear...
Tenemos uranium…
Explotamos los minas…
Tenemos el tratemiento…de primario …uranium
Se fabrica (…)

Tenemos una de las plantas del agua pesada mas grande del mundo…que esta en operación.
Obviamente el agua pesado esta usado por los (…)
Argentina tiene cerado el ciclo nuclear…el parque nuclear esta muy avancada en Argentina.
Australia (…)

091
(…) y va a fabricar (…)

Es lo misma que hacen los franceses con los japoneses.
Hay problemas en los organisaciones ecologistas. Hay problemas que dicen (…) nuclear…no tienen idea …. Por que los grandes paises del mundo … (…) llavarse todos los combustibles quemado que hay…. (…) es un error que tiene los organisaciones ecologistas, pero bueno…
Entonces …por el momento, no hay ninguna perspectiva para…entra….mas nuclear.

104
¿Y por qué?

Los recursos son buenos y la tecnología tiene Argentina. (…)
Pero hay… digamos… los inversiones son muy grandes. Es lo mismo con los centrales **Hidráulicas**….
Lo mejor seria **centrales hidráulicas**…pero quien va a hacer …los inversiones en centrales hidráulicas…es mucho dinero.

111
Ademas tienen problemas ambientales muy importantes los centrales hidráulicas.
Hay que hacer profundos estudios ambientales para avitar que…(…)
En Argentina no tuvimos esos problemas…(…)..en los primeras centrales hidráulicas tenemos suerte…y en las ultimas se hicieron estudios (…) que esta Salto Grande que tuvo estudios muy importantes…..es una aprovechamiento binacional …entre Uruguay y Argentina…..estudias muy importante de la parte ambiental…(…) Quito amoniasis (?) Es endémico el escito (?) (…)

120
(…) por que Brazil (…) caracoles que son los que (…) la reproducción de la larva…..
(…) esta muy bien echo.

Yacyretá y Salto Grande ……los estudios….seramente

Pero los inverciones son muy grandes y en Argentina no esta condiciones en este momento……Por ejemplo Corpus…Corpus es una aprovochemiento muy importante… que la famosa discusión que hubo con los brasileños..….por que la costa de Corpus (…) levanta muche….hay una discusión muy importante con eso…esa central …bueno ahora no tengo idea……que vamos a hacer por el momento. Es mucho dinero…
(…) todo el aprovechamiento en el Río Paraná(?)…..en este momento no creo que hay inversiones.
Es necesario ampliar el parque de generación …se va a hacer térmico…

137
…se va a estar **térmico** …y con **ciclos combinados**…..por que no puede instalar otra cosa….
…por que si tu piensas en ciclos turbo vapor…no lo despacha…
Siempre aca en el mercado se despacha los maquinas mas eficientes…..
El despacho nacional de carga va a despachando la maquinas de major eficiencia.

Si nosotros Veiamos un poco mas …..en el año 2001….los máquinas de turbo vapor estaba parada……
Si quiere entra en el mercado competitiva….. tiene que tener ciclo combinada….

147
¿Hay una regulación?

No hay obligación…si queire poner un turbo vapor …que va despacar es otra cosa…economicamente no es rentable…
Un ciclo combinado esta alrededor de 760 MW… con (…)...con todo sistema de agua refrigador ….400 miliones de dollares…mas o menos.

154
¿Las problemas para hidroeléctrico y nuclear es principalmente las inversiones?

Si, las inversiones.
Por que 400 miliones de dolares no es nada….en comparación con un central nuclear o un central hidroeléctrico.

158
¿Este es en el plazo corto…..Qué pasa en 5 años, 6 o 7 años o 10 años?

Yo no puedo……decir nada.
…por que en este pais nunca se sabe.

Aparentemente podria ser de que…estamos aumento mucho el demanda de energía…
por que el pais se quedo …..(faldt meget?)
Y ahora comenzó a recuberar ….estamos recuberando todo que hemos perdiendo.

Por lo cual la demanda empiezó a aumenta.
La epoca en que la estaba privaticado..…la demanda aumentaba mas o menos 5 % por año … es importante.
Despues bajo en el 2001 con el problema que hubo…..y ahora esta recuberado otro vez…

En las condiciones actuales en el parque de generación……no hay vuelta….
Mi idea que me parece…..que si va a tener apliaciones va a estar en ciclo combinados….
Por que la otra inversion implica inversiones del estado.
Los centrales nucleares son nacinales, no son privados.

174
Y las centrales hidráulicas va a tener …(…) inversiones del estado.
(…)
Las unicas que no esta privatisadas son las binacionales….Yacyretá y Salto Grande….
Todos los otros estan privatisados.

178
Pero obviamente hacer una central hidráulica es un inversion muy grande. Entonces no puedo decir que no va a hacer….

Me da la impreción que en los condiciones actuales la salida mas rapida son los ciclos cominados. Ademas son las mas rapidas construir tambien.

184
¿Y para el **carbón** y **petróleo**?

Argentina tiene carbón y tiene petróleo y tiene gas.
El **carbón** que tiene…hay una sola mina…aprovechamiento… que es la Rio Turbio…
Es un carbón que tiene…5500-5600 kilocaloria/kilogramo (…)…..no es un carbón malo. Tiene bajo por ciento de sulfúreo…hay una solo caldera en todo el pais carbónera que esta en San Nicolás.

¿Y solo hay este?

Es una empresa amaricana.
Cuando se privatizó se puso como condición de esta caldena tendría que usar carbón…..Es una caldena que puso 3 combustibles: carbón, fuel oil o gas natural.
Pero se pusó como condición que tenían que usar carbón para mantener el operación del mina.

197
En carbón…..perdiendo pertroleo y perdiendo gas…como tenemos nosotros. Tenemos mucho gas para nosotros….(…) (arregalando)…para el pais. No parece el mas conviniente recoger carbón. Ademas el petróleo, fuel oil nacional ...tiene muy bajo continiendo de sulfúreo….0,5 a 0,6 por cientos….es muy bajo.

202
Pero hay poco….por que se pasó todo a maxima converción….es decir en la destiliria pasa todo de la produción de fuel oil a maxima converción para producir nafta, diesel oil y gas oil….esto trajó como con consequencia que la producción de fuel oil.

206
Cuando, en el año 2004, nos quedamos practicamente con muy bajo cantidad de gas natural…..
En Argentina …a los primeros que se corta el gas, cuando hay deficiencia de gas, son centrales termicas por que tienen un combustible alternativo.
Despues se lo corta del gas a la industrias.
Y a la parte urbana ….no se corta nunca.

Traeje con consequencia que… si hay poco gas no habia gas para la centrales electrica…tuvimos que quemar fuel oil…por que gas oil en el ciclo combinado es muy caro…entonces tuvimos que quemar fuel oil…para quemar fuel oil no hay cantidades nacionales …...hubo que importar fuel oil….

215
…en cantidades muy importantes…pero fue caro…por que la norma regulatorio nuestras…..no permiten que quemar fuel oil que tiene mas que 1 % de sulfreo…si tiene mas que 1 % de sulfreo….lo pasamos de los limites de emision de sulfreo.
Cual lo cual no se puede…fuel oil con menos de 1 % sulfreo.…es uno de mas caro en el mundo.

219
¿Y por eso es difícil hacer otro centrales de petróleo?

Exactamente. …..a menos que usan gas natural…..pero si usa gas natural el mejor ciclo turbo vapor tiene 40 % (…)…y el ciclo combinado tiene 56 – 57 %…..y no lo despacha nunca.

223
<u># ¿Pero en relación del gas…hemos leido unos cosas sobre el gas aqui en Argentina y….es importante para los inversionistas que el indicador reserva a producción solo esta 19 años?</u>

Usted tiene que saber. Cuantos tiempo tenemos…la reserva de combustible asegurada….para cuantos años tenemos gas natural, para cuantos años tenemos petróleo….

233
<u># ¿…Si pero es importante pero los inversionistas que sólo hay gas… seguramente gas hasta 19 años…?</u>

Si, si, …a menos que descubran nuevas…....por que …..no hay prospecc ahora….
No sabemos …que en otro lugares del país no hay mas gas.
(…) todavia no sabemos…
Pero digamos veinte años….

240
<u># ¿Y no es un problema para los inversionistas que sólo hay para 19 años?</u>

Lo que pasa es que en un ciclo combinada …uno de lo seguro…..que tiene un despacho… tiene un buen rendimiento…que tiene un despacho mediato… ….la tasa interno de retorno es alta….si los precios fueran los internacionales…por eso estamos discutiendo los precios…
Uno se podria llagar a hacer un inversion de 400 miliones de dolares…..si estamas mas o menos seguro que va a tener una buena disponibilidad de gas …y un buen despacho…entonces practicamente lo va a recuperar muy rapido este ciclo combinada…va a estar muy alto este tasa interno
Pero obviamente hay que pensar…por eso lo preguntò usted …sobre los centrales nucleares y hidraulicos…que pasa si termine…bueno...eso es uno de los puntos que defendemos algunos en Argentina, no todos,…que los centrales nucleares es una energía para el futuro en Argentina…y ese va a dar en cuenta muy eso…en contrario que piensa ademas…(…) que no hay un futuro para nuclear…(…) bastante proximo vamos a tener problemas con la disponibilidad de combustibles…

254
<u># ¿Pero con el marco con un marco privado …usinas privadas no es posible aumentar con nuclear?</u>

Hasta el momento no dijieron …que no se va a privaticar los centrales nucleares…no dijo que no iba a privatisar…..no se privatisado por el momento….lo que siga tiene que saber …con privatisada….tiene que tener un control muy estricto del estado…de la comision nacional de la Energía Atomica…por que hasta ahora …por ejemplo en Argentina no huba nunca problemas…con ningun accidente con los centrales nucleares…ningun accidente importante…

Pero pasa en los manos privados….extrema los contoles para que….no diminuyan el mantemiento…para hacer economía …por que ese es muy riesgoso…ese es el tema.

265 (…)
¿En Dinamarca no tienen muchas centrales nucleares?

No, no…….

Snak om Danmark!!

280
Lo que pasa es que centrales eólicas tienen tambien problemas ambientales bastantes.
El ruido y los pajaros…problemas con los imigraciones.
(…)

290
…efecta el paisaje…hace ruido…

300
Bien, sigamos!

Otro pregunta a el gas. ¿Qué es el precio del gas. Si por ejemplo…el precio va a subir…Qué va a pasar con el…no hay otros tecnologías que sean mas atrativas…entonces?

Vuelve a repitir. Las eólicas……en el sur del Republica de Argentina…Patagonia…hay un potencial de aprovechamineto eolico muy importante.

Hay mucho viento. El viento esta 90-100 kilometros por hora en algun lado.
Lo que pasa es que hay tambien limitaciones de los generadores eolicos…es decir si hay …bajo si hay poco viento y bajo si hay mucho viento…..por que las molinas son muy altas los riesgos que entre en resonancia son muy altos….
….

310
¿Bueno, desde tu punto de vista hay un futuro para eolicos aqui en Argentina…?

Yo pienso que para eolico…en el país hay futuro…y ….la Patagonia es uno los lados…

¿Y dentro diez años?

En mi opinion se va a deserollar la energía eólica…
Bueno en el mundo….la energía eólica…
Que dicen siempre …energía eólica y energía solar….Es una utopía que la energía eólica y solar va a replesar ….

Tiene que estar un energía segura….tiene que tener siempre un respaldo térmico….todo la generación eólica tiene que tener un respaldo térmico. Por que no puede generar un energía regular.

320
Entonces eso tipo de problemas…hacen que tener ….respaldo de generación de otro tipo…
(…)

Bahia Blanca (?) esta en la provincia de Buenos Aires…ahi esta un parque eólica (160 MW) que esta parada…
…pero yo pienso que la energía eólica va a tener un desarollo importante…

330
Tambien tenemos unos preguntas sobre el tema…politica energetica…por ejemplo ahora casi todo el sector esta privaticado …¿ Qué método tiene el estado para regular las inversiones y la ampliación del sistema eléctrico?

Bueno en ese momento …(…) …caundo hay una empresa que queire hacer un inversion…ya sea una ampliación de una central existente…o una nueve central …tiene que solicitar la autorisación de la Secretaria de Energía. La Secretaria toma en cuenta la ubicación de la central…es decir hay nodos donde…conviene…
Linia de transmission…entonces conviene….

340
La Secretaria de Energía autorisar. Si la Secretaria de Energía autorisar….tiene que hacer …impacto ambiental…de esa central

…va generalmente a audiencia publica…
Y la audiencia publica defiene…lo digameos…no es vinculante…

El organismo que puede ser la Secretaria de Energía o Ente Nacional de Regulación Electrica…pueden pedir las modificaciones…que surgen de esa audiencia publica…
(…)

351
¿Pero entonces el estado no tiene herraminientos para crecer el inversion en el sector?
(…)
…¿para segurar que los inversionistas van a invertir?

La promoción …si argentina necesita aumentar su generación electrica…en este momento ….necesita…
Desarollo industrial importante…
359
Hay un problem mas grave en la linia de transmission….
Hay que aumentar la linia…

368
Cree que ….

…no esta bien definido…si es para energetica…
no esta absolutamente definido esa…
CAMMESA que es el…..tenia una deuda muy importante…tiene que pagarle ….

385
¿Qué signifa la importación y exportación de electricidad…para el ampliación del sector?

Chile hay una sola linia…esta en Salta arriba de todo. Esa linia …esa central es ….

395
Con Brazil hay …. Va y viene…
Uruguay tambien tiene por Salto Grande…
…y lo mismo pasa con Paraguay…Yacyreta.

En el mismo tiempo …construiendo en gasoducto…
…una cosa de loco…

413
¿Pero entonces no tiene una gran significación que hay este importación/exportación?

En este momento no necesita….

427
¿Qué son los factores mas importantes para los inversionistas? Es el tema economico o hay otros temas tambien?

…es el mas importante. Hay otros temas. Por ejemplo…los controles …prate de emisiones…
Gas natural nacional no tiene ”asufre”….
Alcanza de transporte….no producción…..

467
Bueno, una cosa finalmente, si vas a pintar ese en 10 años…¿Cómo va a estar?

A ver … (…)

472
Nuclear va a ver un pequeño aumento con **Atucha II**.

¿...y finalican este en 5 años o …?

Si concretan esta…en 3 o 4 años…esto podria ser…
El problema esta que …todo la parte informatica y combiarla…el sistema control computizado…esta obsoleto y tiene que cambiarla.

478
Bueno, en carbón…yo no veo una perspectiva para el carbón …(…) no lo veo….
El gas no tiene ninguna duda que va a ser el maxima posible…siempre…y que ademas el aumento va a estar aqui …(”gas natural”)…si hay aumento va a estar aca.
Incremento de generación va a estar aca.
(…)
No bueno **Carbón** igual…no hay diferencias…no vale la pena.

487
Hidráulica…ojala hicimos algo…
Y creo que eólica si va a incrementar…que puede ser que…
….el eólica va a replecar el petróleo…

Ojala tuvimos otro central nuclear…ojala tuvimos mas hidroelectricidad.

¿Es difícil en 10 años?

Bueno, en 10 años no…
(…)

Mail answer

¿En su opinión personal qué perspectivas hay a mediano plazo (dentro 10 años) para las tecnologías en el sector eléctrico?
¿Hidroeléctrico, gas, nuclear, petróleo, carbón y alternativas?
¿Por qué cree Usted que el desarrollo va a estar así?

La declaración del estado de emergencia pública y la salida del régimen de convertibilidad dispuestas por la Ley Nº 25.561, ocasionó consecuencias, mayormente negativas, en el segmento de la generación de electricidad.

Para el **equipamiento térmico** más antiguo ha habido una disminución en términos relativos de los costos corrientes de operación y mantenimiento, debido a su componente nacional. Los nuevos ciclos combinados, en cambio, deben enfrentar con el nuevo tipo de cambio los costos de las tareas de mantenimiento realizadas y exigidas por los fabricantes, para que las garantías existentes sobre el equipamiento no caduquen.

En los últimos años, aun anteriores a la devaluación, el sendero de precios del gas no acompañó al del petróleo y sus derivados líquidos. Este proceso sumado al aumento de las exportaciones a Chile al que inducían los precios bajos, desencadenó la crisis del gas de febrero pasado.
Durante el invierno habitualmente se producen restricciones en la disponibilidad de gas para generación de electricidad (entre 2 a 4 semanas según cuán frío se presente el año), por las prioridades de uso que tiene el sector domiciliario. La sustitución por derivados líquidos sujetos al dólar produce una suba estacional de los precios de la electricidad.
En un marco de racionalidad económica sería de esperar que finalmente se concretarán las ampliaciones de la red de transporte necesarias capaces de reducir el período de restricciones de gas de las centrales térmicas. Esas centrales, como consumidores firmes o semifirmes, deberían contribuir con la tarifa a la expansión de los gasoductos.

En el contexto macroeconómico actual, la recomposición de la ecuación económica de las empresas de servicios públicos y de interés público puede llevar tiempos prolongados.

A mediano plazo existirá cierta volatilidad hasta tanto se alcancen acuerdos de largo plazo con los organismos multilaterales de crédito. Si vislumbran metas razonables y de factible cumplimiento, se volverá a partir del mediano plazo a tener acceso al mercado financiero internacional.
En lo inmediato sólo el saldo positivo de la balanza comercial (viento de cola agropecuario) posibilitará hacer frente a las necesidades de servicios y equipamiento externo.
En tal contexto, no es admisible bajas de grupos existentes ni incorporación de nuevas unidades generadoras en los escenarios de oferta.
El abastecimiento en el corto y mediano plazo se sustentará sobre la base de ampliaciones del sistema de transporte, mientras para el largo plazo se han propuesto dos ciclos combinados (nodo Santa Fé - Paraná) que serían necesarios incorporar para acompañar el crecimiento de la demanda.

Respecto al uso del **carbón**, sólo las calderas de los turbo grupos 1, 2 y 5 de la Central San Nicolás están preparadas para quemar este mineral, mientras que fuel oil / gas son combustibles alternativos. El Pliego de 1993 la obligaba por 10 años a comprar 370.000 toneladas anuales de carbón a Yacimientos Carboníferos Fiscales S.E. (Yacimiento Río Turbio – Provincia de Santa Cruz).
Restricciones ambientales y operativas son contrarias a la utilización del carbón para generación.

Con la actual situación macroeconómica, los **aprovechamientos hidroeléctricos** han mejorado relativamente sus condiciones de competitividad, por la mayoritaria participación de insumos de origen nacional o regional, porque demandan mucha mano de obra y porque incrementan la actividad económica local. Estos proyectos tienen distintos rangos de aplicación de acuerdo a su magnitud.

Los aprovechamientos de pequeña escala constituyen alternativas de fuerte impacto local que podrían contribuir a la incorporación a la actividad productiva de comunidades marginadas, en las que la generación de energía eléctrica está subordinada a otros usos del agua.
En los proyectos de escala media, que tienen impacto considerable en el desarrollo regional, el uso hidroeléctrico tiene mayor significación económica, aunque su importancia relativa es inferior a la de otros usos del agua, como la atenuación de crecidas o el riego. Un ejemplo de esto son los aprovechamientos provinciales Chihuido II (río Neuquén) y Caracoles (río San Juan)
Los aprovechamientos de mayor magnitud tienen a la hidroelectricidad como su uso más importante. En el marco del proceso de integración económica del Mercosur, los proyectos hidroeléctricos binacionales, particularmente Corpus (río Paraná) y Garabí (río Uruguay), son las alternativas más interesantes para el abastecimiento del mercado ampliado. Pero estas obras son de largo aliento (no menos de 5 años de construcción y además son binacionales lo que hace más dificultosa que lo habitual su concreción). Dentro del subgrupo de las grandes obras la elevación de la cota de embalse de Yacyretá de 76 m a 83 m, (incorporaría 1200 MW de potencia efectiva y 8000 GWh/año de energía media anual) es la alternativa más conveniente y sobre todo de más rápida respuesta para sortear la probable crisis de oferta que se avizora.

Respecto a la **energía nuclear** debe señalarse que como opción energética afortunadamente continúa vigente, aunque no es clara la conveniencia económica de su incorporación dentro del horizonte solicitado de 10 años (Central Atucha II).
Los programas "Gestión de Vida" y "Extensión de Vida", que NASA aplica para garantizar y prolongar la vida útil de Atucha I y Embalse, tienden por lo menos a mantener operativo lo existente.

Las incorporación de otras formas de energía, particularmente **eólica y solar**, se manifiestan especialmente en mercados aislados. Sin embargo, en los últimos años y fundamentalmente a partir del incentivo generado con la promulgación de la Ley Nº 25.019, se han incorporado a los sistemas interconectados varios parques eólicos de envergadura y otros presentaron sus solicitudes de acceso, aunque a partir de los cambios macroeconómicos mencionados, los nuevos ingresos han sido postergados Lo razonable es asignarle a este tipo fuentes energéticas una muy reducida participación dentro del segmento de la generación.

Por todo lo expresado no es previsible que en los próximos 10 años se produzca una modificación sustantiva en la matriz de oferta energética en el MEM. El gas seguirá siendo el soporte principal del sistema de generación de la Argentina y la elevación de cota de Yacyretá será la mayor contribución hidroeléctica de la década para mantener una participación de la hidroelectricidad en torno al 40 % .

<u>Inversores</u>
¿Van a invertir suficiente en equipo nuevo para sustentar el abastecimiento de electricidad?
¿Cuáles son los factores más importantes para los inversores?

Con referencia a la posibilidad de nuevas inversiones, los agentes enfrentan un contexto de ausencia de crédito externo y tarifas que no remuneran costos de ampliación. El panorama no se muestra atractivo.

Los factores más importantes para los inversotes son.

la rentabilidad del negocio

la seguridad jurídica

Marco regulatorio

¿Qué métodos tiene el Estado para regular las inversiones, mantenimiento y ampliación del sistema eléctrico en relación al sector privado?

¿Hay alguna posibilidad que el Estado vaya a aumentar su influencia en el sector eléctrico otra vez?

¿Hay planes políticos para renovar el marco institucional del sector eléctrico?

De acuerdo con la legislación vigente, Ley N° 24.065, la generación es una actividad de mercado con operadores que actúan en competencia. Este mercado no establece barreras al ingreso de posibles competidores, por lo cual la instalación de nuevas centrales térmicas o su ampliación es completamente libre, salvo que razones técnicas demuestren que el nuevo equipamiento sea atentatorio en algún aspecto del interés común.

En resumen, la idea básica de la normativa vigente es que la actividad de generación de energía eléctrica, por responder al libre juego de la oferta y la demanda, sólo debe ser regulada en aquellos aspectos y circunstancias que afecten al interés general.

Dentro de este contexto, la señal más potente son los precios atractivos.

La posibilidad siempre estará abierta. La reciente creación de ENASA (Empresa Nacional de Energía Sociedad Anónima) es una muestra de ello.

Pero concretamente, ¿significa ENARSA un aumento efectivo de la influencia estatal en el sector energético o sólo es una mera oficina intermediaria y testigo generadora de negocios?. Por lo visto hasta ahora, me inclino por esto último.

Si existen, no tengo conocimiento de ellos.

APPENDIX 10 – DELPHI QUESTIONNAIRE

In this appendix the second round questionnaire of the Delphi Forecast in the Argentinean power sector is presented. First the introduction letter to the second round is presented followed by the questionnaire that was sent by mail to the experts involved.

Argentinean Power Sector Delphi
Round 2
Questionnaire

Thank you for your participation in the Argentinean Power Sector Delphi survey that we started during our stay at Fundación Bariloche from November 2004 to March 2005.

Nine energy experts have participated in the first round which included personal interviews covering important issues for the development of the Argentinean power sector. This first round gave us many very valuable comments and answers.
The rationale behind making this second round with a questionnaire is to specify and qualify some of the statements made about the technology foresight.

The questionnaire we present you builds on many insights from the first round, but you will find the questions very precise and structured.

The questionnaire that you will find as an attached excel file includes 23 questions with multiple choice answer options and will probably take only 20 minutes to complete depending on if you would like to add some comments.

If you strongly disagree with any question posed or want to clarify one of the issues, please feel free to write your comments in the questionnaire attached. This only contributes to the validation of the results from the survey.

Both first and second round will be reflected in the final Delphi scenario, which will be sent to you after the completion of this survey and analysis.

We kindly ask you to complete the questionnaire in the excel file and send it by mail to engineer.forman@gmail.com as soon as possible.
If you have any comments or questions please do not hesitate to send them to the above mail.

Thank you very much for your cooperation and help.

Writing from the Technical University of Denmark.

Yours Sincerely
Andreas Jorgensen and Jakob Forman

Argentinean Power Sector Questionnaire

The following questionnaire contains 23 questions with multiple choice answer options.

When you begin we ask you to read each question carefully, give the statement some thought, and then put an X at the answer you find most likely.

All the questions is about the future and therefore hypothetical, but what we ask is your expert forecast opinion. If you have any comments to add to any of the statements and questions, please do not hesitate to write them in Spanish at the space beside each question.

Below follow two examples to show how to mark the X and add a comment.

When you have finished the questionnaire, please save a copy of this excel spread sheet including your answers and comments, and attach it to a mail send as soon as possible to engineer.forman@gmail.com

All the answers will be dealt with confidentially and anonymously, and in the final Delphi Scenario your answers will only be present as a sum of all the experts participating.

Thank you very much for your contribution.

EXAMPLES of questions:

When will Argentina win the Football World Cup for men again?
(Choose the option that you find most likely, place the cursor on the corresponding box and write an **X** .)

1) 2006	X
2) 2010	
3) 2014	
4) 2018 or later	
5) It will never happen	

Comments:
I could actually have set more than one **X** , because I find it likely that Argentina. will win the World Cup not only one time in the time horizon outlined

When will China be the biggest economy of the world (calculated in BNP)?
(Choose the option that you find most likely and write an **X** in the corresponding box.)

1) 2006-2007	
2) 2008-2009	
3) 2010-2011	X
4) 2012 or later	
5) It will never happen	

Comments:
My answer is dependent on that the EU is not considered as one big economy, but as a gathering of single countries.

Power Sector Questionnaire

System development

When Argentina experienced the recent deep economic crisis the power sector was at the same time destabilised. In the "*Plan Energético Nacional 2004-2008*" the plan of "normalisation" of the sector is mentioned.

When will the power sector reach this "normalisation"?

1) 2007	
2) 2008	
3) 2009	
4) 2010	
5) 2011 or later	
6) It will never be reached	

Comments:

When will electricity prices reach a level,
where it reasonably can be said that prices reflect cost of production?

1) 2007	
2) 2008	
3) 2009	
4) 2010	
5) 2011 or later	
6) It will never be reached	

Comments:

Hydro power

When will the work of raising the level (cota) of Yacyretá from 76 to 83 (msnm) be finished?

1) 2008	
2) 2009	
3) 2010	
4) 2011	
5) 2012 or later	
6) It will never be finished	

Comments:

When will the Garabi hydro power plant be finished?

1) 2008-2009	
2) 2010-2011	
3) 2012-2013	
4) 2014-2015	
5) 2016 or later	
6) It will never be built	

Comments:

When will the Corpus Christi hydro power plant be finished?

1) 2008-2009	
2) 2010-2011	
3) 2012-2013	
4) 2014-2015	
5) 2016 or later	
6) It will never be built	

Comments:

In the period 1993-2002 according to "*Prospectiva 2002*", 3420 MW of hydro power was installed. From today how much hydro capacity will totally be installed within the next 10 years – 2005-2015?

1) More than 5600 MW	
2) Around 5500 MW	
3) Around 5000 MW	
4) Around 4500 MW	
5) Around 4000 MW	
6) Around 3500 MW	
7) Less than 3400 MW	

Comments:

Nuclear power

When will Atucha II be finished?

1) 2008-2009	
2) 2010-2011	
3) 2012-2013	
4) 2014-2015	
5) 2016 or later	
6) It will never be built	

Comments:

When will a new nuclear plant or reactor (Atucha III) be built?

1)	2015 or before	
2)	2016-2017	
3)	2018-2019	
4)	2020 or after	
5)	It will never be built	

Comments:

Natural gas power plants

When will the planned combined cycle power plant supported by the government fund be operating?

1)	2005	
2)	2006	
3)	2007	
4)	2008	
5)	2009 or later	
6)	Never be build	

Comments:

When will the next fully private combined cycle power plant be build?

1)	2005	
2)	2006	
3)	2007	
4)	2008	
5)	2009 or later	
6)	Never be build	

Comments:

How many MW grid-connected gas turbines, combined cycles or other gas fuelled power plants, will be installed the next 5 years (2005-2010) including the above mentioned?

1)	More than 3100 MW	
2)	Around 3000 MW	
3)	Around 2500 MW	
4)	Around 2000 MW	
5)	Around 1500 MW	
6)	1000 MW or less	

Comments:

Natural gas supply

When will the gas fields and the natural gas pipeline from the Austral basins in the far south be expanded and delivering gas to Buenos Aires?

1)	2007-2008	
2)	2009-2010	
3)	2011-2012	
4)	2013 or later	
5)	It will never be built	

Comments:

When will the additional natural gas pipeline from Bolivia be delivering gas to Buenos Aires?

1)	2007-2008	
2)	2009-2010	
3)	2011-2012	
4)	2013 or later	
5)	It will never be built	

Comments:

When will the last winter with significant shortage (falta de disponibilidad) of natural gas to the power sector be?

1)	Winter 2006	
2)	Winter 2007	
3)	Winter 2008	
4)	Winter 2009	
5)	Winter 2010	
6)	Will remain past 2011	

Comments:

Renewable energy

When will wind power reach 500 MW installed grid-connected capacity, corresponding to approximately 170 new big 3 MW wind mills?

1)	2008-2009	
2)	2010-2011	
3)	2012-2013	
4)	2014-2015	
5)	2016 or later	
6)	Will never be installed	

Comments:

When will Solar panels (Photovoltaic cells) be widely used in areas that are grid-connected?
(Widely used: market penetration to a level where a product or service is in common use.)

1)	2008-2009	
2)	2010-2011	
3)	2012-2013	
4)	2014-2015	
5)	2016 or later	
6)	Will never be used	

Comments:

When will Solar panels (Photovoltaic cells) be widely used in areas that are **not** grid-connected?
(Widely used: market penetration to a level where a product or service is in common use.)

1)	2008-2009	
2)	2010-2011	
3)	2012-2013	
4)	2014-2015	
5)	2016 or later	
6)	Will never be used	

Comments:

When will Micro hydro power plants be widely used for grid-connected power generation?
(Widely used: market penetration to a level where a product or service is in common use.)

1)	2008-2009	
2)	2010-2011	
3)	2012-2013	
4)	2014-2015	
5)	2016 or later	
6)	Will never be used	

Comments:

When will Geothermal energy be widely used in power generation?
(Widely used: market penetration to a level where a product or service is in common use.)

1)	2008-2009	
2)	2010-2011	
3)	2012-2013	
4)	2014-2015	
5)	2016 or later	
6)	Will never be used	

Comments:

Interconnections

When will the import capacity from Brazil reach 2000 MW?

1)	2008-2009	
2)	2010-2011	
3)	2012-2013	
4)	2014-2015	
5)	2016 or later	
6)	Will never be installed	

Comments:

When will the interconnection NOA Norte – ET El Bracho between the NOA and NEA systems be finished (1st stage)?

1)	2007-2008	
2)	2009-2010	
3)	2011-2012	
4)	2013-2014	
5)	2015 or later	
6)	Will never be built	

Comments:

When will the interconnection ET Cobos – Resistencia between the NOA and NEA systems be finished (2nd stage)?

1)	2007-2008	
2)	2009-2010	
3)	2011-2012	
4)	2013-2014	
5)	2015 or later	
6)	Will never be built	

Comments:

When will the interconnection between Comahue and Cuyo be finished?

1)	2007-2008	
2)	2009-2010	
3)	2011-2012	
4)	2013-2014	
5)	2015 or later	
6)	Will never be built	

Comments:

Thank you very much for sharing your expert knowledge.

Please save a copy of this excel spread sheet and attach it to a mail and send it to engineer.forman@gmail.com

APPENDIX 11 – DELPHI FORECAST RESULTS

In this appendix the results of the second round Delphi Forecast of the Argentinean power sector is presented.

The table below lists the answers of the six experts participating on each question of the second round questionnaire. They are given the letters from A-F to preserve anonymity. Please refer to appendix 9 to see the exact phrasing of the questions of the table.

When ever an answer option included a range of two years the average has been plotted in. For instance an X marked in the option "*2010-2011*" would be given the value 2010.5 and if more than one X was marked it would be the average of the total range.

Data processing - determining the median, mean and spread

For determining the median out of six answers often two answers would constitute the median. In these cases the average value of the two median values are taken. In the case of forecasting when "*will Atucha II be finished?*", the median is given be the two answers *2009.5* and *2010.5*. The median is thereby said to be 2010.

The spread is here presented as the range within the respondents excluding the the minimum and maximum value.

The mean has been calculated on all the questions where values permitted it. Often the answer would be for instance "*2016 or later*" and in this case no mean is stated.

In the table below the answers of the six respondents are presented together with the mean, median and spread.

Questions	**A**	**B**	**C**	**D**	**E**	**F**	**Mean**	**Median**	**Spread**	**Baseline Scenario**
Policy										
Normalisation	2007	2010	2010	2007	2009	2009	2008.67	2009	2007-10	**2009**
Electricity prices	2007	2008	2010	2007	2010	2007	2008.17	2007.5	2007-10	**2007.5**
Hydro and nuclear										
Yacyretá	2010	2009	2009	2009	2011	2009	2009.5	2009	2009-10	**2009**
Garabi	2012.5	2010.5	2016-	2016-	2016-	2014.5		2015+	2012-2016+	**By the end of the period. 2015+**
Corpus Cristi	2016-	2016-	Never	2016-	2016-	2016-	2016-	2016-	2016-	**2016+**
Amount of MW	3500	3500	-3400	1400	-3400	3500		3400	(-)3400-	**3400**

hydro plants in 2015									3500	
Atucha II	2010.5	2012.5	2008.5	2009.5	2012.5	2008.5	2010.42	2010	2008.5-2012.5	**2010**
Atucha III	2018.5	2020-	Never	2020-	2020-	2018.5		2020-	2018.5-2020+	**2020+**
Gas										
Government supported CC	2007	2009-	2008	2008.5	2008	2008		2008	2008-2008.5	**2008**
Private CC	2007	2009-	2009-	#	2009-	2009-		2009-		**2009+**
Amount of MW gas plants (2005-2010)	2500	1500	2500	1600	1750	2000	1975	1875	1600-2500	**1875**
Gas pipeline South	2007.5	2007.5	2007.5	2011.5	2011.5	2007.5	2008.83	2007.5	2007.5-2011.5	**2007.5**
Gas pipeline Bolivia	2007.5	2009.5	2009.5	2011.5	2013-	2011.5		2010.5	2009.5-2011.5	**2010.5**
No shortage of gas to power	2006	2009	2011-	2009	2011-	2011-		2010.5	2009-2011+	**2010.5**
Renewables										
Wind power (500MW)	2012.5	2016-	2016-	2014.5	2014.5	2016-		2015.5	2014.5-2016+	**By the end of the period. 2015+**
Solar panels	2016-	2016-	Never	2016-	#	Never	2016-	2016-	2016-	**2016+**
Solar panels (off grid)	2008.5	2016-	2008.5	2013.5	#	2016-		2013.5	2008.5-2016+	**2013.5**
Micro hydro	2016-	2016-	2008.5	2015	#	2016-		2016-	2015-2016+	**2016+**
Geothermal	2016-	2016-	2016-	2016-	#	Never	2016-	2016-	2016-	**2016+**
Interconnec-tions										
Brazil capacity of 2000 MW	2008.5	2010.5	2010.5	#	2012.5	2010.5	2010.5	2010.5	2010.5	**2010.5**
NOA – NEA 1st stage	#	2009.5	2007.5	#	2009.5	2009.5	2009	2009.5	2009.5	**2009.5**
NOA – NEA 2nd stage	#	2015-	2009.5	#	2011.5	2011.5		2011.5	2009.5-2011.5	**2011.5**
Comahue – Cuyo	#	2015-	2009.5	#	2009.5	2009.5		2009.5	2009.5	**2009.5**