

The Argentine case for Energy Security

(Versão preliminar – favor não citar)

Abstract

This work deals with the delicate situation regarding energy security in Argentina, an issue that first emerged in 2004 as a consequence of the particular modalities adopted by the macroeconomic structural and energy sector reforms of the 90s, and which remains to the present.

In this sense, the main argument revolves around several issues. On the one hand, there is the fact that, since then, decisions regarding energy supply expansion depend primarily on the private –mainly international– sector rather than on the State, resulting in serious consequences when it comes to ensure supply, since the international investors' strategies have prioritized obtaining local revenues to be reinvested outside Argentina. The growing dependence on gas supply for ensuring sufficient electricity supply has been, in that sense, a result from such strategies, since a monetization policy for gas and oil reserves has been favored, thus minimizing the exploratory risk, and leading to a situation of inadequate gas supply which has, since the 90s, jeopardized electric supply security every time that the electric generation matrix has been oriented towards thermal generation on the basis of lesser investment cost and cheaper gas. So, hydroelectric, nuclear and non conventional renewable sources' projects have not been able to compete efficiently. Likewise, since the reforms were implemented within the framework of a macroeconomic scheme of overvalued currency, unsustainable in the long term, the initial price signals –valid for the first ten years– were modified as international prices were increasingly rising, contributing to delay, even more, the investments required to increase supply in a world scenario where supply security and environmental safety had become more important than achieving efficiency in the markets. This way, the gap between investments and demand growth has opened more widely. At the same time, the attempts to modify the energy matrix have yet not been able to overcome the problems of diminished public funding or insufficient private investment. Even though the government has adopted a more proactive attitude since 2008, encouraging projects on hydroelectric power, nuclear power and non conventional renewable energy sources, mainly wind power, supply security in Argentina will still be dependent on gas, presumably through import. Finally, the development of huge hydroelectric projects will be subject to the achievement of bilateral agreements with Brazil.

1. Introduction

In order to explain the complexities of the Argentine case as regards energy security, Section 2 describes how the context of electric power demand and supply evolved throughout a long historical period, with the purpose of showing the forces that drove the dynamism and the direction of both of them, during each stage: a) before the reforms; b) for the ten years that the reforms and the so-called “Convertibility Plan” lasted and c) since the abandonment of such plan to the present. Two facts arise from the arguments

and indicators shown in that Section: a) demand has increased well beyond supply and b) in the next years, electricity supply security shall be inevitably dependent on gas offer.

Based on these conclusions, Section 3 studies the behavior of the main energy conglomerate, since the strategy adopted by them determines, in great part, future gas supply. Then, the analysis of such group investment strategy concludes that, as it is the case for many other groups, a policy of investments outside Argentina and the region has been favored. Likewise, Section 3 also discusses which options Argentina would have to obtain imported gas. In this respect, the difficulties to obtain gas supply from Bolivia are listed, as well as the implications that importing LNG would have.

Section 4 explores, one by one, the remaining sources for power generation, analyzing the scope that each of them would have, as well as the financial difficulties they pose and the way Argentine authorities are facing the problem.

The analysis highlights how once again the State adopts the role of subsidizing agency regarding price policies and investments for the development of new projects, as a response to the insufficiency of private investments.

It is therefore concluded that, even though Argentina has recently resorted to developing non conventional energy sources by establishing auctions and future energy prices for these sources through mechanisms that ensure the return of such private investments, the space for clean and renewable sources remains reduced. The same occurs with hydroelectric and nuclear sources, so the biggest challenge consists in finding new natural gas supplies on time and speeding up regional integration, in order to take advantage of the biggest bilateral hydroelectric potentials.

However, the fact that Argentina has failed either to improve its price signals or to implement demand management programs to reduce consumption, and the fact that subsidies are of utmost importance within a context of fragile public account balance, constitute, together with the factors aforementioned, the major obstacles preventing Argentina from achieving a reasonable level of energy security.

Finally, although Argentina has a relatively clean generation matrix, (basically gas thermal, hydroelectric and nuclear) and has actively encouraged the use of renewable energies, there could be a step back, since natural gas shortage has driven it to more pollutant alternatives, such as Fuel Oil and Diesel Oil.

2-The context of electric power demand and supply

2.1. Demand behavior across long periods

At the beginning of the 1990s, Argentina started a vast program of energy sector reforms, which comprised the vertical unbundling of energy chains and the privatization of almost

all state-run company assets. Before the implementation of this program, such companies provided and produced all energy services. This was also the prevailing model in almost all Latin American countries. (Díaz de Hasson, G., 1995; Pistonesi, H., 2000; Kozulj, R. et al., 1993 a y b; Kozulj, R. 2000, 2002 a y b, 2005 y 2009 a y b).

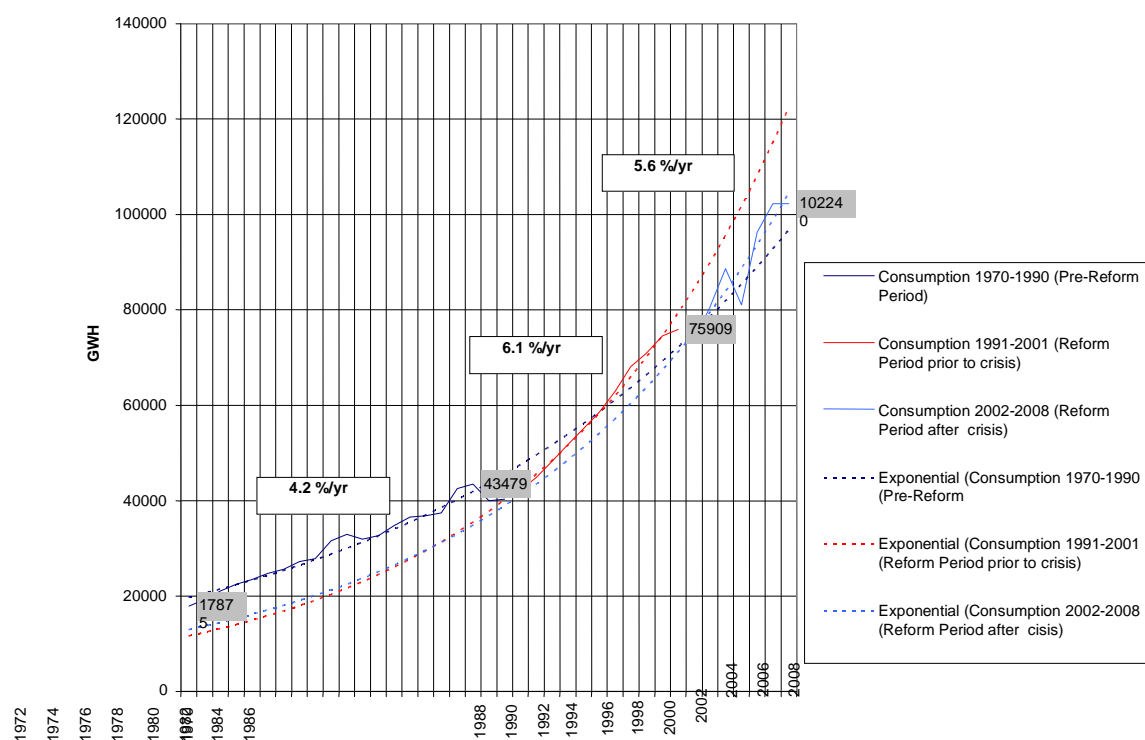
Some of the reasons adduced to support and proceed with the reforms and the privatization of public assets were the high level of indebtedness of these companies, as well as the fact that their management was sometimes guided by political interests, and that prices and tariffs were imposed based on certain targets, fighting against inflation for example. However, in the case of Argentina, though these factors were present too, reforms and privatizations were also part of package of measures that, together with the Convertibility Plan, were crucial to renegotiate the high foreign debt¹.

One of the main consequences of this reform process regarding supply security was that the expansion of energy supply no longer depended on the State but on investment decisions made by private operating and concession companies belonging to the different units and segments into which the energy system was fragmented. This affected regulation issues and others related to energy supply expansion. Investments were then short-term oriented, as almost no obligations to either invest or expand supply were required by the terms & conditions, since it was assumed that the need for such actions would arise naturally from price signals and the market (Kozulj, R. 1993, Solanes, M., 1999; Ruiz Caro, 2009; A., Maldonado, P. y Palma, R., 2004).

Another consequence of privatization was the rapid growth of electricity demand, motivated by easy energy access, price policies, socio-economic transformations and cultural and technological factors. In order to understand the Argentine case it is necessary to consider which were the effects of the currency appreciation, the convertibility plan and the split pricing (prices expressed in US dollars and in the local currency); all these aspects will be dealt with later on. As for now, it will only be highlighted that, while the degree of currency appreciation doubled the tariffs in dollars, in general it reduced them in the local currency, encouraging high levels of power consumption. Whereas between 1970 and 1990 average growth rate reached 4.2%/yr., after the reforms it rose to 6.1%/yr. during the first implementation stage, and 5.6% during the second (4.3% as of 2001). This shows that such rate was already affected by the drastic policy implementations after the privatizations and the legislative changes (Figure 1).

¹ Unlike other Latin American countries, Argentina's foreign debt did not originate in infrastructure investments or in the import of capital assets to modernize the country, but in monetary policies that led to financial speculation.

Figure 1
Growth of electricity demand in Argentina between 1970 and 2008



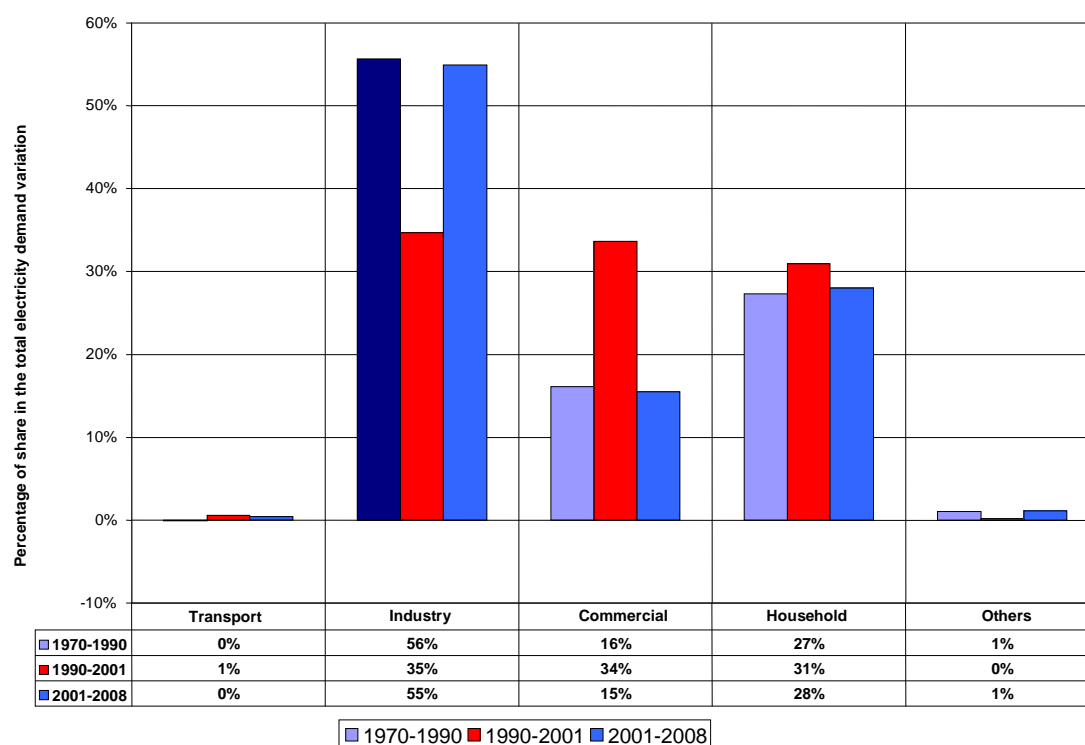
Source: Author's estimates using data by OLADE, SIIE, 2010.

Over the first implementation stage of the reforms, electricity demand grew mainly as a consequence of the enormous increase in commercial, public and service consumption, and consumption by the household sector (9.3 and 6.4%/yr. respectively). These sectors, then, accounted for 65% of electricity consumption increase between 1990 and 2001. However, after the 2001-2002 crisis, which meant the discontinuation of prior policies regarding tariffs and other electricity regulation aspects², the growth was due to an increase in consumption in the industrial sector, which accounted for 55% of the total demand (Figure 2).

² As will be explained below in more detail, the Convertibility Plan implied the automatic conversion of Argentine pesos into US dollars in a one-to-one parity. But this parity was based on an overvaluation of the currency that led to severe over-indebtedness and deindustrialization; the implicit real equivalence or equilibrium exchange rate was two pesos per dollar. Therefore, the Plan was not sustainable without continuous foreign capital inflows. From 1998 to 2001 the country entered a deep recession and also required more than 90000 million dollars for support. By the end of 2001, the system collapsed and in the beginning of 2002, the currency fell three times or more. Tariffs in USD decreased proportionally while the abandonment of the convertibility was translated into the simultaneous freeze of tariffs, expressed in Argentine pesos, a process known as "tariff pesification". Consequently, the industrial growth profile (re-activation) was modified. The energy sector investments were modified as well, since the incomes for private actors from that sector were diminished as a result of such "pesified" tariffs.

This demand behavior was certainly affected by the socio-economic reforms that took place between 1990 and 2001 related, in the Argentine case, to the “Convertibility Plan” cited above. This plan was based on a currency board regime, with monetary overvaluation that had several simultaneous effects: a) it induced the consumption of imported goods³; b) it concealed tariff and energy price increases behind their expression in American dollars; c) it guaranteed a high investment recovery rate within a context of legal certainty, and d) it provoked an unprecedented deindustrialization process. It is then just natural that the commercial sector should grow so much over that period, with the consequent growth of electricity consumption in a context in which its cost was low in the local currency, that is, in Argentine pesos. (Kozulj, R. 1993; 2002 a y b; 2004; Suazo, D., 2002; Rozenworcel, G., 2008).

Figure 2
Variations in electricity demand across long periods according to changes in the electricity regulation model. 1970-2008 – In GWH and %



Source: Author’s estimates using data by OLADE, SIIE, 2010.

³ It should be highlighted that availability of HVAC units at very low prices for the final consumer was an important factor in the growth of electricity demand.

After the 2002 devaluation, electricity tariffs remained practically frozen, but in dollars, the cost was divided almost by three or more. In that new socio-economic context, the industrial sector grew again, causing an increase in electricity demand that totaled 5.2%/yr. Alongside these changes, household and commercial consumption also reached high rates, considering the new threshold that had been reached after the reforms (2.8% and 4.2%/yr.)

In turn, there was belated concern for implementing demand management measures, an aspect for which there is not a well structured program even today. Another important aspect to explain the growth in electricity demand was the adoption of electricity-operated air conditioning systems, whose spread was a consequence of their ease of handling and low purchase and installation costs for the household, commercial, service and industrial sectors.

Finally, it shall be added that, even though the idea of exporting electricity as a means for maximizing sales and revenues after privatizations was among the strategic investment decisions made by the power sector, this never actually happened. For this reason, the following section deals with this issue, since electricity exchanges did not affect significantly electricity demand, which was mainly internal. On the other hand, this export strategy *did* increase gas, oil and petroleum products demand.

2.2. Supply behavior across long periods.

The growth of electricity supply underwent several changes in qualitative and quantitative terms after both periods of the reforms, which is a crucial aspect in order to explain the Argentine energy crisis as of 2004. Although, by definition, the net generation of losses is identical to consumption, the capacity increase of the system was well below the increase in demand (Table 1).

Table 1
Installed capacity trend in Argentina between 1970 and 2008 – In Mw.

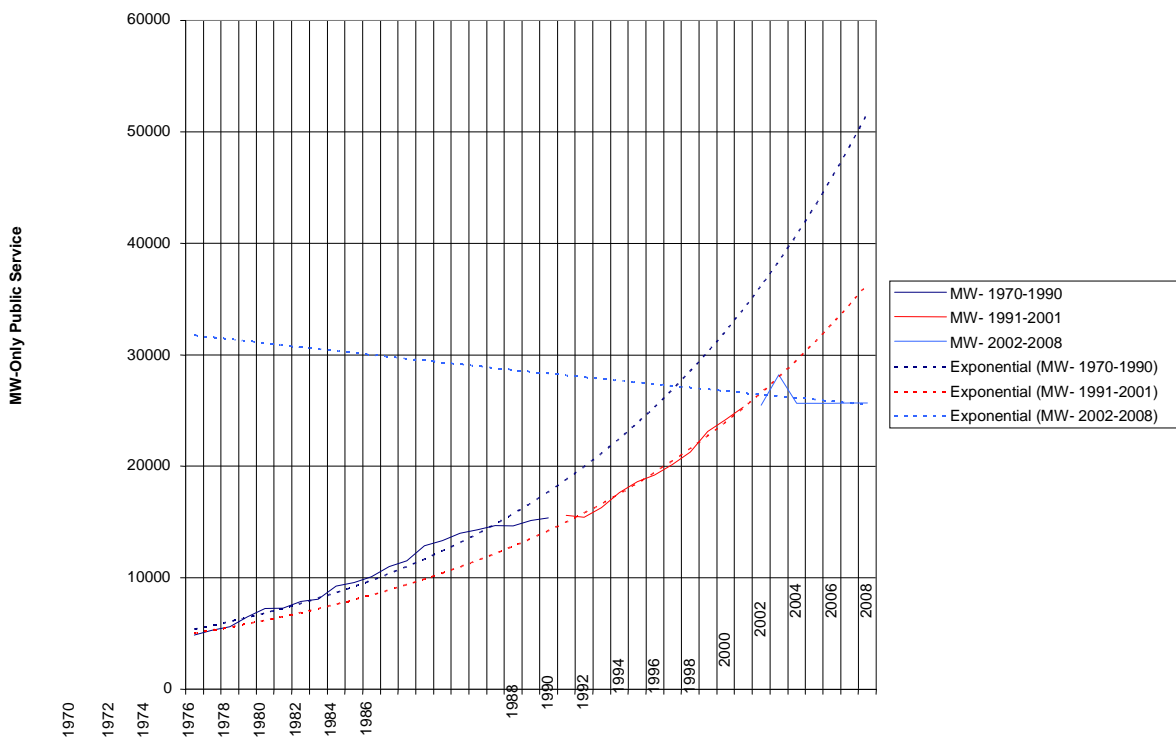
	1970	1980	1990	2000	2008
Capacity GW	6,7	12,0	17,2	25,9	28,1
Average generation GWH (=consumption)	17875	32889	40341	74525	102240
Theoretical maximum capacity GWH	58613	105269	150383	227386	245834
Average Use Factor	30%	31%	27%	33%	42%
	Annual Average Increase in %				
	1970-1980	1980-1990	1990-2000	2000-2008	1990-2008
Capacity GW	6.0%	3.6%	4.2%	1.0%	2.8%
Average generation GWH (=consumption)	6.3%	2.1%	6.3%	4.0%	5.3%
Theoretical maximum capacity GWH	6.0%	3.6%	4.2%	1.0%	2.8%
Average Use Factor	0.2%	-1.5%	2.0%	3.0%	2.5%

Source: Author's estimates using data by OLADE, SIIE, 2010.

Supply behavior, expressed in terms of the growth of installed capacity, has been in line with the different socio-economic and electricity sector models in force before and after the reforms. Between 1970 and 1990, the growth of installed capacity greatly exceeded the growth of the demand. The installation of large national and binational hydroelectricity and nuclear power plants created an atmosphere of supply security that collapsed at the end of 1989, when a high level of unavailability was evident in view of old conventional thermal capacity requirements. However, after the reforms, that capacity recovered thanks to a series of minor investments made by the private sector immediately after privatization. By the end of the 1980s, Argentina, like many Latin American and other countries, faced serious domestic and foreign debt problems, which limited the budget of their public companies, sometimes reporting deficits as a consequence of taxes with net tariffs below the real cost of electricity. In fact, the Convertibility Plan was meant to overcome – at least in the medium-term – the limits to domestic and foreign financing derived from such situation and from an inflationary process that, in Argentina, was severe since 1975. However, electricity sector investments were highly dynamic in spite of such context.

Figure 3 shows that, towards the end of the 1980s, there is relative stagnation of the increase in installed capacity, but between 1970 and 1990, the trend of investments in generation capacity exceeds investments over the reform period. After the convertibility crisis (2002), however, stagnation continues, and capacity even decreases because some thermal plants were taken out of service as they reached the end of their lifetime.

Figure 3
Installed capacity trend for the public service across long periods. In Mw.

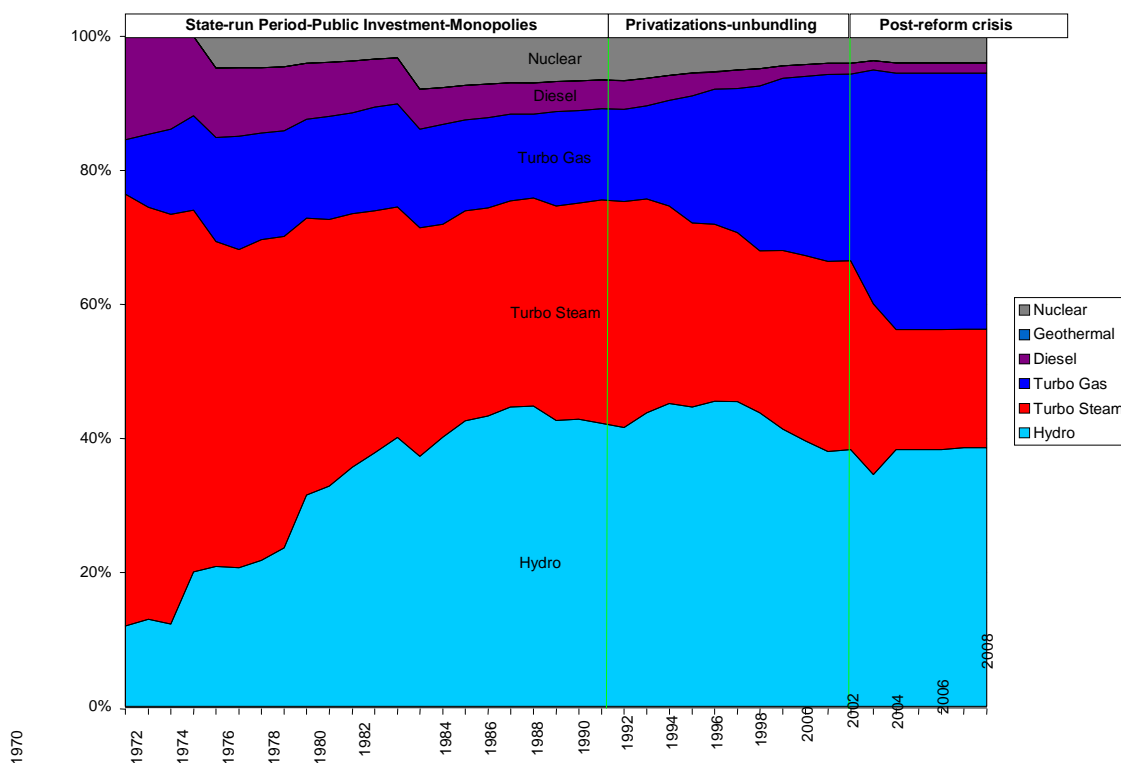


Source: Author's estimates using data by OLADE, SIIE, 2010.

2.3. Thermal generation and the problem of natural gas supply

One of the most important aspects brought about by the structural transformations of the 1990s was the drastic change in the technological pattern. As is well known, the introduction of high-efficiency combined cycle technologies was an outstanding feature at the world level as of the beginning of that decade. In Argentina, that trend was also boosted by the vertical and horizontal reintegration of energy chains, which led to the emergence of energy conglomerates. As a consequence, interactions between the gas and electricity markets became highly dynamic.

Figure 4
Generation trend by type of technology across long periods.
In % of generated total



Source: Author's estimates using data by OLADE, SIIE, 2010.

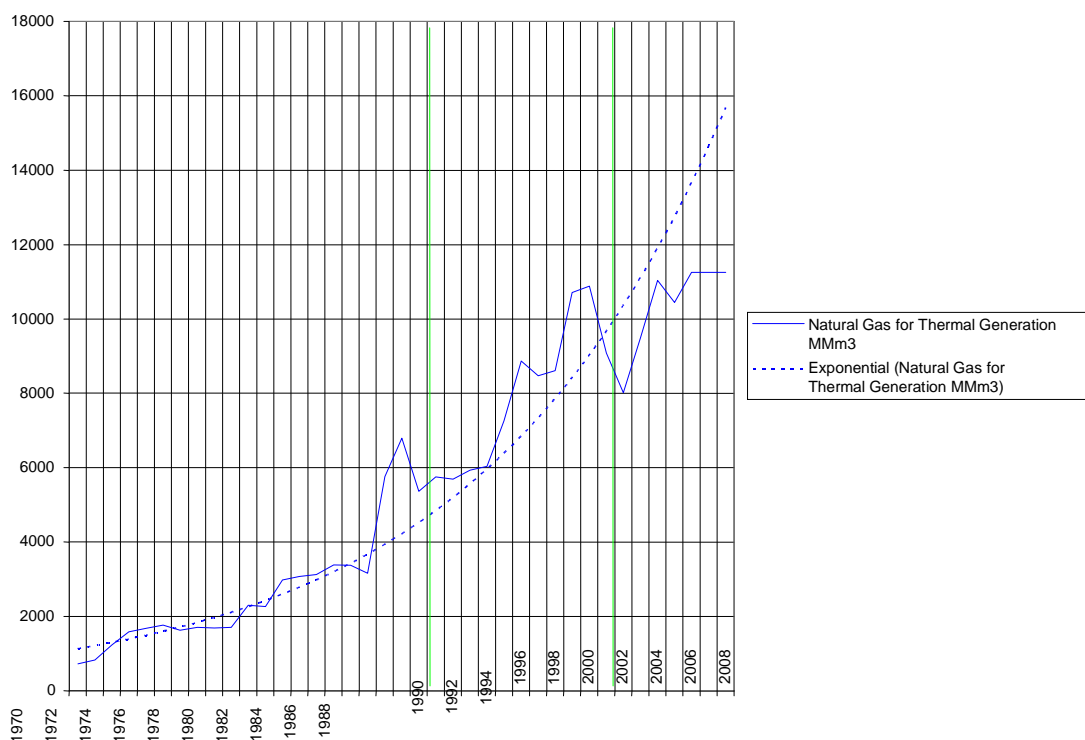
The growing trend of thermal generation, mainly with natural gas equipment, was correlated with a dramatic increase in gas demand (Figures 4 and 5). Such trend, which was already growing before the reforms, intensified. .

Several factors contributed to this type of expansion of electricity supply. On the one hand, over the 1980s, several countries became indebted for different reasons, but in many cases in Latin America, the building of large-scale hydroelectric facilities required massive investment and foreign loans. In Argentina, such works – particularly those over the Limay River basin, carried out by the state-run company Hidronor – were financed by a creative and efficient system comprising domestic funds coming from the oil revenue. In the case of binational works, however, delays, overpricing and the growing importance attributed to their environmental and social impact restricted the construction of new hydroelectric power plants. The Yacireta case was emblematic in that the cost per installed MW greatly exceeded initially expected costs⁴.

⁴ The initial budget had been estimated in around 1500 million dollars. By 1979 it had already reached 5350 millions. Without the current expansion, it is estimated that the cost per MW is over 3600 u\$sd/KW; this figure should be compared, for example, to the approx. 2000 u\$Sd/KW that

On the other hand, the reform process enabled private groups to have access to gas reserves and to electric generation assets. This created opportunities to expand generation with pre-existing conventional thermal plants and with new combined-cycle plants which, thanks to investment and operation costs influenced by low-cost gas, led to a rapid increase in value of the purchased reserves and guaranteed high returns of electricity and hydrocarbon sector investments. Vertical integration, permitted to a certain extent, and the horizontal integration of gas and electricity chains, brought about the emergence of private electricity conglomerates with interests in Argentina, but also in other Latin American and Caribbean countries and in the rest of the world.

Figure 5
Natural gas consumption trend for thermal generation.
In millions of m³/year



Source: Author's estimates using data by OLADE, SIIIE, 2010.

One of the aspects of this new strategy was that the main actors also tried to achieve the expansion of their markets through natural gas or electricity exports. In fact, much of the capacity installed between 1992 and 1997 was meant to be sold to Brazil, which

was Itaipú, which was also affected by high costs. During the 90s, these values were compared to the investment costs for combined-cycle plant technology, which were estimated between u\$sd 600 and 800 per kW, with low operative costs due to natural gas price and to the high efficiency level of this technology, which was new back then.

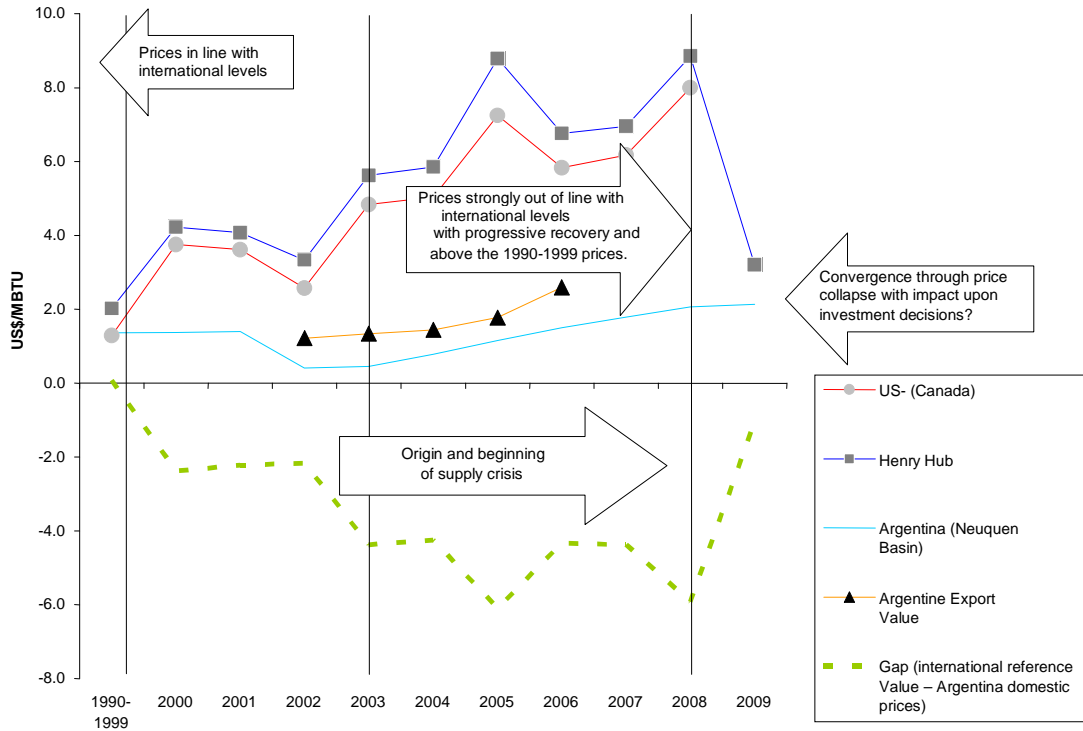
demanded ever larger amounts of energy. Likewise, in order to monetize their reserves, gas producers started exporting gas to Chile, Brazil and Uruguay, much of which was meant for electricity generation. In Chile, expansion restrictions imposed on hydroelectric generation boosted the installation of combined-cycle facilities running with cheap gas imported from Argentina.

A prevailing idea at the time was that plenty of gas was available and that prices would not rise. It must be remembered that over most of the 1990s, the price of the oil barrel fluctuated around an average of 18 dollars/barrel. In Argentina, export reference values for gas were near the Canadian gas price exports to the USA, which did not differ much from Argentine domestic prices and from export prices to Chile and Brazil. In this context, there was an amazing growth of gas production in Argentina. However, since no investments were made for exploration, such policy resulted in a fast reserve depletion rate.

Since the aim was to monetize reserves, and proved reserves were overvalued, very little exploration was carried out. In fact, the number of oil wells increased by over 52% between 1990 and 2004, in relation to those drilled between 1973 and 1990, whereas the average number of exploration wells decreased more than 32%. Actually, producers used to report reserve increases on the basis of figures that had decreased thanks to a re-categorization of reserves prior to the privatization. At that time, proved reserves were thus transferred to the unproved category (Kozulj, R. et Al., 1993; Kozulj, R. 2000). As time went by, reserves that had always been proved were reported as discovered. No correlation existed between exploration wells and the report of reserve discoveries by areas. Year after year, the amounts produced were compensated for by reports of reserve increases that were not correlated with the scarce exploratory activity that was carried out (Kozulj, R. 2000).

On top of this, the economic crisis between 1999 and 2002 did not favor high-risk investments. The domestic market remained stagnated, and oil and gas exports continued to grow. In 2004, several factors combined to make the problem evident. On the one hand, after the 2002 crisis, Argentina “pesified” its gas price, which meant dividing its dollar value by three between 2002 and 2004. On the other, as of 2003-2004, the price of crude oil, gas and related commodities started to rise. In this context, the distance between domestic and international prices became an additional factor to freeze investments, both high-risk and development ones (Figure 6).

Figure 6
Domestic and international gas prices. In US\$ / MBTU



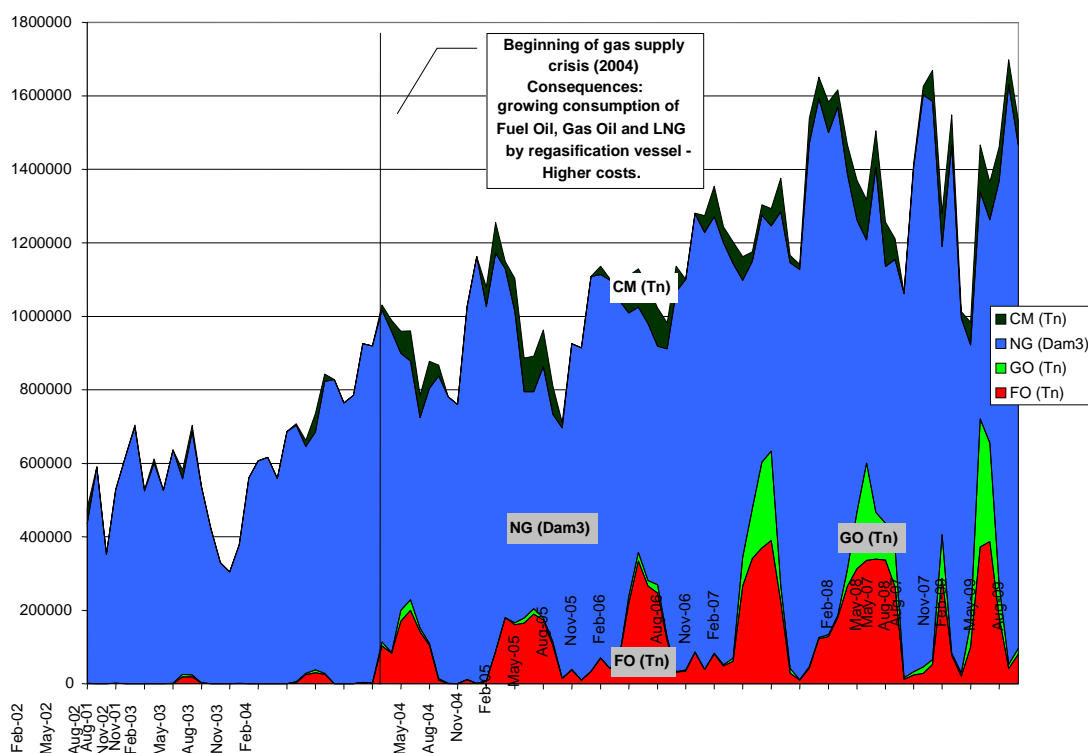
Source: Kozulj, R. (2009) using data by the Argentine Energy Secretariat and BP Statistical Review of World Energy, 2009.

In Argentina, the gap between domestic gas prices and international reference prices for gas transactions between the United States and Canada was almost non-existent between 1990 and 1999, but it widened as of 2000-2003, reaching almost US\$ 4/MBTU in 2003-2004, and US\$ 6/MBTU in 2005. In this complex domestic and international context, the Argentine authorities permitted a relaxation of certain regulations⁵ so that gas value could reach similar and even higher levels than it had had over the reform period (1993-2001), but in the new price context, these “market signals” were still far from producers’ expectations, who wanted to establish domestic gas price signs based on the opportunity cost. From the point of view of security supply, this situation became absolutely crucial for Argentina.

⁵ A first step to restore the price of gas consisted in agreeing with producers a minimum supply barely below the price that was in effect during the convertibility period. This measure was accompanied by the expansion of an OTC market. Both measures helped to bring the average price obtained by the producers to a value close to u\$sd 2 MBTU, which was higher than that obtained during the convertibility period but lower than the international transactions’ reference price. Recently, the government launched the “Gas Plus” program, which acknowledges international prices for all “new” gas added to the supply.

The first measure that the unavailability of gas brought about, was the progressive discontinuation of exports to Chile⁶. Consequently, private Chilean investors had to invest in diesel plants, re-invest, partially at least, in hydroelectricity, and also build a regasification plant that has recently started operating. But this discontinuation of Chilean exports was not enough to avoid the growing consumption of alternative fuels, such as Fuel Oil imported from Venezuela, Gas Oil and even LNG imported by the main energy operating company, largest producer and trader in natural gas in Argentina. Since the authorities did not adjust end user tariffs either, much of the cost was absorbed by the State by means of subsidies and compensations granted to generating companies.

Figure 7
Fuel consumption for thermal generation 2001-2009
Natural Gas in dam³, FO,GO y CM in tons



Source: Author's estimates using data from CAMESA.

⁶ Although the development of gas exports concerned private actors, it was the Argentine government who authorized them. But such authorization was granted on condition that internal demand had to be satisfied first. For this reason, when the first shortage symptoms appeared, exports were progressively interrupted. As the Chilean investors had invested around u\$5 000 millions in gas power plants and in gas transportation and distribution infrastructure, the only solution found was to import LNG. For that purpose, in 2004 the decision to build a regasification plant was made.

The peculiarity of the Argentine case is not only that it kept a distorted scheme of prices and tariffs, but also that, in spite of state intervention in this policy area, it was not able or willing to change its main institutional and regulatory model to adapt it to the crisis described above.

The negative impact of gas nationalization in Bolivia on private investments was probably a contributory factor to prevent a radical course of action in Argentina (Mora, J. 1998). Negotiations carried out by the authorities aiming at improving producers and generating agents' incomes by means of subsidies seems to have been the prevailing option so that the crisis could be faced without resorting to a deep change in the model and, on the other hand, without dealing with the domestic political costs that price liberalization would have implied (Bariloche Foundation, 2004).

As stated above, however, the situation regarding gas supply is critical in that, since 2004, the system has exceeded a thermal generation average equivalent to 55% of total electricity generation including imports, with a share that reached 70% in months of peak consumption. Such a situation deserves a special analysis for at least two main reasons: a) the fact that investments meant to increase gas supply and reserves are not made by the national government but by external private actors; b) the possibility of diversifying the Electricity Generation Matrix is a limited option in the short and medium term, and does not depend entirely on the authorities either. Strong as these statements might sound, they are not so when the context is taken into consideration. Thus, special attention shall be devoted to this issue in the following section.

Firstly, though it is true that energy price signs have played a role in the development of this situation, and that this is what the authorities could modify, there is no certainty that the actors would respond to them by means of larger investment in order to guarantee the gas or liquid fuel supply necessary for thermal generation. Secondly, Argentina has a relatively limited number of hydroelectric plants, since the largest projects are binational. Even though the promotion of renewable fuels launched by the national Energy Secretariat by means of the GENREN⁷ program could overcome both problems, since they are fifteen-year contracts entered into by tender, they comprise only a total of 1145.7

⁷ The program, launched at the end of 2009, comprised the supply of 1,000 MW worth of renewable energy by means of fifteen-year contracts, to be awarded by the state-run company ENARSA. It should be clear that ENARSA is actually a government office in charge of project, works and energy purchase management, not an energy company with physical assets. The GENREN program means to tender 50 MW modules, with a repayment mechanism that could soon recover investments in new generation projects. Initially, it was expected that 50% of the 1,000 MW could be produced by new wind farms. Also, an additional amount of 150 MW were to be produced by thermal plants running on biofuel, 120 MW by waste, 100 MW by biomass, 60 MW by mini-hydro, 30 MW by geothermal, 20 MW by solar power and 20 MW by biogas. If these projections by the Energy Secretariat were fulfilled, investment by 2016 would range between 2,200 and 2,700 million dollars.. However, though the supply exceeded the expected 1,000 MW, it comprised 85% of wind farms.

Source: www.energiaynegocios.com.ar and ENARSA.

MW distributed across more than 30 projects, offered by 27 private companies⁸. Each one of these aspects will be analyzed below.

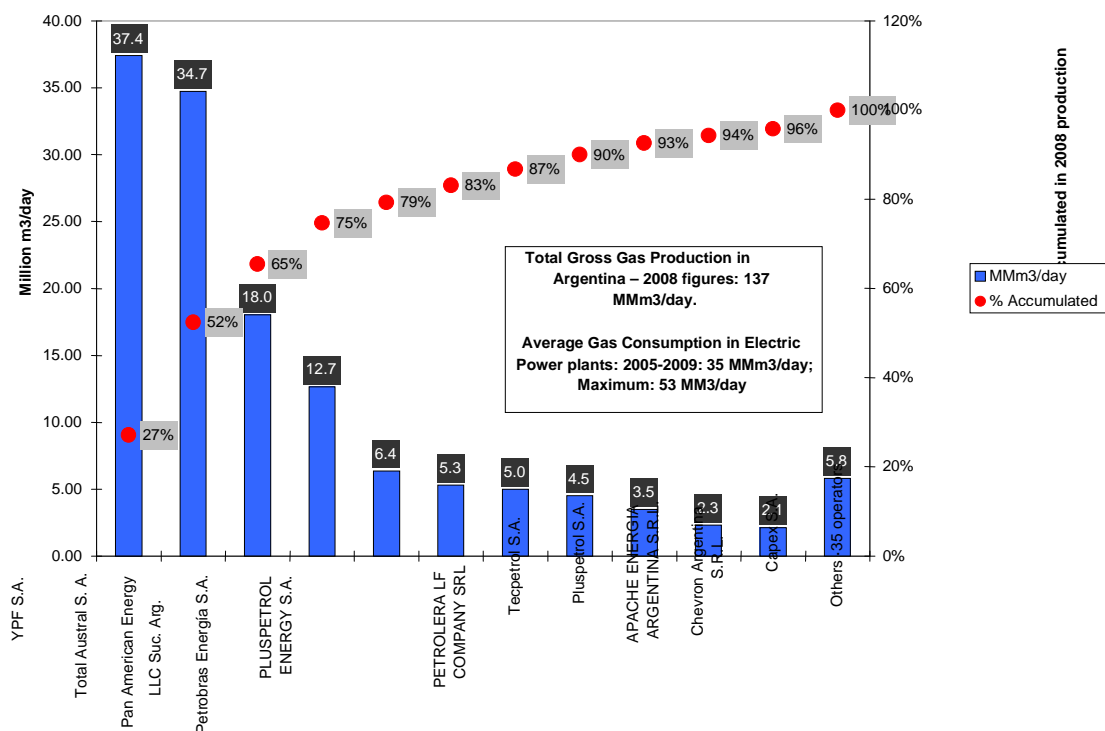
3. Problems faced by Argentina regarding the achievement of gas supply security for electric power generation.

3.1. Natural gas supply and company strategies adopted by the main actors

The natural gas supply market has always been highly concentrated in Argentina. Considering only gas production amounts by each main operating company, REPSOL-YPF, currently called YPF S.A. in Argentina, accounted for 27% of the total (according to the Energy Secretariat, 2008). It also operates the largest gas field in the country (Loma La Lata-Sierra Barrosa), accounting for 50% of total reserves or resources of the Neuquen Basin. This, in turn, accounts for only 23% of total gas resources in the country. Even if it is difficult to estimate the actual share of this group in reserves and production – both because of deficient official data and because the company also trades in gas from other operating companies where it is not among the main actors – its leading position in the market is beyond question. Figure 8 shows the remaining operators.

⁸ The GENREN program has been awarded to local equipment producers like IMPSA and to international operators too, such as Endesa and AES.

Figure 8
Gross natural gas production by main operator in million cubic meters/day



Source: Author’s estimates using data by the National Energy Secretariat.

The strategic position of Repsol-YPF is also a consequence of its production concentration on the Neuquen Basin, which is only 1300 km away from Buenos Aires, whereas the second main operator, Total Austral, though also operating with Neuquen Basin reserves, concentrates its work on the Austral Basin, most of which is off-shore, and with a transport infrastructure that needs to extend over 3000 km in order to reach the main consumption points. Besides, transport capacity from the Neuquen Basin triples that of the Austral Basin.

In this context, and considering that proved, probable and possible reserves until the end of the concession of current operating companies represents 85% of the total in the country, the analysis of the strategy adopted by Repsol-YPF becomes a key element in order to understand the vulnerability of the Argentine electricity supply system.

3.1.1. Repsol-YPF production and investment strategy: connection between the policies adopted by the Government of Spain and their impact on Latin America in general and on Argentina in particular⁹.

⁹ The contents of this section belong to research work carried out by the author for ECLAC in 2009.

Once the strategic importance of the Repsol-YPF¹⁰ group for supply security in Argentina has been established, it is necessary to examine what has been the impact of YPF privatization on the growth of Repsol-YPF international activities, the role played by institutional changes in Spain, and how investments have shifted from Argentina and other Latin American countries to regions such as the north of Africa, which is a crucial step to see to hydrocarbon supply in Spain and improve the cost-effectiveness profile in the LNG world market (Iza, M. P., 2007; Kozulj; R. 2009).

Before purchasing 99% of YPF S.A total share issue in 1999, Repsol was a Spanish state-run company with no significant international activities. Their operation in Argentina took place within a context of a generalized aggressive investment by Spanish companies in every energy sector areas and in other public services in the beginning of the 90s. The importance of such strategy was outlined together with financial actors such as the BBVA and La Caixa. The aim was to strengthen Spain's position within the European context by their state companies operating in Latin America and supported by the most powerful of Spain's private financial sector. YPF S.A. takeover meant the entry of the Spanish state-run company to almost every Latin American country since YPF S.A., before being purchased by Repsol, had acquired Maxus assets, which in turn operated in Peru, Bolivia, Ecuador and other countries. At the same time, with PEMEX becoming part of Repsol, their access to the Mexican and USA markets was facilitated (IZA, M.P., 2007).

However, this action stage through the Spanish government and their public companies changed as Spain also started its own privatization process.

That is, it is necessary to examine on the basis of empirical evidence, how the pursuit of clear objectives regarding supply security in Spain, in the context of the European market opening, has conditioned supply security in a periphery country such as Argentina as from the exploitation of its natural resources (Rozas; P. 2008; 2009). The importance of this issue lies in the fact that the emphasis on market liberalization in Argentina implied, among other things, that the State would be freed from the financial burden related to investment expansion in the energy sector, in order to devote efforts to social purposes, whereas supply security would be safeguarded by a process of private investments attracted by the incentives and advantages granted to the international private sector through the design of the new rules of the game.

¹⁰ Repsol YPF S.A., is a corporation founded in 1987, originally comprising a group of companies previously belonging to the National Hydrocarbon Institute (INH), whose activities included exploration, production, transport and refining of oil and gas. When in 1999 Repsol took over most of the assets of the Argentine state-run company YPF, the corporation was named Repsol YPF, S.A., becoming an integrated multinational oil and natural gas company, one of the largest private oil companies in the world, with operations in more than thirty countries. It is also the largest private energy company in Latin America in terms of its assets, and it employs over 37,000 people around the world.

This is not a side issue, since it reveals one of the weakest points in Argentine energy policy, which based the expansion of energy supply on market opening and liberalization rules. This came against company policies of reserve monetization that were conceptually far from the government's objective of ensuring internal supply.

The purchase of YPF in Argentina-el principal actor antes de las reformas- brought about a 140% increase of Repsol's assets, whereas its long-term liabilities grew to 349% and the short-term ones to 267%. Pero, Repsol-YPF (así denominada tras la adquisición de YPF S.A. de Argentina) considerably reduced its debt between 2001 and 2002, a fact that has not found a likely explanation either in relation to physical assets de-investment or to net operation incomes (Table 1). Curiosamente este desendeudamiento de Repsol-YPF fue paralelo a la gran fuga de divisas que ocurrió en la Argentina entre marzo de 2001 y diciembre de ese año. Aunque formalmente ninguna prueba puede ser establecida, ciertamente el hecho de que los principales bancos privados de Argentina fuesen españoles y accionistas de la petrolera española es un hecho llamativo

Table 1
Description of the change in the main items of Repsol's balance sheet after its YPF takeover in 1999-2000, and its indebtedness process until 2003

Description of Repsol's Balance Sheet Items	Variation 1998/1999	Debt (millions of Euros)	
		Year	Variation
		1998	3534
		1999	17136
		2000	20398
		2001	16555
		2002	7472
		2003	5047
			-2425
Operating Income	38%		
Results before taxes	16%		
Operating Results	59%		
Total Assets	140%		
Assets	140%		
Equity	107%		
Minority stakes	24%		
Long-term Financial Debt	349%		
Other Long-term debt	85%		
Non-current Liabilities	61%		
Short-term Financial Debt	267%		

Source: Author's estimates using data by Repsol published in their webpage, 2003-2004.

As a consequence of policy changes in Spain and of the search for private investment opportunities, as of 2004 Repsol-YPF dejó de ser estatal y was controlled by a principal shareholder related to the construction business, el grupo Sacyr Vallehermoso. In 2008,

its total share issue comprised: Sacyr Vallehermoso, S.A.: 20.0 %; Criteria CaixaCorp¹¹: 14.1%; Chase Nominees Ltd.: 9.8%; Petróleos Mexicanos (PEMEX): 4.9%; AXA, S.A.: 4.2%; Barclays Bank: 3.2%; Mutua Madrileña: 2.0%; Caixa Cataluña¹²: 1.62%; Stock Exchange/minority shareholders): 40.18 %. However, the government of Spain kept considering it a relevant actor in the Spanish energy policy, in the context of the European opening of energy markets.

As has already been said, most of the assets controlled by the Repsol group in Latin America derived from the prior purchase by YPF of Maxus oil company, which had assets in Bolivia and other countries in the upstream sector. This is how Repsol-YPF became one of the main regional actors (Table 2).

Table 2

Repsol's main assets and contracts in the upstream sector in Latin America

Argentina	YPF has mining rights over 113 blocks in Argentina. <ul style="list-style-type: none"> • 21 exploration blocks, with a net area of 50,221 km² • 92 exploitation blocks covering a net area of 26,501 km²
Brazil	<ul style="list-style-type: none"> • Repsol participates in 22 blocks in Brazil's main exploratory basins: Cuenca de Campos • It is the operating company in 11 of those blocks. • It is the first private company with off-shore exploratory mining domain in the Santos Basin • It holds 10% of one of the largest oilfields in the country. It is currently one of the main energy integration bases in Latin America.
Bolivia	<ul style="list-style-type: none"> • Repsol has mining rights over 31 blocks. • 6 exploration blocks with a net area of 7,022 km² • 25 exploitation blocks with a net area of 1,489 km², in the Beni, Pie de Monte, Subandino Sur and Subandino Norte Basins.
Peru	<p>Repsol has mining rights over 8 blocks: 39, 57, 90, 109, 76, 103, 56</p> <ul style="list-style-type: none"> • 6 exploration blocks with a net area of 31,395 km² • 2 development blocks, with a net area of 202 km² • Repsol operates the consortium that will exploit the Kinteroni X1 field situated north of blocks 88 and 56, also shared by the company and from which the Camisea project production comes. • The Camisea Consortium, where Peru has a 10% share, announced in 2008 the beginning of operation of block 56 with commercial extraction from the Pagoreni oilfield in Cuzco, Peru.
Ecuador	<ul style="list-style-type: none"> • Repsol has mining rights over 2 development blocks with a net area of 770 km² • Block 16, in the eastern province of Orellana; with Tivacuno and Bogi-Capiron it extends across 220 thousand hectares. • The agreement signed in Ecuador extended the exploitation period to six years – from 2012 to 2018 – for block 16, and a transitional one-year period was established.
Colombia	<p>Repsol has mining rights over 9 blocks.</p> <ul style="list-style-type: none"> • 7 exploration blocks with a net area of 4,278 km² • 2 exploitation blocks (Capachos and Cravo Norte) with a net area of 268 km² • Three new discoveries took place in 2008, two of which with Cosecha Z and Cosecha Y Norte test drillings, in the Cosecha block of the Llanos Orientales basin, where Repsol has a 25% share and Oxy, (with 75% share) is the operating company.
Venezuela	<p>Repsol has mining rights over 6 blocks in the eastern and western regions of the country, specifically in Quiriquire, Barrancas, Mene Grande and Yucal Placer.</p> <ul style="list-style-type: none"> • 2 exploration blocks with a net area of 669 km² • 4 exploitation blocks with a net area of 443 km² • It has exploratory rights in the Cardon IV Project belonging to the Rafael Urdaneta Project.
Mexico	<ul style="list-style-type: none"> • Repsol has a multiple service contract over one development block called Reynosa-Monterrey in the Burgos basin, north of the country. • Initially, it is a 20-year contract. • It will be enforced as of December 2014 • Original area: 3,538 km² • Current area: 373 km² • It has 51 active oilfields.

Source: Author's estimates with Repsol data.

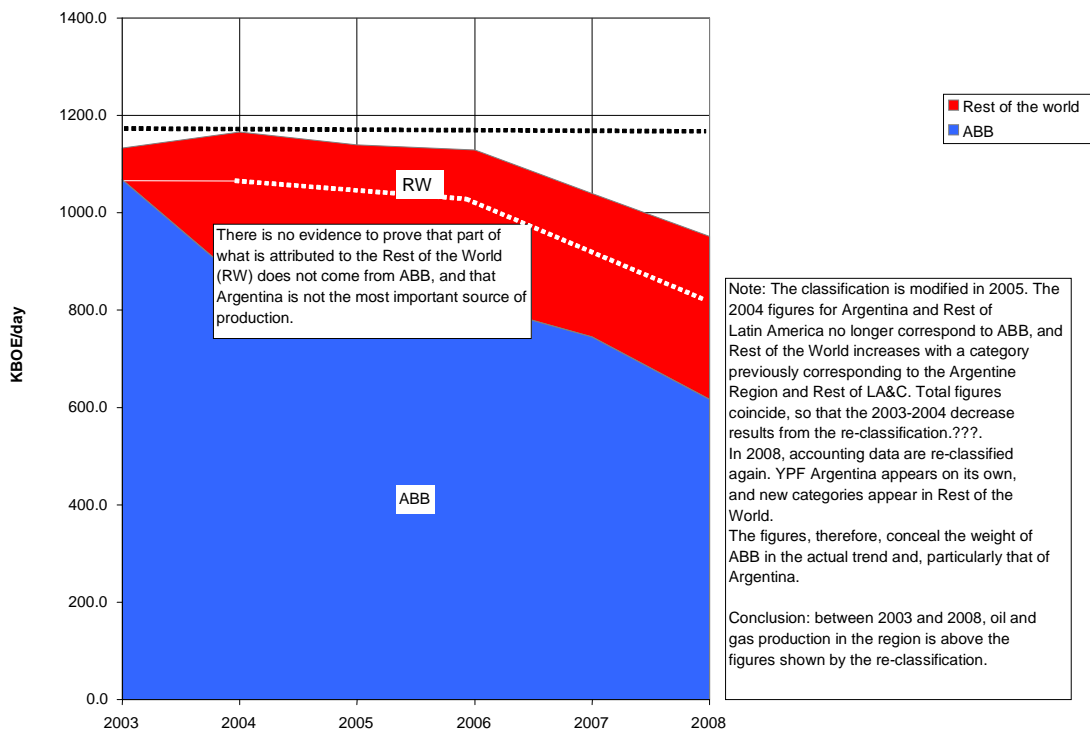
¹¹ Through Criteria and Repinves

¹² Through Repinves

Over the 2003-2008 period, important changes took place in the orientation of Repsol's investments, with an important displacement – as was evident through its financial results – in the space relation (or relation by geographical areas) between: 1) origin of production; 2) origin of income; 3) purpose of investments.

In order to fully understand this process, it is necessary to analyze a series of figures that will show the strategy adopted by the group. Firstly, then, the origin of production in the upstream sector will be shown (Figure 9).

Figure 9
Trend of upstream production (activities classed as E&D)¹³
according to origin of production.
ABB (Argentina-Bolivia-Brazil) and Rest of the world – 2003-2008 period.



Source: Author's estimates using Repsol data.

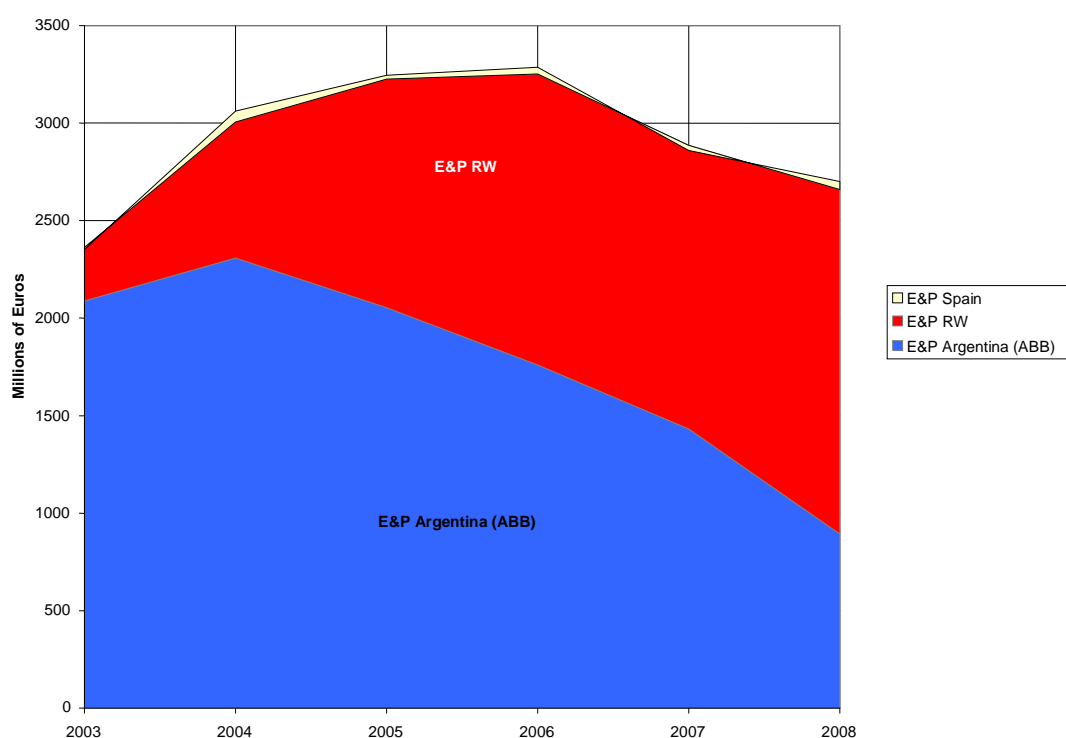
Even though the real contribution of the ABB region (Argentina-Bolivia-Brazil) to production cannot be assessed accurately because of the modifications introduced to the way of classifying the origin of production between 2003 and 2004 (and after 2008), total

¹³ The activities that Repsol classifies as E&P (Exploration and Production) refer to activities of the Upstream sector within the hydrocarbon industry chain, that is, exploration, exploitation and development in the oilfields to produce hydrocarbons (gas and crude oil).

production clearly decreased as of 2004. Anyway, it is essential to point out that most of the hydrocarbon volume is extracted in Latin America, with Argentina as the main source.

Operating results, however, followed a different pattern mainly as a consequence of the price policies implemented in Argentina, and secondarily in Bolivia, as of 2006.

Figure 10
***Operating Result trends in the Upstream sector (or activities classified as E&P)
according to the origin of production.
ABB (Argentina-Bolivia-Brazil) and Rest of the World – 2003-2008 Period***



Source: Author's estimates using Repsol data.

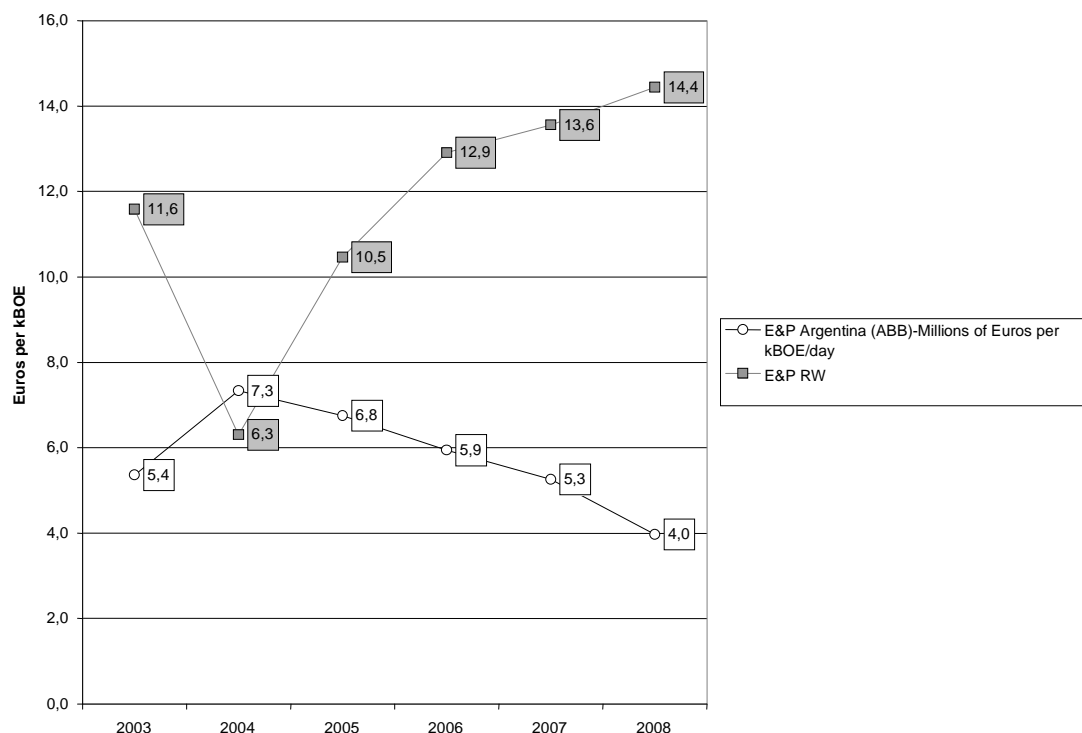
Note: In this case, part of the results in Rest of the World may also come from some ABB country as a consequence of change in classification criteria effected in 2004 with respect to 2003, and 2008 with respect to 2004-2007.

In order to understand the extent to which price policies affected changes in the total production profile according to the geographical areas, the quotient between Repsol's operating result values¹⁴ and production levels in the Upstream sector was estimated, as expressed in kBOE¹⁵/day (Figure 11).

¹⁴ For this estimate, values of the item Operating Results before taxes as displayed in the figures submitted by Repsol were taken into account, as well as those regarding production magnitudes.

¹⁵ kBOE/day means a thousand barrels of oil equivalent a day.

Figure 11
 Trend of net benefits per unit before taxes – Euros per kBOE



Source: Author's estimates using Repsol data.

Although these results are also a consequence of the different Gas-Oil mix in each region, they reflect the impact that diverse price policies have had in the ABB region, basically dominated by the results for Argentina, with respect to the rest of the world. Thus, whereas the *ad hoc* regulations imposed in Argentina and the changes in Bolivian legislation tended to reduce the net profit per unit obtained in the exploration and production stage, in the rest of the world this profit per unit grew according to the international price trend.

Anyway, the low profit per unit obtained in each case and the high average total costs per unit implied (Euros per BOE), as resulting from the estimates based on Repsol's balance sheet¹⁶, are quite striking.

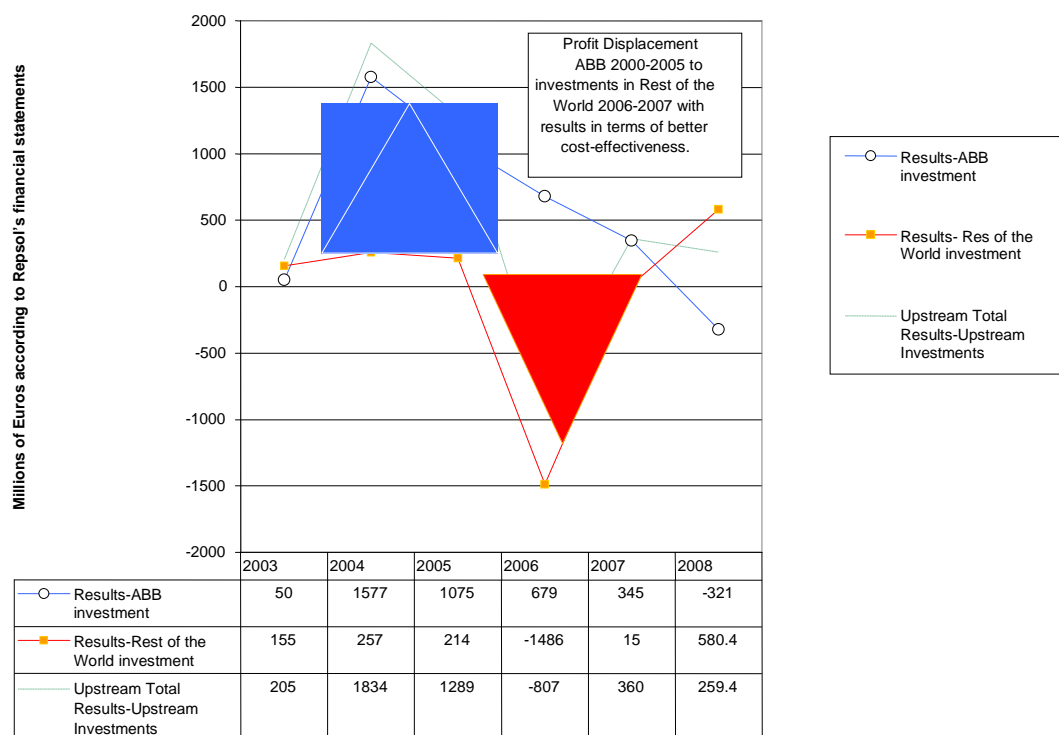
¹⁶ The difference between the international average reference price (as estimated with data from BP, Statistical Review of World Energy, 2009) and operating results according to Repsol's balance sheets and magnitudes would yield average total costs for 2003-2004, including all the "government take" in ABB (with Argentina as the main country) and Rest of the World, of 45 US\$/BOE in Argentina (ABB) and 39.4 US\$/BOE in the Rest of the World.(Author's calculations).

However, Repsol's decision of investing abroad was particularly emphatic as of 2004, irrespective of the fact that operating results for that year in ABB exceeded those of 2003. This is not a minor fact since it reveals that it is quite likely that better price signs would not have meant larger investment in Argentina anyway – something that cannot be either confirmed or refuted. Yet it does draw attention to a crucial aspect related to the fact that central countries search for their own supply security and better horizons of cost-effectiveness, specially after the change of context in the world energy market as from 2003 when China and other emerging countries showed up as big consumers and potential foreign investors in the search of gas and oil reserves disputable at a global scale. In a country such as Argentina; in turn, this strategy (basing its supply security on a private investment process) has not brought about positive results. To sum up, the arguments in this discussion intend to confirm that while central countries –Spain in its relation to Latin America in this case– had very much in mind the strategic side of energy security in a world considering global and geopolitical aspects, Argentina took for granted that microeconomic and macroeconomic interests would coincide, since the market forces would indicate so; it was also believed that the energy sector was not necessarily of strategic importance since resources were superabundant¹⁷.

The symmetric displacement of Repsol's investments with profits obtained in ABB (mainly Argentina) towards the rest of the world may be verified by subtracting a) operating results for each geographical region each year; 2) total investment for the same year in each region. This is represented below, in Figures 12 and 13.

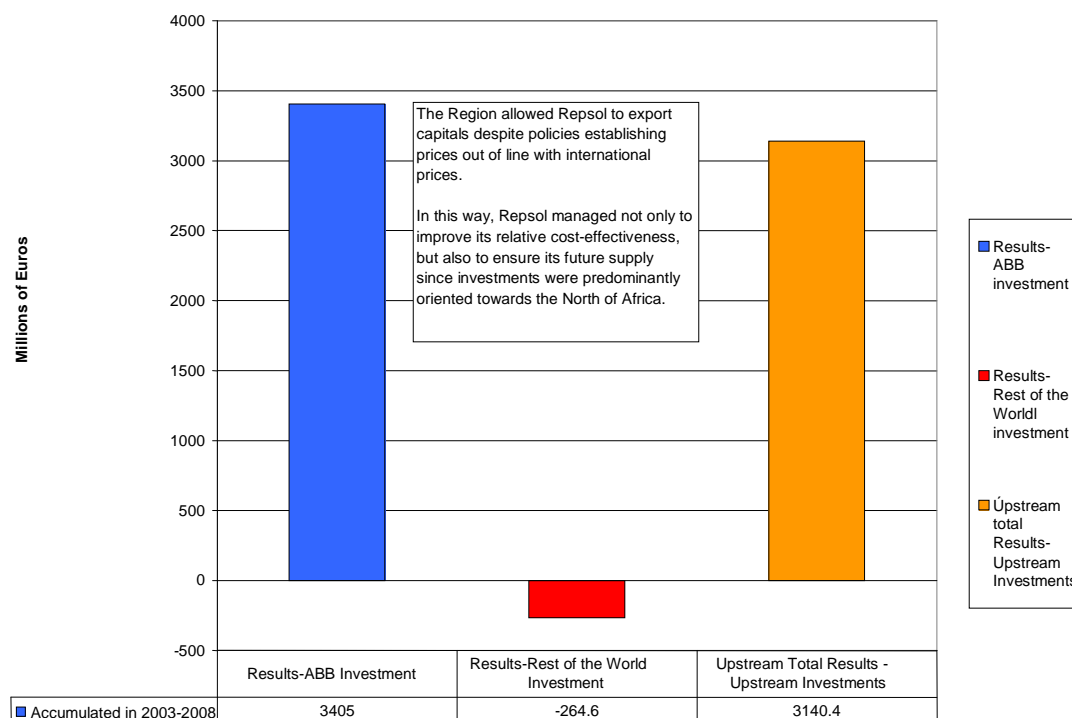
¹⁷ Indeed, this statement was explicit at the initial stage of oil companies' privatizations in Argentina, under Carlos Saúl Menem's term. It was even argued that leaving unexploited reserves in the underground would be meaningless since oil would be replaced in the future by new energy forms and that considering oil as an "strategic good" instead of as a simple "economic good" was a huge conceptual mistake (Cf. Kozulj, R. et. al, 1993).

Figure 12
*Net Investment Operating Results by regions in the 2003-2004 period.**



Source: Author's estimates using Repsol data.

Figure 13
Net Investment Operating Results by regions.
Accumulated results in the 2003-2008 period



Source: Author's estimates using Respol data.

If the targets of global cost-effectiveness improvement and increase in supply security in Spain are taken into account, this strategy could hardly have been reversed only by means of improvements on cost-effectiveness in ABB, since oil production decline – and also gas decline, according to Repsol – would be a geological fact, not merely an economic one. It could have been reversed only by means of heavier investment in exploration from the beginning of the reforms, which was not the case precisely because the strategy implemented was to monetize reserves. Whereas this mechanism is correct from the entrepreneurial point of view, it can be clearly perceived that it has become a serious obstacle to improving supply security in the region with strong implications for the electricity sector.

However, some facts need to be remarked as from this analysis: 1) Repsol did not get better total operating results from its upstream activities at the global level in 2007 and 2008, which were the best years for oil companies all over the world as a consequence of the combination of high prices and growing demand; 2) production levels so far have been declining, and investments in the rest of the world were not enough to produce an increase that could compensate the decline in ABB until 2008/2009.

In this context, the fact that the majority shareholder in the group, SACYR Vallehermoso, is an actor strongly related to the construction industry has meant that financial vulnerability has been transferred from one economic sector to another¹⁸.

Likewise, public purchase offers for Repsol in 2009 must be considered within this uncertainty context that has had a heavy impact on the region. This has been so both because of the strategy followed by Repsol and because of the crisis of the international financial system – in turn derived from the real estate market crisis in the United States and other countries. The impact of these trends has obviously not been the same in each of the countries, but it was certainly very serious in Argentina¹⁹ and Bolivia.

On the contrary, it is quite likely that Repsol's most profitable business in LA&C is in Mexico, where the synergies between SDG Natural GAS, Unión FENOSA, Repsol and PEMEX (one of Repsol's shareholders) have strengthened. Among other factors, this has been a consequence of the validity of the concept of Independent Energy Producers which, by preventing the massive privatization of public companies in the energy sector, has managed to achieve the participation of these private actors in groups of companies not so subjected to public regulations restricting their profits.

All of the above indicates that the new world context emerging from the 2009 crisis is different in certain respects. It no longer has to do with the fact that national governments have restrictions to manage their energy policy by means of private investment, but with the fact that this investment, which has a speculative nature in countries with a weak institutional character such as Argentina, is also exposed to more complex financial strategies and affected by high-risk factors completely outside the energy sector but with an impact on it through the behavior of its actors and its own difficulties.

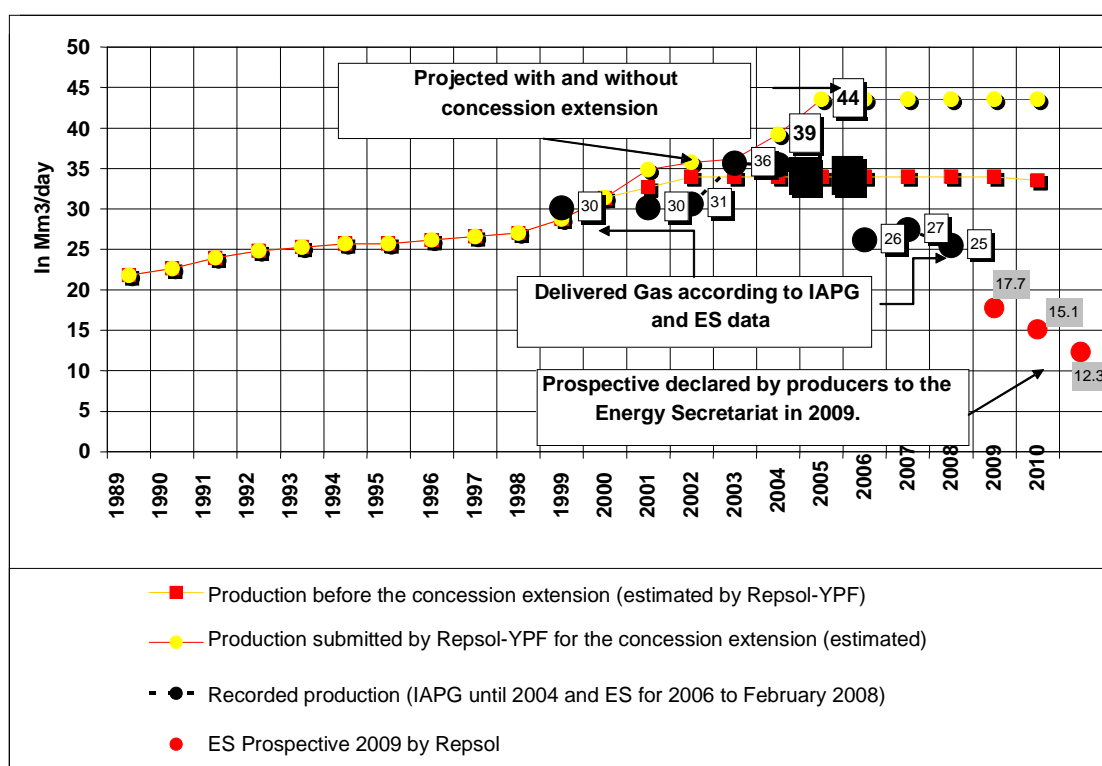
¹⁸ SACYR Vallehermoso, Repsol's majority shareholder and an important actor in the construction industry in Spain (involved in the construction of the third set of locks of the Panama Canal, which was awarded to "Grupo Unidos por el Canal", where SACYR Vallehermoso is a leader company) is indebted by around 16 thousand million dollars, after its reduction by 20% with respect to the 20 million dollars at the end of 2008. Although SACYR Vallehermoso states that negotiations to pay its debt are being carried out "case by case" and on a continuous basis, formalizing them by operations, without syndicated collective agreements, and considers that there will not be any "important problem" in renewing the rest of the debts which are due in 2009, offers by some groups on Repsol in 2008 and 2009 apparently originated in such debt. For now, however, the Repsol group seems to have strengthened after the purchase of Unión FENOSA via Gas Natural SDG S.A. There was a critical moment when, by the end of 2008, the Russian oil company Lukoil made a bid on SACYR that produced a division in Spain between those who were favorable to the incorporation of such a majority partner as long as Repsol was still managed by Spaniards, and other groups that opposed such option because they considered it politically risky. The takeover of ENDESA by ENEL may have played a positive role in re-negotiations with the Spanish banks. The cancellation of part of the debt with Citigroup as from the sale of Itinere, a company working in the freeway sector, meant that the debt is now only with Spanish Banks, different from La Caixa and the BBVA. However, after the recent crisis in Greece, Spain is still facing significant financial challenges, which increases the uncertainties regarding Repsol's future and, even more, its future in the region.

¹⁹ If the fact that most of the investment incurred by Repsol was in Argentina is taken into account, and if the total foreign investment received by this country from the European Union is compared across all economy sectors, the result is that almost 40% of direct foreign investment (DFI) from the EU in Argentina between 1998 and 2008 corresponded to Repsol in E&P. The purchase of Repsol in 1999 would certainly account for over 80% of the DFI from the EU in Argentina and at least a third of the regional total.

This being a brief account of the strategy adopted by Repsol, it is still necessary to examine what it has meant in terms of the behavior of gas production in Argentina. In order to do this, the case of the Loma La Plata gas field will be considered, since it is, the most important in the country.

Figure 14

Production prospective of the Loma La Lata-Sierra Barrosa natural gas and oil field in the re-negotiation of the concession extension to 2026 submitted by Repsol-YPF to the government of the province of Neuquen, delivered production according to the IAPG and the National Energy Secretariat and prospective declared in 2009.



Source: Author's estimates using data from Repsol, IAPG, the National Energy Secretariat (ES) and the Government of the Province of Neuquen.

In order to be granted the concession extension to 2026 for the Loma La Lata gas field, which expired in 2016, Repsol submitted in 2000 – only a year before the complete purchase of YPF S.A.²⁰ – two likely production alternatives. The argument put forward was that it could invest in Bolivia or in Argentina but, since the concession expired in 2016, investing in Argentina in order to increase production level by 10 MMm³/day was not justified because without the additional investment, production could be around 34

²⁰ Such was the name of the Argentine company – and still is – before it was bought by Repsol when it was privatized in stages as of 1990.

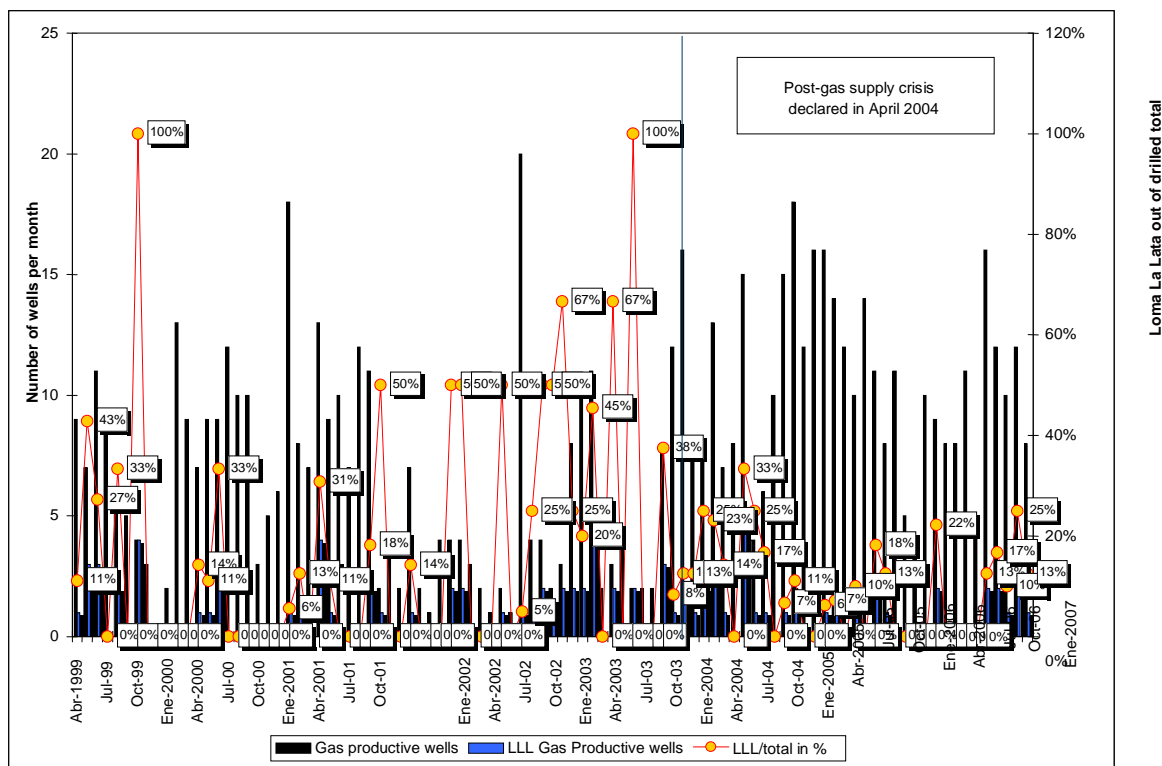
MMm³/day until at least 2010. If, in turn, the concession was extended by 10 years (expiring in 2026), Repsol committed itself to investing in order to extract up to 44 MMm³/day.

However, just at the time of the 2004 crisis, Repsol announced that there had been a mistake in the prospective estimates for Loma La Lata, that the gas field had undergone severe depressurization and that it would not be able to deliver more than 25 MMm³/day. According to Repsol experts, the depressurization had been caused by excessive extraction in order to meet the growing gas demand. As Figure 14 shows, however, production in Loma La Lata never exceeded the foreseen upper limit, except in 2003 – and that was in relation to the lower limit, never to the 44 MMm³/day that the company had promised. As of 2005, the amount delivered was even below the lower limit, and since 2007, production forecasts have revealed ever decreasing amounts²¹.

When considering the gap between the projected production that would derive from the concession extension and the amounts delivered, the conclusion can be drawn that only this gas field produced a growing deficit of at least 9 MMm³/day with respect to the lower projections (that is, not considering investment from contract renegotiation) and of more than 19 MMm³/day considering the expected increase in production that had been promised. On the whole, the Argentine authorities seemed to ignore these issues and accepted that Argentine gas reserves were limited.

²¹ Undoubtedly, this strategy also reveals an interest in increasing the LNG export business, in which Repsol constitutes a major international actor.

Figure 15
Productive gas well and drilled well totals in Loma La Lata



Source: Author’s estimates using data from the Energy Secretariat.

Investment in Loma La Lata stagnated as of 2004, as shown by the trend in both the total number of drilled gas wells, and the number in that gas field. This is also reflected in Repsol’s financial statements and coincides with the process of reinvestment of earnings coming from the exploitation of Argentine resources, those from abroad and from the ABB region. The company then devoted the surplus to regions such as the North of Africa, where Repsol YPF gets part of the gas required for its own supply to Spain. The Repsol group is one of the main actors in the LNG market. In fact, it supplied Argentina with LNG from a regasification vessel in periods of peak demand over 2009, and since then it has been supplying the fuel on a continuous basis at a high cost (US\$ 18/MBTU).

To sum up then, and looking into the future, it is very unlikely that the process by which Repsol reoriented its investment outside Argentina can be reversed. The Argentine authorities have tried to send international price signs since 2008 by means of the “Gas Plus” program. Yet this initiative seems to be more in the way of increasing domestic supply by means of lax regulations that will allow operators – Repsol among them – to report discovered and not declared gas as “new gas” (and as such, subject to international market prices), which, as has been explained, was an accepted practice.

3.1.2. Production and investment strategies adopted by other private operators

The second largest strategic gas operator in Argentina, as has been said, is Total Austral, a subsidiary of the French group Total S.A.²². Unlike Repsol, its assets in Argentina are not a significant portion of its world portfolio. The growth of gas supply coming from the Austral Basin depends on the increase in transport capacity from the southern gas field. However, gas transport tariffs and the depletion of public resources coming from the fiscal surplus that Argentina kept until 2007, render it very unlikely that gas supply from the Austral basin will become significant in the midterm²³.

The third operator in strategic importance is Panamerican Energy Argentina (PAE), though it can now be considered second after its partnership with Total S.A. PAE is a consortium of the British company BP, which absorbed important assets from Amoco, and the Argentine company Bidas. This last company has recently sold part of its share in PAE to the Chinese state-owned company China National Offshore Oil Company (CNOOC) for US\$ 3100.?

According to official reports from the group, investment in gas development meant contributions from PAE of 60% of all the gas that Argentina added to its energy supply between 2002 and 2008.

Some of the milestones in these developments have been:

- Between 2001 and 2006, Pan American Energy (PAE) increased daily gas production of the UTE Acambuco (Salta) five-fold, since it rose from 1.4 million m³ (49.4 million cubic feet) to 7.8 million m³ (275 million cubic feet). When the Macueta 1003 well started operation at the beginning of September 2007, daily gas production in the area in 2008 was 8.4 million m³ (297 million cubic feet).
- As of 2001, Pan American Energy developed gas production in the Cerro Dragon Area (Chubut), when the Tres Picos gas field started operation. The area injects 6.3 million m³ a day (222 million cubic feet) into the gas pipelines.
- Between 2001 and 2006, US\$ 485 million were invested by the Cuenca Austral Marina Consortium in the development of the Carina-Aries gas field, in the Tierra del Fuego sea. Today, Carina-Aries is the main offshore gas field in the country.

²² Total was founded in 1924 under the name *Compagnie française des pétroles* (CFP), with private and public share (from the French government). In 1985 it was renamed Total-CFP, and in 1991, simply Total S.A. After Total's takeover of the Belgian company Petrofina and after it acquired Elf-Aquitaine in 1999, the company became known as Total Fina S.A., and later, on 22 March 2000, as Total Fina Elf, S.A. Finally, on 6 May 2003 it was renamed back to Total S.A.

²³ Total S.A. has also been in the field of hydroelectric generation since it participated in the AES de-investment process in Argentina. It thus acquired 70% of the Argentine generating company Hidroneuquén from AES Gener at US\$ 72.5 million, and it also assumed US\$ 50 million worth of liabilities. In August, AES, which controlled AES Gener, had sold TotalFinalElf 64% of the shares that Gener had in the Argentine generating company Central Puerto at US\$ 255mn. All these operations form part of an agreement between AES and TotalFinaELF for the former to sell its assets to Gener in Argentina, after having taken over the Chilean generating company last year. Part of the agreement also provides for the sale of Termonandes to TotalFinaElf.

The Cuenca Marina Austral block has a daily potential for gas production of 15.3 million m³ (540 million cubic feet), equivalent to 10% of Argentine gas demand.

However, despite the fact that PAE is the most dynamic group, the reserves they operate in Argentina, could not compensate for decreased supply produced by the strategy adopted by Repsol.

Next in importance comes Petrobras. Since the second half of the nineties, Petrobras has been using the privatizations and de-regulations of the Latin American countries to change its trans-nationalization strategy. In the case of Argentina, for example, Petrobras entered the picture in 2002 at the time of the devaluation, by purchasing from PECOM, an important national operator, their block of shares, during the initial stage of privatizations. It thus increased its international investment, which is always lower than in Brazil, and concentrated it in the region, at the same time that it added new segments (such as refining, petro-chemical, fuel commercialization, electricity generation or natural gas distribution and transport in Brazil). It grew to such an extent that it became the eighth largest transnational company in the world belonging to a developing country, the third in Latin America and the first in Brazil, with operations in all five continents.

In this way, Petrobras investments abroad in general, and in Latin America in particular started to grow on a yearly basis. The company used to invest in associations and oil concessions; in fact, in 1997 it operated in 9 countries, among them Argentina, Bolivia, Ecuador, the United States, the United Kingdom and Angola. Then, however, it started to buy companies in different sectors of the energy chain.

As said above, the 2001-2002 crisis in Argentina meant an opportunity for Brazil, when Petrobras bought PECOM Energy and thus positioned itself as a strong actor in the Argentine market. The expansion of Petrobras activities in the rest of LA&C was favored by the opening of, for instance, the Bolivian and Colombian markets. Although the 2006 nationalization in Bolivia and the 2002 pesification in Argentina affected its potential cost-effectiveness, never did these later crises and changes in the context weaken its regional position, and even less so its domestic position in the Brazilian market. On the contrary, the high profitability after the implementation of an international price policy in the domestic market contributed to the group's self-financing capacity, so that it is still expanding at the extra-regional level, particularly as a consequence of its forerunner role in deepwater exploration.

However, the Bolivian nationalization in 2006 had a strong impact on its decision to enter into further agreements with that country, and to concentrate investment in Brazil, with a view to becoming a net long-term exporter of liquid and gas hydrocarbons. Another impact, maybe also with historical roots, was a tendency towards the continuation of a relatively high share of hydroelectricity with respect to the expected potential for generation by means of combined cycles.

In spite of its international expansion, investment outside Brazil barely exceeds 20% of the total investment made by the company. Petrobras acquired companies all over the

world: it bought from Exxon a refinery in Japan, and 50% of another one in Pasadena, Texas, and it carried out extraction operations in Western Africa. Nonetheless, its operations concentrated mainly on diversifying its assets in the whole of Latin America. Its behavior in each of those companies is not very different from that of the other transnational companies in each country. However, according to the investment plan for coming years, Latin America will not receive as much capital as the United States.

Therefore, supply expansion in Argentina seems not to be capable of reversing the gas supply situation in the mid-term in the case of Petrobras either.

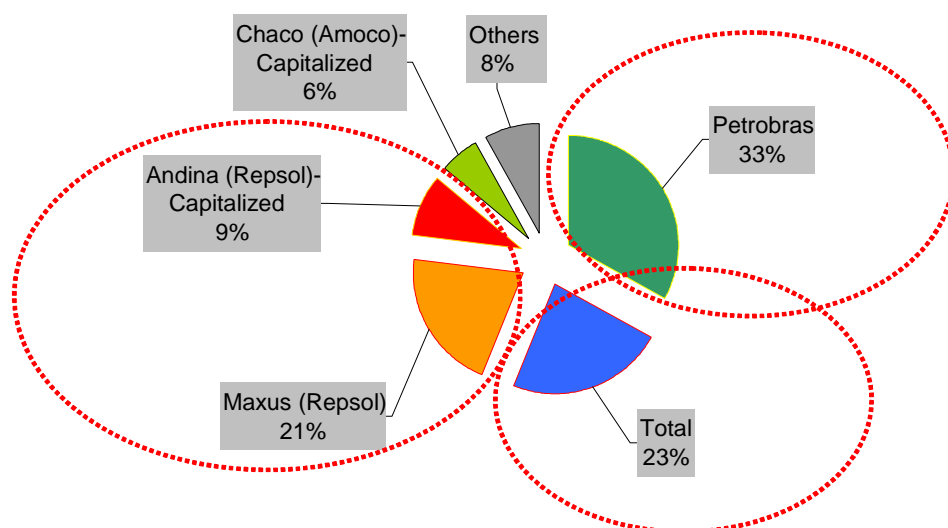
3.1.3. Gas supply from Bolivia and the NEA gas pipeline.

At the beginning of the 2004 crisis, and prior to the 2006 nationalization, Argentina oriented its future gas supply strategy towards Bolivian reserves. Indeed, the 2004-2008 Energy Plan meant that the country expected to receive not less than 20 MMm³/day of Bolivian gas transported through a new pipeline that would connect the gas fields in the northern country with the Argentine Litoral region and the city of Buenos Aires. However, the situation in Bolivia at the time – the 2005 referendum and the subsequent nationalization by means of a Supreme Decree in 2006 – brought about several consequences for Argentina, and also for Bolivia itself and Brazil.

On the one hand, Bolivian reserves are also operated by the same main actors as in Argentina (Repsol, Total, Pan American Energy and Petrobras – cf. Figure 16). On the other hand, in spite of agreements signed with Argentina, Bolivian export commitments with Brazil are prior to the Argentine ones, and of a higher priority. The lack of investments since the nationalization has then led to a gas production deficit that has made it impossible so far to guarantee both the volume for the new pipeline and other more restricted commitments (7 MMm³/day) transported through existing infrastructure.

Figure 16
Gas reserves in Bolivia by main operators

Reserves in Bolivia: 3 companies 86%



Source: author's estimates using YPFB data.

A new gas pipeline was planned, the NEA, that would connect Bolivian reserves with Argentine markets through the Argentine north-eastern region (called NEA) and would reach Buenos Aires, covering a distance of 1500 – 1700 km, with a capacity of 30 MMm³/day. However, the outlook is still uncertain in this case. Work should have started in 2004 and been inaugurated in 2006, but it was still in the bidding stage for construction and with uncertain bid-opening date in mid 2009.

Although the PAE²⁴ consortium had announced investments in the upstream sector in Bolivian gas fields to increase production, the chances for Bolivia to increase its gas supply are still unlikely. This of course can hardly lead to a consolidation of the NEA gas pipeline construction.

3.1.4. LNG as an alternative.

Given this outlook, and regarding gas supply as essential for energy security, the state-run company ENARSA and the Venezuelan oil company PdVSA are preparing the

²⁴ In turn, one of PAE's Argentine partners, the Bridas company, has announced – as has just been pointed out – the sale of its assets and the likely participation of Chinese capitals, which makes the production prospect even more unsettled, since China is trying to cater for its own supply security.

bidding for the building of a regasification plant in Argentina, with a similar capacity to the Quinteros Plant in Chile (10 MMm³/day)²⁵.

This LNG project promoted by both state-run companies is a joint venture. It would mean the setting up of a liquefaction plant in Venezuela, supplied by gas coming from the Mariscal Sucre basin, and a complementary unit in the Argentine coastal region. This would probably be in Bahia Blanca, where the main gas node and the core of the petrochemical industry are located in Argentina.

The building of a similar plant is being considered in Uruguay, which could export gas to Argentina. This is an ENARSA initiative, jointly with the Uruguayan state-run electricity company UTE and oil company ANCAP. Among likely gas suppliers for those projects are Repsol, Petrobras, Total and British Petroleum.

In this context, it is interesting to see that Repsol, together with the Italian company ENI, has discovered reserves and has a 50% share in the exploration of the well, which has been called Perla I. If production in that gas field is confirmed, Repsol is entitled to 32.5% of the resources, the same proportion as the Italian group. The remaining 35% will belong to the Venezuelan state-run company²⁶. Yet, the plants may not be ready before 2015, assuming that four or five years may be necessary between the feasibility study and the actual building.

4. Alternatives for the diversification of the energy matrix in electricity generation

4.1. Hydroelectric projects

The policy in the 1990s in Argentina was clearly contrary to new hydroelectric facilities, for which the country does not have many independent options now. In fact, the national Energy Secretariat cancelled the area in charge of hydroelectric uses and only resumed studies in this respect in 2004. At the time it also decided to finish the Atucha II nuclear plant, which had been interrupted as a consequence of the policy of State withdrawal from its entrepreneur and energy generation roles. Contrary to what happened in Chile and Colombia, only very recently has the Argentine government promoted private

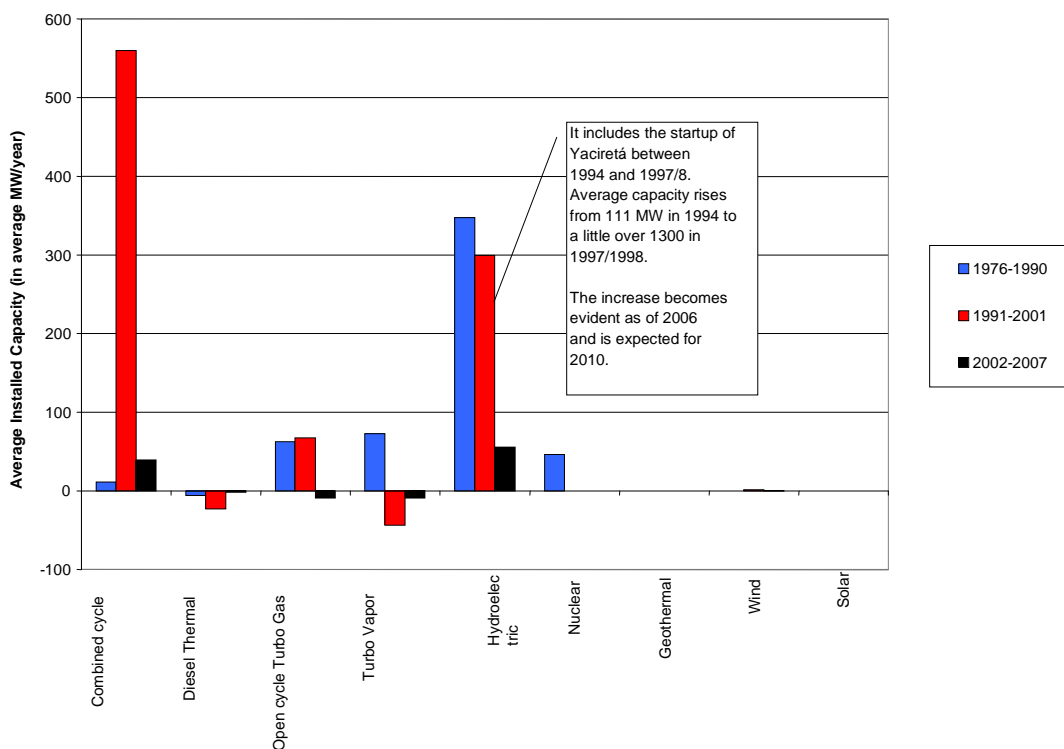
²⁵ According to ENARSA, pursuant to the National Executive Power objectives regarding natural gas supply security in the mid- and long terms by diversifying energy supply, and to the memorandum of agreement signed between the Argentine Republic and the Bolivarian Republic of Venezuela, ENARSA and PdVSA have agreed to start development of the project called "Liquefied Natural Gas Regasification Plant", to be set up in Argentina jointly by ENARSA and PDV S.A. Initial natural gas capacity of the project in transport conditions is meant to be 10 million m³/day, with a potential to expand to 20 million m³/day. An initial action already in progress is a call for potentially interested companies to participate in the development of feasibility studies (extended conceptual visualization and engineering) of the facilities for the LNG regasification plant. The main objective is to obtain a well-grounded pre-feasibility study in the technical, economic, environmental and regulatory fields of at least three alternatives for micro-location of the plant, the port terminal and the gas pipeline to connect to the Argentine gas transport system, as well as the identification and choice of the most suitable technology and the estimated cost of the project. Source: ENARSA.

²⁶ Source: <http://www.20minutos.es/noticia/515673/0/chavez/gas/repsol/>. September 11, 2009.

hydroelectric works. This has to be considered in a context of inexpensive supposedly abundant gas, and with relatively low investment costs for combined-cycle plants. No large works in that field based on market remuneration rules would then have been feasible.

Figure 17 below shows this change in the pattern of installed generation capacity that has already been described. Had it not been for the startup of Yacireta and other plants that were being built thanks to prior policies, practically 99% of the new installed capacity would have been produced by combined-cycle plants dependent on gas supply. Anyway, between 1991 and 2002, plants of that type accounted for 65% of the new installed capacity, thus changing the previous hydrothermal balance.

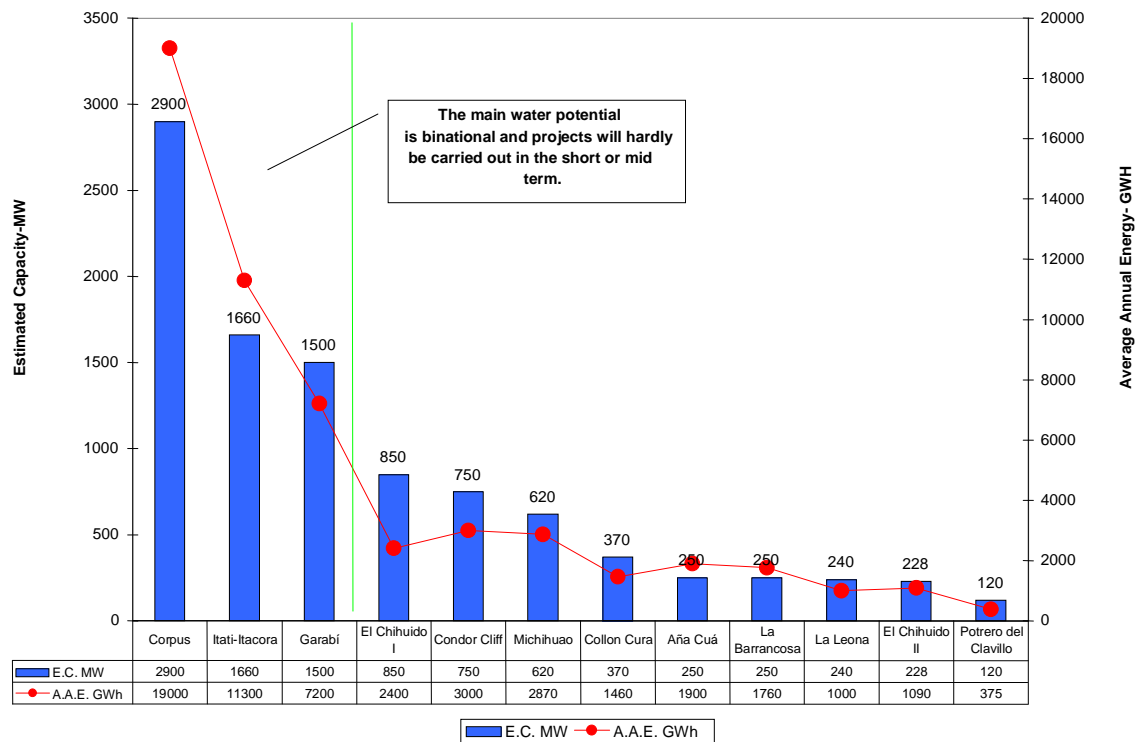
Figure 17
Average installed capacity per year by type of plant in the pre-reform period, during the reforms and from 2002 to 2007.



Source: Author's estimates using data from the National Energy Secretariat.

Figure 18 shows that the inventory of hydroelectric projects is limited in Argentina.

Figure 18
Argentine inventory of hydroelectric projects



Source: Author's estimates using data from the Energy Secretariat.

Works such as Condor Cliff (750 MW), Chihuidos I (850 MW) and others could be part of future mid-term capacity since bids have been accepted or are about to be so soon. Anyway, startup will not be before 2015.

The largest contributions, however, are expected from binational works such as Corpus, Garabi and others, which are more difficult to agree upon because they depend on joint decisions and access to financial markets. The countries involved in such decisions have recently been unable to agree about matters such as surplus energy exchanges (Brazil), or raising the Yacireta water level (Paraguay), not to mention unresolved financial problems between Brazil and Paraguay.

Delaying decisions regarding the increase of new hydroelectric supply is another question affecting supply security in Argentina. However, there seems to be a clear interest by the private sector, given the conditions imposed for the biddings, which comprise not less than 30% of private financing and an investment repayment with 15-year concession grants. In fact, important national groups in the field of turbine construction such as IMPSA, or cement industries such as Odebrecht (Brazil), associated to Cartellone (Argentina), participate in these bids, offering amounts well above the minimum. The Brazilian BNDES could take part in the financing, but the origin of government funds is

not clear, and neither is the nature of foreign loan guarantees. The high cost of the plants is also one of the problems to overcome²⁷.

4.2. Nuclear Power Projects

Although Argentina has a long-standing tradition in the use of nuclear technology, the fact that it was interrupted in the 1990s created an important gap with respect to other developed countries such as the United States or France. These nations have strengthened the nuclear option in view of the challenges that guaranteeing future energy supply poses in a context of scarce natural resources and growing demand. In 2004, Argentina decided to carry on construction of Atucha II, when almost 80% was already finished. Although the re-launching of the work was delayed, it is expected that it will start operating before the end of this year. This would contribute a capacity of almost 695 MW to the system.

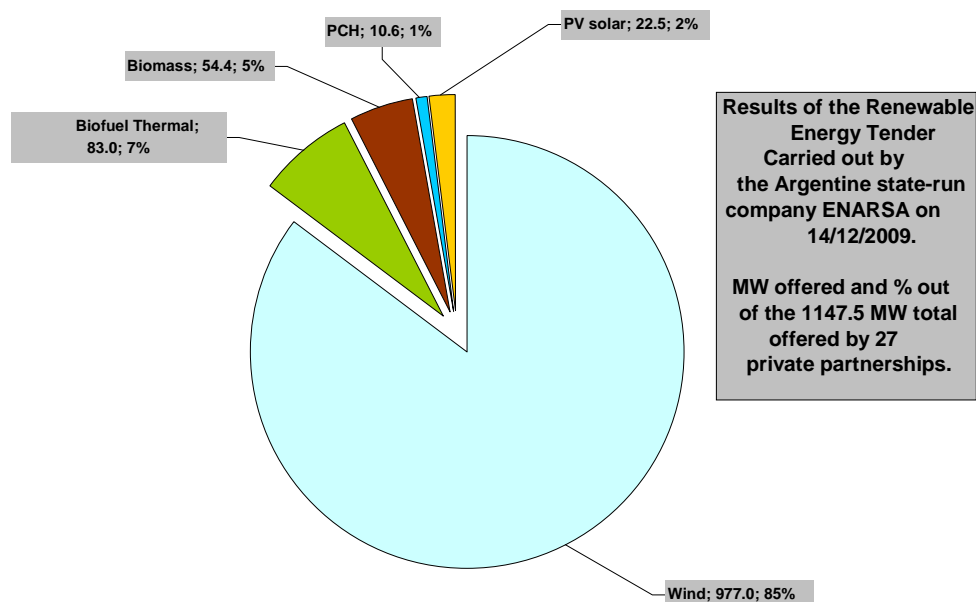
On the other hand, the Argentine company INVAP (SE) has developed a prototype called CAREM that might be implemented before 2015, with efficiency well above third generation designs and a range of low and medium capacity. This model already has competitors which, though some stages behind in the development, are advancing rapidly. They are the IRIS (Westinghouse, USA), SMART (DAERI, South Korea), IMR (Mitsubishi, Japan) and PBMR (South Africa). The extent to which Argentina will set up more high-capacity reactors or will resort to the CAREM prototype is still to be defined. Although the global resistance to nuclear power plants has partially decreased, financial obstacles and concerns by environmental groups may delay a new Argentine Nuclear Plan, the strategy that led to the building of the two plants now in operation (Embalse and Atucha II). Anyway, larger nuclear power contributions are not to be expected before 2015 and 2020 either. Yet, as of 2009, government support to the nuclear sector has been significant.

4.3. Renewable energy projects

Just as in other countries, the promotion of renewable energies in Argentina has mainly taken place by means of biddings or tenders in which the bidders describe the project to be developed, the MW it will contribute, characteristics and cost of the works. The government, in turn, ensures repayment. Even when comprehensive tariff revisions are still pending in Argentina, the authorities will surely implement feed-in mechanisms to buy and repay the energy. Although transmission networks are operated by Transener, a private company consisting of national and foreign capitals and of a small state portion, it is assumed that free access rules and dispatch-inherent problems shall not constitute an obstacle.

²⁷ The estimated cost of the MW in hydroelectric plants for private projects ranges between the following values: Caracoles, 3.85 million dollars; Punta Negra, 5.6 million dollars; Chihuidos I, 2.4 million dollars and C ndor Cliff - La Barancosa, 2.3 million dollars.

Figure 20
Projects offered by means of the GENREN program by the end of 2009



Source: Author's estimates using data from ENARSA

In 2009 the Argentine government passed Law 26190 which established the National Scheme for the promotion of renewable energies for electricity generation. Pursuant to that Law, 8% of electricity consumption has to be supplied by renewable energies within 10 years. The Law was regulated by Decree 562/2009, and the first round of biddings exceeded the expected offers for 1000 MW by almost 15%. The tendency towards wind energy was evident, as well as the presence of national and international actors that have lately made important investments in the development of that technology (cf. Figure 20).

5. Conclusions

Electricity consumption has grown at a rate well above the net domestic product in the last years, whereas capacity increase has been slower than consumption increase. Even when statistical deficiencies make it difficult to estimate energy demand elasticity with respect to growth of the economy, for an average growth of the GDP of about 2.5%/year, electricity consumption is estimated not to grow less than 3%/year. Even at those modest rates of demand growth, it is estimated that without improving average levels of capacity use, it would be necessary to incorporate at least 1000 MW a year between 2010 and 2020, that is, around 10,000 MW.

The hydroelectric potential still not used according to the inventory of relatively feasible projects is approximately equivalent to that amount, but over 60% depends on large-scale binational projects. The goal of catering for 8% of the demand with non-hydro renewable energies by 2020 means not less than 4000 or 5000 MW coming from those sources, particularly because their use factor may be very low. In both cases, the cost of installed capacity would exceed 2 million American dollars per MW, which means not less than 20,000 million US\$ for the next 10 years.

Like many other countries, Argentina went through a period of prosperity between 2003 and 2008, but has seen a decline in its economy in 2009 and 2010. In this context, the possibility of financing works with public funds becomes more difficult. In particular, the growing fiscal surplus between 2003 and 2008 has been reduced mostly by the incidence of energy sector subsidies, which in 2008 used almost all the tax resources coming from the energy sector itself (Kozulj, R. 2007 a y b). Therefore, the first question to be solved has to do with the origin of the funds necessary to expand electricity supply with renewable fuels, including hydroelectric works. Tender results are encouraging in terms of bids, but they will require an important tariff re-engineering as a consequence of the displacement regarding costs between 2002 and 2009.

The possibilities of significantly diversifying the Argentine energy matrix imply, then, a qualitative step forward with high investment costs. In spite of the important delay in definitions, nuclear, hydroelectric and renewable options have been launched since 2009. As it is still not possible to schedule all these works, many of which are just in the beginning stages, it is not possible either to estimate with any accuracy how much installed capacity they will contribute in coming years. It is clear, however, that in the next five years, supply security will still be precarious, particularly because there has not been any development regarding demand management policies either, and because the impact of higher tariffs on aspects such as governability may be considerable obstacles.

In the short term, although the right steps are being taken in order to reduce dependence of electricity supply on non-renewable energies, dependence on gas or liquid fuels for thermal generation will continue to grow. It is not possible to estimate accurately the amount of capacity that will be installed with each type of technology in the next 10 years, but it is difficult to consider that not less than 3000 to 5000 MW must come from conventional thermal plants. This will necessarily increase natural gas demand.

Considering that the displacement of investment decisions from the public to the private sector has led to strategies for the territorial relocation of hydrocarbon exploitation revenues, investments in the supply of larger amounts of gas or other fuels will also be very difficult and costly.

To sum up, in the next ten years Argentina will face serious challenges in order to get a reasonable level of electric power supply security and, if it manages to achieve it, it will be at prices several times higher than in the last decades. In the medium term the situation is even more complex because of both the little supply and the terms required to increase

supply of hydroelectric, nuclear and renewable energy capacity and gas supply infrastructure.

Only a rapid solution of the gas production context in Bolivia, then, as well as strong regional agreements with Brazil could alleviate the foreseen situation, which is serious when considering that all the estimates on which this reasoning is based are frankly modest.

All the above makes it impossible to foresee how, when, and in which manner Argentina will be able to fix the current distortions of their energy policy and ensure an energy security context. Historically, the way to solve the energy policy inconsistencies has consisted of ruptures before extreme critical phenomena, usually accompanied by structural changes in macroeconomic aspects. However, not necessarily history will repeat itself. Internal political confrontation certainly jeopardizes any attempt to fix prices and achieve some relax in public funding, but the process still lacks a clear definition.

Finally, in spite of all the above, the Argentine trend seems to go in the right direction of reduced greenhouse gas emissions as a consequence of the high level of natural gas use for electricity generation as well as of the likely development of hydroelectric and nuclear plants, together with a progressive penetration of wind energy. Even though Argentina is not a major emitter of greenhouse gases, its position regarding climate change has always been favorable. A backward step to greater emissions by using fossil fuels is to be considered temporary. But to keep it temporary and prevent it from becoming structural, obstacles regarding internal governability must be overcome, and strong regional agreements must be achieved, specially with Bolivia and Brazil. Both issues also lack a simple definition or prediction.

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Acronyms and abbreviations

ABB, name of Repsol operations division for Argentina, Bolivia and Brazil.
BBVA, acronym for *Banco Bilbao Vizcaya Argentaria*, bank originally from Spain.
BOE, Barril Oil Equivalent.
BP, British Petroleum.
CAMMESA, acronym for *Compañía Administradora del Mercado Eléctrico Mayorista* [Wholesale Electric Market Management].
CM, mineral coal
CNOOC, China National Offshore Oil Company
Dam3, 1000 cubic meters
E&P, Exploration and Production
ENARSA, acronym for *Energía Argentina Sociedad Anónima*, state-run company in charge of energy businesses, created in 2004
FO, Fuel Oil
GENREN, name of the government program for power generation from renewable sources
GO , Gas Oil
Hidronor, name of the former state-run company for power generation with hydro projects in Limay River Basin
IAPG, acronym for *Instituto Argentino de Petróleo y Gas* [Argentine Oil & Gas Association]
IMPESA, Argentine Corporate Group, acronym for *Industrias Metalúrgicas Pescarmona Sociedad Anónima* [Pescarmona Metallurgical Industries].
Kboe, thousands of BOE
La Caixa, name of a Spanish bank of Catalonian origin.
LA&C, Latin America and the Caribbean.
LNG, Liquefied Natural Gas.
MBTU, Millions of British Thermal Units
NG, Natural Gas
OLADE, SIIIE, acronym for *Organización Latinoamericana de Energía* [Latin American Energy Organization], *Sistema de Integrado de Información Energética* [Energy Information Integrated System].
PAE, Pan American Energy
PEMEX, *Petróleos Mexicanos*, Mexico's state oil company.
Repsol-YPF, name for Spanish company REPSOL (acronym for *Refinería de Petróleos de Escombreras Oil*) when it takes over Argentina's YPF S.A.
SACYR, Sacyr Vallehermoso, Spanish conglomerate made of several companies devoted mainly to the building of infrastructure, households and other constructions, currently and as from 2004, Repsol-YPF controlling company.
SDG Natural GAS, acronym for *Sociedad Distribuidora de Gas Natural Sociedad Anónima*, Repsol-controlled Spanish company.
YPF S.A., acronym for *Yacimientos Petrolíferos Fiscales Sociedad Anónima*, name of the estate company after its privatization in 1992, when the State still had shares.
YPF, acronym for *Yacimientos Petrolíferos Fiscales*, name of the state-run company before its privatization.