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Regulation of Transmission Expansion in Argentina:

Part I – State Ownership, Reform and the Fourth Line

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Regulation of transmission expansion in Argentina Part I: State ownership, reform and the Fourth Line[1]

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Abstract

From 1992 to 2002, major expansions of the Argentine electricity transmission sector depended on users proposing, voting and paying for such expansions, which were then put out to competitive tender. Commentators hold this novel policy to have been unsuccessful, mainly on the ground that it substantially delayed investment in a much-needed "Fourth Line" to Buenos Aires. Part One of this paper challenges this interpretation. The policy was chosen because the conventional regulatory framework could not be trusted to deliver more efficient transmission investment decisions. The delay to the Fourth Line was short. Most importantly, the Fourth Line was not economic. Hence the delay was beneficial both in deferring and in reducing costs. It indicated a need to reappraise transmission investment policy because the availability of gas had made it more economic to generate electricity near Buenos Aires than to transmit it a long distance. Part Two of this paper examines Argentine experience since the Fourth Line.

Key words: Argentina, electricity, transmission, regulation

JEL classification: L33, L51, L94, L98

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Executive Summary Part One

Introduction

When Argentina reformed its electricity sector it introduced a novel scheme for regulating transmission expansion. The beneficiaries (users) of major expansions had to propose, approve and pay for them, and the construction, operation and maintenance had to be put out to tender. It is widely held that this electricity reform was a success in all respects except transmission expansion, primarily because a much-needed Fourth Line was delayed. Part One of this paper examines the reason for this policy and the events surrounding the Fourth Line. Part Two examines experience since then.

1. Before privatisation

Before privatisation, the Argentine electricity industry was characterised by very poor performance, not least in transmission. Many high voltage lines were built, but mainly for political reasons without economic justification.

2. Privatisation and restructuring

During President Menem's first government (1989-95), the electricity industry was restructured and privatised in 1992 under Secretary of Energy Bastos. The reform was along similar lines to the UK, but went further with respect to restructuring. Transmission was restructured into an extra-high voltage 500 kV system (Transener) and seven separate high voltage systems. An important aim was increased efficiency in the location of transmission and generation facilities. To this end there was reduced reliance on regulation, which had proved inadequate in the past.

3. Regulation of existing transmission

Existing and new transmission lines were regulated separately and differently. Existing systems were subject to a price cap with incentives to efficient operation and maintenance. This has worked well. Operating costs, number of faults, forced outages and average recovery time have all been reduced.

4. Regulation of transmission expansions

Transmission expansions had to be proposed and voted by users of the system (generators, distribution companies and large customers). Construction, Operation and Maintenance of these expansions were put out to tender. The regulator ENRE was formally required to check that total costs of generation, transmission and outages would be lower as a result of an expansion (the Golden Rule). Three methods of expansion for public use were specified: Contract Between Parties (that is, by agreement), Public Contest and Minor Expansions (under $2m), plus expansions for private use under

Article 31. The system operator CAMMESA identifies the set of beneficiaries in the Area of Influence of a proposed Public Contest expansion, and their estimated usage. This Area of Influence method determines their votes and subsequent payments. If a line is supported by over 30% of the beneficiaries and not opposed by more than 30%, it is put out to competitive tender, and paid for by all beneficiaries.

5. Early experience and the Fourth Line

Generation was increasing in Comahue to meet increasing demand in Buenos Aires. This increased congestion in that corridor and led to lower 'local prices' for generators. The government put the resulting congestion revenues into Salex Funds for use in reducing the costs of expansion. In September 1994 some Comahue generators proposed a 1300 km Fourth Line to Buenos Aires with an annual fee of nearly $60m. Over 30% of beneficiaries voted against. The rejection of what was held to be a necessary line was a surprise and disappointment. In May 1996 after further negotiations and two modifications to the regulations, the Comahue generators again proposed the Fourth Line, this time jointly. The proposal was agreed, and the competitive tender yielded an annual fee of $24.5m after allowing for a Salex contribution of $80m worth about $11m annually.

6. Criticisms

Many commentators - led by the regulator ENRE and including NERA consultants to the Secretary of Energy, the main transmission company Transener, and several economists - have criticised numerous aspects of the transmission expansion process. The main concerns have been the Area of Influence method, the absence of transmission rights, the implications for quality of service and the role of distribution companies. The main evidence cited was a long delay to the Fourth Line.

7. Evaluation of criticisms

In fact the delay to the Fourth Line was brief: little over 1½ years. And part of this reflected a transitional struggle about the role of incumbent transmission companies in a competitive transmission sector. Concern about delay presumes that the line was economic. However, contemporary calculations by ENRE and others do not confirm this. Our calculations suggest that, at the time, the congestion benefit of the line was, at best, less than half the cost of building it. Even in a fully adjusted (and more congested) system the cost would have outweighed the benefit. Delay to the line saved between $10m to $150m, depending on the extent to which delay enabled a reduction in construction costs. The assumptions in a much-quoted simulation study, often used to criticise the public contest method, are not inconsistent with this finding.

8. Fourth Line: background to first proposal

Traditionally, transmission lines were built to send peak hydro energy from Comahue to Buenos Aires. Gas fired generation developed in Comahue to use the spare off-peak capacity. To overcome increasing congestion, the Comahue generators jointly encouraged better control equipment to increase transmission capacity. However, calculations suggest that the cost of building the Fourth Line, net of the Salex contribution, exceeded the benefits for most generators. But the generators proposing the Fourth Line were also owners of the independent transmission company proposed to construct and operate it; the opponent generators were rivals of one of these owners in Chile and suspicious of the fee proposed; they also had an interest in a generation plant in Buenos Aires that would be adversely affected by the new line.

9. Fourth Line: analysis of the second proposal

After the first vote, all the generators worked together to make the Fourth Line feasible. They secured modifications to the Regulations that made the bidding process more competitive and allowed Salex Funds to be used to defray up-front expenses. These changes, that reduced cost and risk, contributed to the different vote in 1996, as did evidence of greater congestion and higher Salex Fund contributions. Negotiations and getting agreement between beneficiaries were not a problem. The failure of the first vote reflected the then-unattractive prospects of the line, not a deficiency of the Public Contest method. The extent of the Salex Fund nearly halved the final cost to beneficiaries and, more important, the fact that congestion revenues were taken from market participants gave them the incentive to expand the system. This made the Fourth Line privately profitable on the second proposal. However, it seems unlikely that it was or is economic to build long transmission lines just for peak electricity supply to Buenos Aires. It is more economic to pipe gas to Buenos Aires and to generate electricity there. The Public Contest method deserves credit for stimulating a new economic awareness and enabling more efficient decision-making.

10. Conclusion

Argentina's novel Public Contest method of transmission expansion has been widely held to be a failure, on the ground that it delayed a much-needed Fourth Line. In fact, the Fourth Line was uneconomic at the time it was first proposed, and probably later too. Delaying it was beneficial. The private profitability of eventually building the line is likely to have reflected the contribution from the Salex Funds and the incentive on market participants to avoid the loss of revenue from local prices. These factors outweighed the other alleged defects of the method. Subject to these limitations, the Public Contest method worked well in that it increased the efficient use of transmission, and forced a much-needed reappraisal of the most economic way to supply electricity to Buenos Aires, especially with the new availability of gas-fired generation.

Introduction

In 1992, Argentina restructured and privatised its electricity sector, along similar lines to the UK[4] but in some respects going further.[5] As part of the reform, restructured incumbent companies were made responsible for operation and maintenance of the existing transmission systems, but not for most new investment. A novel approach called the Public Contest method provided that major transmission expansions were to take place only where users proposed them and a majority voted in favour, confirming that they were prepared to pay. Financing, construction, operation and maintenance of the agreed expansions were normally to be put out to competitive tender.

There are many excellent accounts of electricity reform in Argentina.[6] The prevailing view is that in general it has been a remarkable success. However, regulation of transmission expansion is widely reported to have been deficient or unsuccessful. It is held responsible for preventing or delaying investment needed to meet increasing demand – specifically, the so-called "Fourth Line" from a main generation centre in Comahue to the main load centre in Buenos Aires. The blame is particularly placed on deficiencies of the Public Contest method, inadequate incentives and transactions costs, and also on the absence of transmission rights.

Views to this effect were expressed by an independent consultant in 1994, the industry regulator ENRE from 1994/5 onwards, a consultancy report to the Ministry of Economics and a World Bank note in 1996, a consultant's report commissioned by the Secretary of Energy in 1998, and a widely-cited academic study of the Public Contest method commissioned by ENRE. [7] Subsequent authors take a similar view about Argentine transmission regulation, often citing the previous studies.[8]

Only a few commentators defend some aspects of the approach. Some are sympathetic to users determining transmission expansion, but are nonetheless critical of the detail of the Public Contest method.[9] Others have recently argued that putting the construction of transmission lines out to tender yields lower tariffs than regulation, that the tariff for the Fourth Line would have been 61 per cent higher if the traditional regulatory approach had

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4 For example, separation of generation, transmission and distribution, creation of a Pool, retail competition for larger customers, and introduction of sector regulation.
5 For example, generating stations were privatised individually, system operation was separated from transmission ownership and operation, the high voltage (500 kV) transmission network was separated from sub-transmission (132 kV) networks, and nodal pricing was introduced.
6 E.g. Bastos and Abdala 1993/6, Estache and Rodríguez-Pardina 1996, Bouille et al 2002, Gómez-Ibáñez 2003 and Pollitt 2004, plus Abdala and Chambouleyron 1999 on transmission, as well as more specialised articles cited herein.
7 Abdala 1994; ENRE *Annual Reports* 1994/5, 1996, 2002; Spiller and Torres 1996, Estache and Pardina 1996; NERA 1998; Chisari et al, 2001.
8 E.g. Leautier 2001, Bouille et al.2002, Woolf, 2003a, Gómez-Ibáñez 2003, Pollitt 2004.
9 E.g. Abdala 1994, Spiller and Torres (1996), Abdala and Chambouleyron 1999, Abdala and Spiller 2000.

been adopted, and that "the supposed costs of postponement were clearly outweighed by its benefits".[10]

The success or otherwise of this policy has implications that go beyond Argentina and beyond transmission regulation. Briefly, there has been much debate as to how best to determine and regulate investment in a privately owned electricity transmission system – or, indeed, whether to regulate it at all. Conventional wisdom has been that transmission is a natural monopoly, so investment and pricing decisions need to be regulated. But regulation can distort incentives (e.g. towards gold-plating)[11] and is characterised by incomplete information. More sophisticated models of regulation have been proposed to overcome or reduce these difficulties.[12]

Others have advocated merchant investment (sometimes called contract networks) as a means of avoiding these difficulties.[13] Several objections have been raised to merchant investment (based on economies of scale, indivisibilities, externalities, information asymmetries, transactions costs, etc).[14] Experience in Australia suggests that merchant interconnectors may not be as problematic as feared, and that regulated interconnectors are also problematic.[15]

An alternative proposal, to secure some of the advantages of market disciplines and competition without the disadvantages of merchant investment, is a 'competitive solicitation process' for transmission projects identified by the regulator.[16] However, this is still vulnerable to concerns about the regulatory role in identifying such projects.

The Argentine approach to transmission expansion uses such a competitive solicitation process but enables users rather than regulators to identify the investment projects. Others are as sceptical of such an approach as of merchant investment, and for similar reasons, suggesting that experience in Argentina supports this pessimistic assessment.[17] They also note that the implications go well beyond electricity transmission systems to network infrastructure in other sectors.

It is therefore of some importance for utility regulation generally to assess whether the reported limitations and criticisms of Argentine transmission regulation and the Public Contest method are justified. These two papers seek to provide a reasonably systematic and comprehensive account of Argentine policy and experience with transmission regulation. Part One examines the early history with specific emphasis on such questions as:

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[10] Galetovic and Inostroza 2004, p. 22. The subtitle of their paper is "why auctioning is (much) better than regulating".
[11] E.g. De Alessi 1974 for theory and early evidence from the electricity sector.
[12] E.g. Leautier 2000, 2001, Vogelsang 2001.
[13] E.g. Hogan 1992, 2003, Bushnell and Stoft 1996, 1997 and Chao and Peck 1996.
[14] E.g. Joskow 2003, Joskow and Tirole 2004.
[15] Littlechild 2003, 2004.
[16] Rotger and Felder 2001, p. 38.
[17] Joskow and Tirole 2003, citing Chisari et al 2001.

- Why, given the potential difficulties involved, did Argentina nonetheless adopt this novel scheme for transmission expansion?
- Is there evidence that the mechanism unnecessarily and uneconomically delayed needed investment in the Fourth Line?
- What were the magnitudes of the costs and benefits involved?
- Why was the Fourth Line proposed in the first place?
- What explains the market participants' subsequent change of mind with respect to the Line?
- What has happened on that corridor since?

This Part One is divided into nine sections: Before privatisation, Privatisation and restructuring, Regulation of existing transmission, Regulation of Transmission expansion, Early developments, Criticisms, Evaluation of criticisms, Fourth Line: background to the first proposal, Fourth Line: analysis of the second proposal, followed by Conclusions. Part Two of this paper examines how and why the initial regulatory mechanism in Argentina has been modified since the Fourth Line, and what lessons can be learned from this.[18]

1. Before privatisation

1.1 Performance of the Argentine electricity sector before privatisation

The Argentine electricity industry was initially developed by the private sector, then nationalised in the 1940s. Its poor performance led to privatisation by President Menem's first government (1989-95), along with many other state-owned enterprises. [19]

Commentators have documented the problems of the state-owned era. A "tremendously distorted regulatory regime" involved political decisions leading to inefficient investments in generation and transmission facilities. These investments were financed in large part through increased debts and transfers from the treasury. Tariff increases were

[18] Littlechild and Skerk 2004. A forthcoming paper (Littlechild and Ponzano 2004) examines the experience of a voluntary user-determined transmission investment scheme in Buenos Aires province.

[19] "Argentina's electric industry was founded by private entrepreneurs at the end of the nineteenth century, but the companies were expropriated by provincial and national governments beginning in the 1940s. After expropriation, the national government assumed the primary responsibility for developing new generating capacity and a national high voltage transmission system. The provincial governments assumed responsibility for the local distribution companies, although the national government owned the company that served the greater Buenos Aires metropolitan area where roughly half of Argentina's population lives. // The poor performance of the government-owned electric companies made the industry an early target for Menem's reformers. Under public ownership, electric service had been extended into rural areas and many new generating stations had been built, including major new hydroelectric dams in the west and north as well as two nuclear power plants. But [later] the public companies operated at a deficit and their equipment was poorly maintained. These shortcomings became obvious in the summer of 1988-89, when a combination of low water flows in the hydro systems and poor availability of many thermal and nuclear plants meant that electricity had to be rationed for many months. Initially, the government considered proposals to reform the sector but keep it in public ownership. By 1991, however, key officials became convinced that the industry would improve only through private ownership." Gómez-Ibáñez 2003, p. 304. See also Bouille et al 2002.

delayed to control inflation, thereby encouraging further consumption growth. Distorted financial incentives favoured investment in new assets rather than operational expenses.[20]

The minister responsible for energy privatisation noted later that "almost half the thermal generating plants in Argentina were not available"; sector enterprises as a whole made losses and the federal government did not have funds to invest.[21] The sector was used as a means to achieve a variety of other government and political objectives.[22] Previous attempts at reform had failed.[23]

One official description of the state of the industry probably needs no translation.

> 1988-89 Crisis energética – Deterioro administrativo – Autogeneración. Condiciones de ineficiencia, gigantismo, burocracia, ingobernabilidad, desprofesionalización en la dirección, politización e incapacidad de gestión contribuyen a una situación de crisis energética de magnitud.[24]

1.2 Transmission planning and construction before 1992

Before 1992, the national government owned three main electricity companies:

- Servicios Eléctricos del Gran Buenos Aires (SEGBA), responsible for distribution and eleven generation stations in the greater Buenos Aires area;
- Agua y Energía Eléctrica (AyE), responsible for transmission and distribution and about 30 generating stations in many provincial areas of Argentina, mainly in the north and west;
- Hidroeléctrica Norpatagonia (Hidronor), responsible for transmission and six hydro generation stations (some still under construction at the time of privatisation) in the south of Argentina.

Most of the 23 Provincial governments had a distribution company, which in some cases also engaged in generation. In most cases it also operated lower voltage (132 kV) transmission systems. Several hundred cooperatives throughout the country, some wholly or partly owned by local municipalities, mainly distributed electricity.

Table 1 lists the main transmission lines constructed from the 1950s to 1992. The 500 kV lines were built primarily to bring power from the hydro and nuclear stations around the borders of the system to the Greater Buenos Aires area, which accounted for about two-thirds (depending on definition) of the load in the country. Hidronor and AyE typically

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[20] Spiller and Viana 1996.

[21] Bastos and Abdala 1993/6, p. 21.

[22] "The companies' objectives were not necessarily aimed at economic efficiency and the long-term growth of the sector. For example, the creation of jobs and the use of tariffs as a tool for carrying economic policy and policies for the redistribution of wealth were historically constant features of the sector. The use of electricity prices to control inflation or to grant subsidies in favor of certain users gave evidence that there were inherent conflicts in the multiplicity of the Government's objectives. In most cases this was detrimental to State Owned Enterprise (SOE) performance." Bastos and Abdala 1993/6, p. 23.

[23] "Repeated efforts to 'corporatize' these utilities had proven unsuccessful. Vested interests, including the utilities' own technicians and bureaucrats, trade unions, federal and provincial politicians, and private suppliers and contractors limited the effect of such efforts." Bouille et al 2002, p. 32.

[24] CAMMESA, Sector eléctrico, antecedentes, 1988-89, at www.cammesa.com.ar

built new transmission lines to transport the power to Buenos Aires as and when they built new power stations. Over time, 500 kV lines were also used to link the separate electricity systems within the country and, later, to link the country internationally.

Table 1 Construction of major transmission lines in Argentina 1970 to 1992[25]

Date	Company	Line location	Length
132 kV lines[26]			
1958	AyE	San Nicolás – Ramallo (1 x 132 kV)	6 km
220 kV lines			
1958	AyE	San Nicolás – Ramallo (1x 220 kV)	6 km
1973	AyE	Ramallo – Atucha – V.Lía – Rodríguez (2 x 220 kV)	2 x 201 km
1974	AyE	Ramallo – Rosario (2 x 220 kV)	2 x 77 km
Total 220 kV lines			562 km
500 kV lines			
1974/6	Hidronor	Chocón interconnection	9 km
1974	Hidronor	Chocón - Ezeiza (Comahue to BA 1st line)	1038 km
1976	Hidronor	Chocón - Ezezia (Comahue to BA 2nd line)	1038 km
1977	Hidronor	P Banderita – C de la Costa	27 km
1981	AyE	Colonia Elía – Campana – Rodríguez	236 km
1981	AyE	Salto Grande – Santo Tome – Rodríguez	704 km
1981	Segba	Rodríguez – Ezeiza (BA ring)	2 x 53 km
1983	AyE	Almafuerte - Rosario	345 km
1984	Hidronor	Alicurá – P Águila – Chocón	(246 + 241) + 2 x 4.5 km
1984	AyE	Rio Grande – Embalse – Almafuerte	32 km
1984	AyE	Rio Grande – Gran Mendoza (Cuyo)	407 km
1985	AyE	Resistencia – Romang – Santo Tome	526 km
1985	Segba	Ezeiza – Abasto (BA ring)	2 x 58 km
1986	Hidronor	Chocón – Olavarría – Abasto (Com' to BA 3rd line)	1161 km
1987	AyE	Almafuerte – El Bracho	619 km
Total 500 kV transmission lines			6870 km

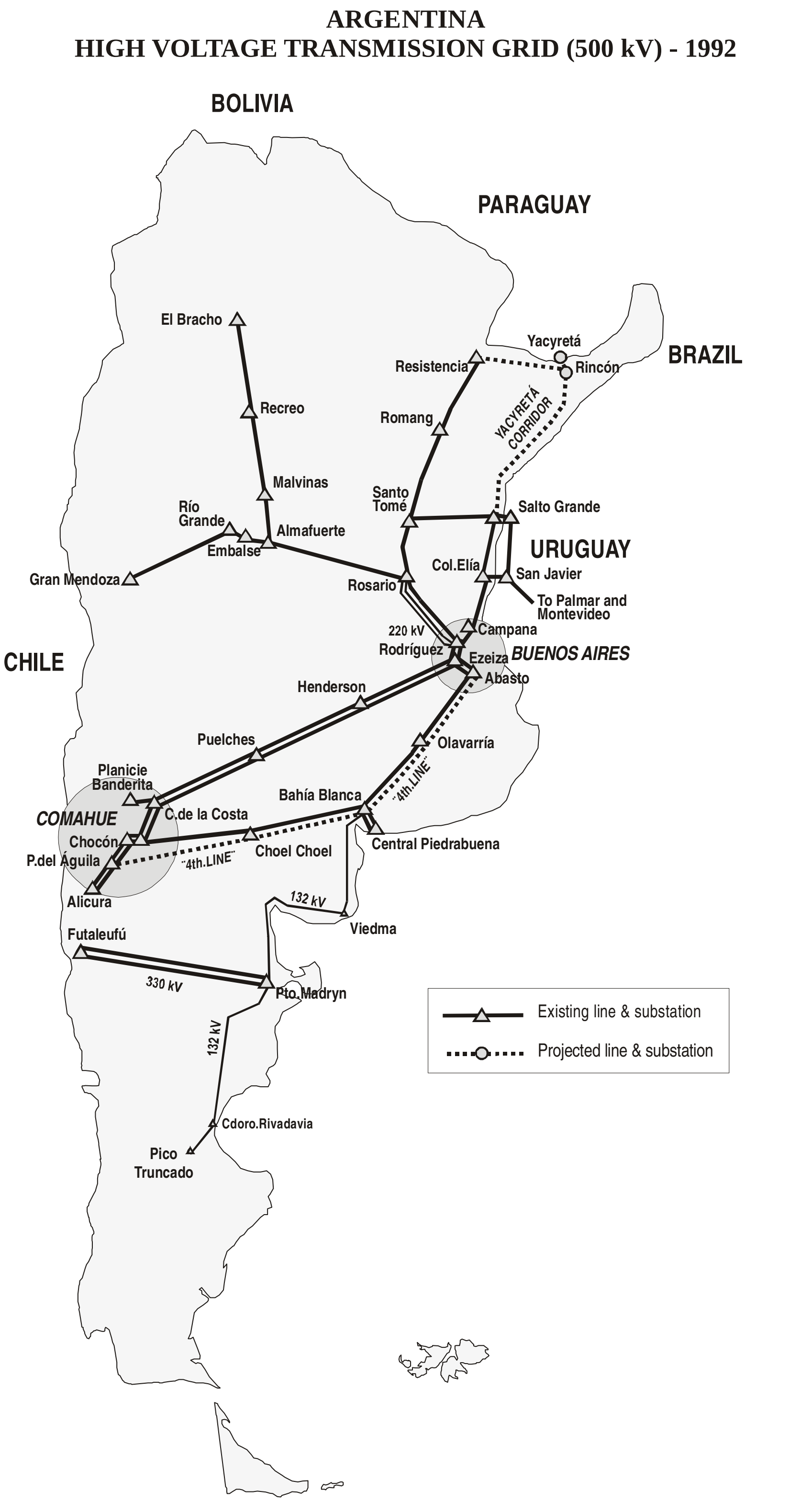
Figure 1 shows the high-voltage (500 kV) system that these lines formed, as it existed at the time of privatisation in 1992.[27] It was essentially a radial system, largely interconnected but owned and operated by three different companies. The separate system in Patagonia was linked to the rest of the national system by a 132 kV line.

[25] Source: Mercados Energéticos. These are the lines that were subsequently retained by the successor transmission company Transener. The 500 kV lines generally have a capacity of around 965 MW to 990 MW. 500 kV lines are sometimes referred to as Extra High Voltage or EHV lines. 132 kV lines are sometimes referred to as sub-transmission lines. Table 1 does not include 332 km of 500 kV lines in the 'Salto Grande Square', which are jointly owned with Uruguay and partly located in that country.

[26] The Table does not include several 132kV lines built by Distribution companies before 1970 that were conceptually designed as local distribution grids rather than as part of a national transmission system.

[27] Source: Mercados Energéticos.

Figure 1 Map of Argentine transmission system



1.3 Limitations of transmission planning and construction before 1992

The electricity companies had capable engineering planning groups that planned the lines, and the earlier lines (in the 1970s) were well designed to meet the load. But there was typically little or no external consultation or discussion about building the lines. Sometimes they were built as part of generation schemes that were themselves uneconomic.[28] Power transmission was not considered a separate activity, and therefore no explicit costs (or benefits) were allocated to it.[29]

The problems of the Argentine electricity industry generally were equally characteristic of the transmission sector in particular. In some cases, high voltage transmission lines were built to meet political pressures, without adequate justification. Provincial leaders argued for interconnection at 500 kV since that would be paid by the Central government whereas lower voltage lines would be paid from the provincial budgets. For example, from 1984 onwards the province of Misiones in northeast Argentina pressed for connection at 500 kV, to fully integrate it into the interconnected Argentine system, when its load justified only a 132 kV connection. This was agreed in principle, and in 1990 it was agreed to construct a 500 kV line to coincide with the opening of Yacyretá hydro station.[30] In 1992 the Secretary of Energy approved its implementation with federal government funds. The line - from Yacyretá's neighbouring substation Rincón to San Isidro 80 km east - was commissioned in 1996. However, due to the limited power flow the 500 kV line has been operating at only 132 kV ever since.

To justify such high voltage transmission lines, governments specified implausible rates of demand growth. For example, two provincial governments arguing for the 500 kV line from Almafuerte to El Bracho 600 km to the north projected annual growth rates of 14%; in the event after the line was commissioned in 1987 the actual growth rates were negative. The line had a capacity of around 1000 MW but its average usage was only 34 MW.[31] This average load factor of about 3½ % compares with about 25% in the Comahue corridor (and double that observed more recently, see below). The cost of this

[28] "For example, according to the energy model proposed for Argentina in the period 1982-1985, the projects of Alicurá (1000 MW), Salto Grande (1890 MW) and the Embalse de Río Tercero Nuclear Plant (600 MW) represented an expansion of 2990 MW beyond the 500 MW of capacity required according to the model." Bastos and Abdala 1993/6, p. 35. Similarly, others have suggested that in 1984 there was no system need for the Río Grande reservoir and 600 MW pumped storage system, but they were built anyway, and connected to Buenos Aires at 500 kV.

[29] Bastos and Abdala 1993/6, p. 65

[30] Yacyretá was a binational undertaking with Paraguay, initiated in the mid-1960s, officially commenced by a treaty in 1973. It was planned to take 8 years in construction but delays incurred "huge unforeseen cost overruns". The first turbine began working in 1994. Bastos and Abdala 1993/6, p. 30.

[31] Sanz 2004, p. 2

line averaged nearly US $100/MWh transmitted.[32] This is more than double the retail price of electricity during the 1980s (and four times the price during the late 1990s).[33]

System planners were asked to find assumptions to justify the construction of lines that politicians wanted. Those familiar with the industry did not take the resulting studies seriously. State owned enterprises (SOEs) generally, including transmission lines, were used as mechanisms for public works to support particular regions or to reward particular political allies. The padding of suppliers' costs[34], and corruption including payment for work not performed, led to excessive costs as well as inappropriate lines.

There were also territorial struggles between the three state companies AyE, Hidronor, and SEGBA as each sought to expand its network. This affected the location and timing of the Buenos Aires ring, important substations such as Campana, and the interconnection with the Patagonian System. For example, AyE sought to expand its area of operation by proposing to build lines to connect to parts of Hidronor's area in the south and west. Hidronor responded by proposing to construct the lines itself. The outcomes were not based on technical or economic considerations.

A Working Group for Planning the National Transmission Network was set up from 1984 to 1991, reporting to the Secretary of Energy, with the task of appraising future investments in the extra-high voltage bulk transmission system.[35] The Working Group began to develop a simulation model of the national system and to consider, for example, whether a Fourth Line was needed from Comahue to Buenos Aires. This depended amongst other things on whether the main need in the system was for more capacity or more energy. But views of the companies differed on the need for a line: Hidronor argued in favour, AyE argued against, DEBA (the company supplying Buenos Aires province) argued for routing a line further south through Mar del Plata. It became a political rather than a technical or economic issue. The Working Group was unable to make a unanimous recommendation.

There were many other deficiencies of the pre-privatisation transmission system[36]:

- There was a low level of use of much transmission capacity: the line from Almafuerte to the north noted above was not an isolated example. This is indicated by the later ability to increase output in the system substantially without corresponding increases in transmission capacity.

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[32] In round terms, 600 km line @ $200,000/km = $120m + $60m substations = $180m. Amortised over 15 years at 10% rate of return this is 16% p.a. x $180m = $29m/yr. Assume 34 MW average flow x 8760 hours/year = 300,000 MWh/year. Then average cost is $29m/300,000 MWh = $97/MWh.

[33] The symbol $ is used to denote the Argentine peso as well as the US dollar. For most of the period of interest, the peso was equal to the dollar, and it is not necessary to distinguish the two. Since the devaluation, the Argentine peso stands at about 3 to the US dollar.

[34] "Contractors inflated their costs when submitting offers to the State and, naturally, so did other suppliers filling purchase orders from the SOEs." Bastos and Abdala 1993/6, p. 141.

[35] Julio DiSalvo headed the group; vice-directors were Luis Caruso and Gerardo López. Ramón Sanz was part of this group.

[36] R. Sanz 2004, p. 2, supplemented by information from that author.

- Operation and maintenance cost, largely determined by the number of people in the organisations, reached 6% of replacement value in the 500 kV system (against a normal or efficient level of about 2%, and 1.7% in that system today).
- At the time of privatisation the consortium of international consultants (following an analysis by SIGLA) advised that 600 staff were sufficient for the 500 kV company: at the time there were 1200 staff in that part of the system and a year before there had been 2000.
- The time to recover collapsed towers after major incidents (tornados) was very long: the average in the 1970s (when these problems were little understood) was 9 days. Although the average reduced to under 2 days from 1981 to 1992, it was more than 30 days on at least one occasion. Much time was taken up with negotiating contracts for the work and getting approval for them before recovery could begin.

In conclusion, the pre-reform transmission sector in Argentina was just as inefficient as the rest of the electricity sector. Moreover, the inefficiency lay not just in higher costs and poorer performance of given lines. The inefficiency lay also, to an important degree, in over-expansion: the construction of high voltage lines that were uneconomic at that particular time and place. In simple terms, the problem lay in *what* was done, not simply in *how* it was done.

2. Privatisation and restructuring

2.1 Electricity privatisation and restructuring

The treatment of electricity transmission at the time of privatisation reflected government policy towards the public utility sector generally.[37] In August 1989 Administrative Reform Law 23696 established the basis and principles for privatising all state-owned companies. During the next few years the implications were explored in each sector, with privatisations following in rapid order.[38]

Carlos Bastos, Secretary of Energy 1991-96, led the privatisation of the electricity sector, within the general policy framework of the Minister of Economy Domingo Cavallo. Bastos was formerly an electrical engineer, researcher and consultant.[39] He brought the

[37] "The privatisation and restructuring of Argentina's electricity industry was part of a much larger effort to reduce the role of government in the economy begun by President Carlos Menem in 1989. Argentina's economy had been stagnating for decades, both because of large government deficits and because of government intervention to protect Argentine industry from competition. The Menem government began a radical effort to open the economy to domestic and international competition and to eliminate government deficits, in part by privatising money-losing public enterprises." Gómez-Ibáñez 2003, p. 304.

[38] The size and speed of the privatisation program are striking, even compared to the UK. Privatisation proceeds in Argentina represented a larger proportion of GDP than in the UK, and were raised in about one third of the time. Pollitt 2004, p. 2.

[39] Bastos graduated in electrical engineering and electronics from the National University of Cordoba. Before being appointed Secretary of Energy he was researcher in public utilities and energy economics at IEERAL (Instituto de Estudios Económicos sobre la Realidad Argentina y Latinoamericana), head of investment analysis at EPEC (Empresa Provincial de Energía de Córdoba, a provincial distribution

conceptual vision and insistence on a reformed, privately owned and competitive sector. He gave general direction and control to the privatisation of the energy sector, and took on the political battles, including with parties from the existing industry.

The Secretary of Energy appointed a team within the Department to define and drive through the process, leading to the Electricity Regulation Act (Law 24065) that came into effect in early 1992. [40] There were financial, technical and other consultants. [41] The World Bank and other lenders played a supportive role.[42] Experienced industry people were an important part of the Department of Energy team, and were actively involved in implementing and developing the policy over the rest of the decade, as discussed below. Table 2 notes the main office holders who contributed to policy in the electricity sector during the two successive Menem governments (1989 – 1999), primarily the Secretary and Under-Secretary of Energy and the Executive Vice-President of CAMMESA.[43] The relative stability of personnel (and of policy) during this decade stands in contrast to the turnover in the few years since then.[44]

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company, still state-owned), and a consultant on electricity issues for the Inter-American Development Bank and the Harvard Institute for International Economic Development.

[40] "Over a two year period (1990-1991) a small team in the Secretary of Energy carried out technical studies and developed rules and operational guidelines that formed the basis of the electricity sector's restructuring. In 1992-93, the reform process accelerated with the passage of the Electricity Regulation Act, the privatisation of federal utilities, and the creation of a new sectoral regulation body known as the National Entity for Electricity Regulation (ENRE). The speed of the reform was such that generation and distribution assets were privatised before ENRE began to operate." Bouille et al 2003, p. 33

[41] UK consultants included KPMG on accounting issues and Merz & McLelland on separation of transmission assets. Professor Ignacio Pérez-Arriaga from Madrid, who had worked with NGC during the UK privatisation, was an adviser on regulatory issues. Local consultants included Ruy Varela, Luis Sbértoli (later Under-Secretary of Energy) and colleagues (Eduardo Rodolfi, Orlando Samartín, Miguel Mazza Campos and Gustavo Husson) of Sigla group.

[42] "At the initial stages of reform (1990 – 93), the strongest donor support for Argentina's power sector reforms came from the World Bank. … To speed resources to the government, the World Bank amended loan agreements initially intended to support improvements in the operational and managerial performance of the three main federal utilities (SEGBA, Hidronor, and Agua y Energía Eléctrica). These funds were reprogrammed to permit payment of consultants and support staff within the Secretary of Energy who were developing the reform and privatisation plan. … The Inter-American Development Bank (IDB) also provided considerable support for the power sector reforms, but it did so around 1994, a few years after the World Bank, when the reform and privatization was already defined and the process of implementation under way. IDB staff were more critical of the Argentine power sector reforms than were World Bank staff." Bouille et al 2003, p. 37-38.

[43] Other office holders obviously had an impact on the industry, such as the President of ENRE: Carlos Mattausch (6/4/1993-10/10/1997) and Juan Antonio Legisa (10/10/1997-19/6/2003). Legisa had been Secretary of Energy for the six months preceding Bastos. Alberto Devoto was Vice-President of ENRE (6/4/1993-5/4/2002) and Secretary of Energy (8/8/2002-24/5/2003).

[44] Menem was president for over ten years, Bastos was Secretary of Energy for over five years, and his successor Mirkin held the post for over two years following five years as Under-Secretary. In contrast, during the two years of the De La Rua presidency from December 1999 to December 2001 there were four Secretaries of Energy. Their tenures ranged from 8 months to 20 days, with an average tenure of six months. In the two and a half years since then there have been five presidents (three of whom served from 2 to 8 days) and four Secretaries of Energy. The tenure of the present office holders, at just over a year since May 2003, is the longest since 1998. The redirection of policy during these later periods is discussed in Part Two of this paper.

Table 2: Office holders related to transmission regulation 1991-1999

Office	1989-95	1995-99
President[45]	Menem	Menem
Minister Economy[46]	Various/Cavallo	Cavallo/Fernández
Secretary Energy[47]	Various/Bastos	Bastos/Mirkin/Mac Karthy
UnderSec Energy	Sperman/Mirkin	Mirkin/J Sanz/Sbértoli
ExecVP CAMMESA[48]	-/Caruso/Mirkin	R Sanz /Blanco

Restructuring of the federally-owned electricity sector took place during 1990-91. In many respects it followed the policy adopted a couple of years earlier in the UK (or more precisely in England and Wales), though it went further with respect to restructuring.

The main restructuring decisions were

- The generating stations of the three companies owned by the national government were formed into over twenty separate generating companies.
- The high voltage (500 kV) transmission lines of the three companies were allocated to a new company Transener, and the lower voltage (132 kV) transmission lines were divided into regional sub-transmission companies.
- The distribution lines of SEGBA were divided into three distribution companies with 99 year leases: Edenor and Edesur in Buenos Aires and Edelap in La Plata. These three companies accounted for some 60 per cent of the energy distributed in the country.[49]
- The transmission and distribution companies were required to provide access and use of system for generators, suppliers and large users.
- Large users (initially with maximum demand over 2 MW, by 1994 over 100 kW, by 1999 over 50 kW and by 2000 over 30 kW) were allowed to buy power directly from generators on the wholesale market. The distribution companies had exclusive concessions to sell electricity to households and other small users within their areas.
- A Wholesale Electricity Market Managing Corporation called CAMMESA[50] was created as the independent system operator (ISO). It was a not-for-profit company with directors from government and the industry and chaired by the Secretary of Energy. It was quite separate from the transmission and generation companies.
- A National Electricity Regulatory Agency ENRE was created.[51]

[45] President: Carlos Menem 1st election 14/5/89, in office 8/7/89 – 10/12/1995; 2nd election 14/5/1995, in office 10/12/1995 – 10/12/1999.
[46] Minister of Economy: Domingo Cavallo 1/3/1991 – 6/8/1996.
[47] Secretary of Energy or equivalent: Carlos Bastos 3/4/1991 – 10/10/1996, Alfredo Mirkin 10/10/1996 – 10/12/1998, Cesar Mac Karthy 10/12/1998 – 10/12/1999. Appointment dates of Under-Secretaries typically matched those of the Secretaries.
[48] Executive Vice President CAMMESA (created July 1992): Luis M Caruso August 1992 – June 1993, Juan Carlos Berra July – August 1993, Alfredo Mirkin September 1993 – July 1995, Ramón Sanz August 1995 – November1998, Horacio Blanco December 1998 – February 2004.
[49] Pollitt 2004, Table 1 based on end-2001 data
[50] Compañía Administradora del Mercado Mayorista Eléctrico Sociedad Anónima.
[51] Ente Nacional Regulador de la Electricidad. Its duties include to protect customers; to promote competition, optimal operation and non-discriminatory open access to transmission and distribution

Congress passed the new Electricity Regulation Act (Law 24065) on 19 December 1991, which came into effect on 3 January 1992. The national government sold its main thermal plants and distribution companies to the private sector through competitive bidding in 1992 and 1993 and most of its hydro plants in 1994. The President of ENRE was appointed in April 1993. The high voltage transmission company Transener was privatised on 16 July 1993, with an initial tariff fixed for 5 years, and a concession period of 95 years. Three of the regional sub-transmission companies were privatised in the first half of 1994, the others by the end of 1996. The national government retained two nuclear power plants (Embalse and Atucha), one hydroelectric plant (Río Grande). Two hydroelectric plants were owned jointly with other governments (Salto Grande with Uruguay and Yacyretá with Paraguay).[52] In addition to its access to knowledge and influence as chairman of CAMMESA, the Secretary of Energy retained control over the Market Rules, which could be changed by ministerial resolution.[53]

Some two dozen companies owned by the Provincial governments, plus hundreds of cooperatives, distributed most of the remaining 40 per cent of the energy. Many of them generated energy too. And some also operated 132 kV sub-transmission lines. Over the next few years the government sought to reform this part of the sector too, with limited success. [54] This had implications for the effectiveness of transmission regulation and for its future direction, as explained later.

2.2 Underlying considerations in reforming the transmission sector

The Secretary of Energy transmission privatisation team, headed by Luis Caruso, was largely responsible for the practical implementation of government policy with respect to the structure, regulation and privatisation of transmission, as well as the electricity wholesale market. Caruso and his team had many years experience in transmission

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networks; to regulate transmission and distribution activities and ensure reasonable tariffs; to provide incentives to efficient use of electricity; and to encourage private investment in generation, transmission and distribution activities, ensuring market competitiveness wherever possible. Bastos and Abdala 1993/96, pp. 200-1.

[52] These plants have contracts specifying their remuneration to cover operating costs, and are required to sell their electricity into the spot market, with any surplus revenue going into a Fund that has been used for several purposes. Bastos and Abdala 1993/6, pp. 157-8.

[53] This continuing government involvement was a risk for investors, but may not have been perceived as serious at the time. From the perspective of those promoting reform, it facilitated introduction and revision of the reforms, and resistance to critics or pressure groups, but meant that the system was vulnerable to change by later governments of different political persuasion.

[54] "After reforms and privatisation were complete at the federal level, the Secretary of Energy, led by Carlos Bastos, sought to extend reforms to the provinces. Under Argentina's federal system, provincial authorities retain regulatory and policymaking powers and can structure ownership of local generation and distribution assets as they see fit. Beginning in 1993-94, the federal government used the power of the purse to push provinces to follow the federal reforms. … By 2001, 14 of 24 provinces had privatized their distribution assets. … [However] Many provinces were reluctant to emulate federal reforms because they garnered considerable rents from local utilities and they were convenient vehicles for political patronage." Bouille et al 2003, pp. 33, 38

matters. [55] In drawing up proposals for the restructuring and regulation of the transmission sector, they had in mind three main considerations.

First, transmission was the key to the main electricity investment decisions that would arise in the near future, which would concern the location of new generation plants. Demand for electricity was expected to increase significantly.[56] Greater Buenos Aires represents about 43 per cent of the overall national demand; adding in Buenos Aires province and neighbouring Litoral region to the north brings the proportion to 70 per cent.[57] Other areas of the country are more than self-sufficient in generation. As in the UK the fuel of choice for future generation would be gas, using combined cycle gas turbines (CCGTs). Argentina had large gas reserves located in the south (Comahue and Austral basins) and in the northwest. The main question was whether it was more economic to transport the gas to Buenos Aires and generate electricity there, or to generate electricity near the gas reserves and transmit the electricity to Buenos Aires. That is, given the existing gas and electricity networks and the prospective costs of expanding them, would it be more economic to transport increasing quantities of gas or electricity over more than a thousand kilometres?

Transmission decisions are important in any country, but particularly so in Argentina, given the size and configuration of the country. At that time, the average length of transmission line in Argentina was nearly 200 km per TWh of electricity produced and consumed in the economy. This was one of the highest levels in the world: not exceptional in parts of Latin America but about three times the average lengths in the US

[55] Caruso joined the Operations Department of Hidronor in 1974, was head of its Operation Engineering division 1977-87, participating in the commissioning of the Comahue hydro power plants and associated transmission system; and was director of the inter-company Working Group for Planning the National Transmission Network 1984–87. He was manager of the National Dispatch Center 1987-91; National Director of Energy 1989-91; National Director of Coordination and Regulation 1991-93; in charge of the Market and System Operator OED, the precursor of CAMMESA, and a member of the Electricity Privatization Committee 1991-93. His group was responsible for the organisation of the market authority CAMMESA, the formulation of the market rules, and the restructuring, regulation and privatisation of the transmission sector. (Alfredo Mirkin, who later succeeded Bastos as Secretary of Energy, oversaw the privatisation of the generation sector, while Bastos himself oversaw the privatisation of the distribution companies.) Caruso was later the first Executive Vice President of CAMMESA 1992-93. Caruso's transmission team, who formulated often-critical details of that regulation, included Beatriz Arizu, Juan Carlos Berra, Roberto D'Addario and Ramón Sanz. All had worked in the industry with him previously: Arizu and Berra in Hidronor, D'Addario in the National Dispatch Centre, and Sanz in the Transmission Planning Group. Sanz later took over as Executive Vice President of CAMMESA. In 1993, Caruso and his team founded the consulting group Mercados Energéticos.

[56] As indeed it did. In the event, consumption per head grew at an average of 3.3% annually from 1992 to 2002. (Source: Mercados Energeticos based on data from Energy Secretariat Annual Report 2002 and CAMMESA Annual Report 2002.) The number of customers in the two largest successor distribution companies increased by 11% over the period, and installed generation capacity grew at 5.4% annually. (Source: statistics at www.cammesa.com.ar) Output grew at an average of 4.6% per annum from 1992 to 2002. (Pollitt 2004, p. 13). The rate of increase was even faster at first: "… a 67 per cent increase in electricity demand during the same period [1992-97]. Electricity consumption grew at an average annual rate of 7.3 per cent after the reforms, compared with 2.5 per cent in the decade before." Gómez-Ibáñez 2003, p. 307

[57] Sanz 2004, p. 1

and Europe (about 60 and 75 km/TWh respectively), which in turn were nearly three times the average level in the UK (24 km/TWh).[58]

The second consideration was that much high voltage transmission investment during the previous decade had been uneconomic and excessively costly, as the team designing the transmission regulation were acutely aware from personal experience. They had seen at first hand the inefficient competition between incumbent state-owned electricity companies, and with the state-owned gas monopoly, to extend their territories for the sake of size alone. The knew the extent of inefficiencies in both generation and transmission caused by lack of maintenance and lack of availability, and the higher costs that this caused. They had participated in staff meetings discussing how to use available funds and how to pay the bills, when the companies were losing about a million dollars a day. As manager and operators of the National Dispatch Centre they knew the costs that were used for economic dispatch and how different these were from the prices charged for electricity. At one time they had had to cut energy output for several months because of the inefficient operation of the companies.

So transmission was a key issue in Argentina, and it was crucial to ensure that the transmission system, particularly the 500 kV component, was both planned and used more efficiently than in the past.

The third consideration was regulation. Previous management of transmission had been seriously inadequate. The failure was not technical but political. Regulation itself had failed.[59] The conventional concept of transmission regulation had no credibility in Argentina. Nor was there any reason to believe that it would be immune to these difficulties in future. In fact, with private ownership the incentive and ability to influence public decision-makers to over-build transmission could be even greater than before.

A new approach was therefore imperative. The government's policy, as adopted in the rest of the electricity sector, was to create competition to provide the services, as far as possible independent of regulation and government involvement. The challenge was to achieve competition in transmission, while retaining the technical unity of the transmission system as a whole. This had implications both for restructuring of the sector, and for its subsequent regulation.

2.3 The restructuring of transmission

How should the transmission sector be restructured to facilitate greater efficiency? Closer examination suggested that, even before privatisation, the transmission sector was by no

[58] Sanz 2004, p. 2. Two countries are shown with higher figures: Russia and Brazil (about 230 and 290 km/TWh respectively).

[59] "It is useful to remember that, in the past, regulatory efforts in the sector failed not only because the Government arbitrarily interfered in the sector, to the detriment of its enterprises, but because of the failure of the regulatory regime itself, as well as of its implementation of the regulations." Bastos and Abdala 1993/6, p. 296.

means a homogeneous monopoly, and could be restructured into components such that some would allow competition.

In practice, the availability of capacity in the system as a whole depended not only on the availability of generation stations and transmission lines, but on the control and dispatch of the system. Better transmission control devices could enhance this overall capacity. In fact, control of the system could be separated from ownership and management of the transmission lines, just as it was proposed to separate it from ownership and management of the generation stations. Hence followed the creation of CAMMESA as an ISO, separate from the transmission as well as the generation companies.

Parts of the transmission system were already in separate ownership and management, notably the existing interconnection with Uruguay jointly owned by the Argentina and Uruguay governments. Other such links could be envisaged, especially with Brazil. So transmission lines were not necessarily a monopoly.

Within the country, the 500 kV and 132 kV systems were essentially operated independently of each other before privatisation. Hidronor, based on 500 kV lines without significant lower voltage lines, was more efficient than the other two companies. It would make a suitable basis for a future transmission company that would operate all the existing 500 kV lines. Then the remaining lower voltage (mostly 132 kV) regional systems would split naturally into separate regional sub-transmission companies.

The 500 kV high voltage lines of Hidronor, AyE and SEGBA were therefore separated out and amalgamated to form a new transmission company Transener.[60] The lower voltage networks of AyE, comprising mainly 132 kV lines, were formed into four regional sub-transmission companies plus the isolated system in Patagonia.[61] The transmission lines of Buenos Aires province, privatised later in 1997, constituted the fifth regional sub-transmission company.

These transmission and sub-transmission companies were not allowed to buy or sell energy. They were not allowed to own controlling stakes of generators or distribution companies or large users.[62]

Table 3 shows that, at the time of privatisation, Transener owned some 7000 km of high-voltage (mainly 500 kV) transmission lines (plus 27 substations). The Patagonian regional transmission company Transpa owned a separate network of about 800 km of

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[60] The High Voltage Electricity Transmission System (or STEEAT) operated by Transener is defined as the set of transmission installations at 220 kV and above including reactive compensation, transformer, handling, control and communications equipment for the purpose of electricity transmission between different electric regions. Bastos and Abdala 1993/6, p. 120.

[61] The sub-transmission system, technically the Electricity Transmission System of Trunk Distribution (or STEEDT), is the set of transmission installations between 132 kV and 400 kV, aimed at linking generation stations, distribution companies and large consumers together within the same electric region, or to STEEAT or to another STEEDT. Bastos and Abdala 1993/6, p. 120

[62] In practice, however, some international companies set up separate subsidiaries to engage in all these activities.

132 kV lines, plus 1100 km of 330 kV line from a jointly owned generation station on the west of the province. The other five regional sub-transmission companies owned about 9,000 km of 132 kV lines between them.

Table 3 Lines owned by Argentine transmission companies 1992 [63]

Voltage	500 kV	330 kV	220 kV	132 kV	Total
Company					
Transener	6624		562	6	7192
Transpa (Patagonia)		1111		798	1909
5 Regional Transcos[64]			841	8510	9351
Total	6624	1111	1403	9314	18,452

In terms of line length Transener's Extra High Voltage transmission system of 500 kV lines accounted for about one third of the total transmission system, while the 132 kV regional sub-transmission systems accounted for about two thirds. However in financial terms the importance is reversed: the 500 kV system accounts for about two-thirds in terms of replacement value, and the 132 kV system about one third.[65]

Looking to the future, the entrance and growth of other transmission companies could be envisaged. While ownership and operation of existing lines might be given to a single company, the construction and operation of new lines could be open to competition. Interested competitors might include the construction companies that used to bid for tenders to construct lines put out by the existing companies, and transmission companies in other countries.[66] Bidding for new lines could therefore lead, in due course, to the development of a system with several transmission companies, perhaps ultimately of comparable size to the initial incumbent. Even if this were not to be the outcome, the

[63] Source: derived from CAMMESA Annual Report, 2002. In addition, one of the regional transmission companies owned 391 km of 66 kV lines and another owned 24 km of 33 kV lines. (Table 3 figures obtained by subtracting these from totals in CAMMESA Report.) The Provincial companies are also thought to own some 132 kV lines but data is not readily available. For Transener's 500 kV network, it is not clear why CAMMESA shows 6624 km in 1992 when Table 1 shows 6870 km already built. CAMMESA's report shows 6875 km in 1993, which is close to Table 1. The increase of 251 km may correspond to the 2nd circuit Alicurá – Chocón 246 km, although this was already finalized in 1992.

[64] The five regional transcos are Transnoa (northwest area) 2075 km, Distrocuyo (west area) 1245 km, Transcomahue (southwest area) 830 km and Transnea (northeast area) 796 km plus Transba (Buenos Aires province) 4820 km. These figures include 391 km of 66 kV line within Transba and 24 km of 33 kV line within Transnea that are not included in the total 9351 km in Table 3.

[65] This assumes, as a rough rule of thumb, that replacement costs of 500 kV, 330 kV, 220 kV and 132 kV lines stand in the proportions 4:3:2:1. In practice the costs of 500 kV and 132 kV lines have been falling over time as a result of competition to build them, whereas the costs of other voltage lines are somewhat hypothetical as they are not being extended.

[66] This proved to be the case. SADE Ing y Construcciones and National Grid Company were members of the consortium that purchased Transener at privatisation. Another construction company, Litsa, became an independent transmission company after winning the tender to construct the Rincón – Salto Grande line.

very possibility of new entry would put pressure for greater efficiency on the incumbent transmission company.

3. Regulation of Existing Transmission

3.1 Basic framework

How should the restructured transmission sector be regulated? A key step was the recognition that the existing and new facilities could be regulated separately and differently. The operation and maintenance of the existing transmission systems could be subject to incentive price caps, as recently introduced for the transmission and distribution businesses in the UK. This was now a known procedure, and evidence was beginning to suggest that it was conducive to improved efficiency. In contrast, the construction and initial operation of new facilities could be put out to competitive tender.

The 1992 Electricity Regulation Act (Law 24065) provided the framework for the regulation of the existing transmission systems. The concessions themselves are distinctive[67], but beyond the scope of this paper. The more familiar requirements are that concessionaires of transmission systems must operate and maintain their systems to comply with defined quality of service standards. They must allow third parties open access to the capacity of their systems on non-discriminatory terms in return for remuneration determined by the Secretary of Energy.

Regulation of transmission revenues was expressed in a variety of Laws, Decrees and Resolutions.[68] It evolved during 1991 to 1993.[69]

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[67] For Transener, the concession period is 95 years (Art.3 Transener Concession Contract), divided into a series of management periods, the first being 15 years and the subsequent ones 10 years (Art.5 Transener Concession Contract). Six months before the end of each period the regulator organises a sale of the concession, with the incumbent allowed to bid. If another party bids higher than the incumbent, the latter is reimbursed for the value of the sale (Arts. 6 to 11 Transener Concession Contract). This provides an incentive to preserve the value of the assets under concession. Abdala 1994.

[68] A note on statutory terminology may be helpful. The 'hierarchy' of statutory instruments is Congressional Law, Presidential Decree, Ministerial Resolution. The relevant ministry was initially the Sub-Secretary of Electric Energy (SSEE), later the Secretary of Energy (SE), and in one later period the Secretary of Energy and Mining (SEM). Resolutions are numbered in chronological order, starting anew each year.

[69] Briefly, Resolution SSEE 38 (19 July 1991) was the first version of the Market Regulations, then applicable in the state-owned environment. Article 38 provided for Transcos to receive remuneration based on nodal price differentials, at that time determined by transmission losses in the absence of congestion. Resolution SSEE 61 (19 April 1992) introduced the concept of Local Prices, effectively acknowledging the possibility of congestion. It introduced 'fixed' components (connection and transmission capacity charges) to provide stability of revenue, and a cap on the 'variable' components (losses and congestion revenues), with any excess over the cap transferred to the Stabilization Fund; this cap was abolished in November 1992. This resolution also introduced an 'adaptation factor' associated with reliability and quality of service; this was initially applied to energy prices, but from February 1993 applied to capacity payments instead. Resolution SE 137 (30 November 1992), in force from February 1993, set basic rules for the Wholesale Market. Its revised Annex 16 to the Market Regulations set the framework for transmission regulation including expansion that essentially applied until 1999. Annex 16 was ratified in Decree 2743 (29 December 1992) which also created Transener. Annex 18 of the Market Regulations created the Apartamientos Accounts to hold the balance of the 'variable' components, Article 22 of SE 137 provided

3.2 Nodal pricing

Since an important part of the revenue was related to nodal prices, a brief explanation of nodal pricing in Argentina may be helpful at this point.

> "The market price is determined by the price at the reference node or 'swing bus', located near Buenos Aires, the main consumption node. The price there is calculated as being the highest marginal cost of generation adjusted by marginal transmission cost in the nodes integrated to the market. A node is integrated to the market if the capacity restrictions of the line connecting it to the market are not binding. If they are binding, the node is not integrated to the market and prices are set regionally as the highest marginal cost in the non-integrated node." [70]

In simple terms, price at Buenos Aires is set equal to marginal system cost. Where the line between Buenos Aires and another node is uncongested – that is, there are no transmission constraints - the difference between the price at that node and in Buenos Aires is marginal transmission cost including marginal transmission losses. Where a line is congested – that is, there is a transmission constraint because the economic power flow from a node would exceed the line's capacity - that node is said to be 'isolated' and a 'Local Price' applies. This is calculated as the marginal cost of generation at that node, taking account of the amount actually transmitted through the line.

The local price will typically be lower than the price in Buenos Aires, since the latter will reflect the marginal cost of generation from some other higher cost source. If the transmission constraint is severe, so that a great deal of generation is precluded from being transmitted to Buenos Aires, then the difference in prices could be considerable. The local price could even be zero if enough generators were declaring zero marginal costs (e.g as a result of hydro generators spilling water, as indeed happened in Comahue at one point).

3.3 Allowed revenue

From the time of Transener's privatisation in July 1993 the allowed remuneration for a transmission company's existing capacity had three main components:

- Connection revenue: derived from a regulated access charge for each type of connection, related to the operating and maintenance costs of the equipment directly required for each user or small group of users, and set per hour of availability.
- Capacity revenue: derived from a regulated charge for each type of line, related to the estimated or efficient operation and maintenance costs of existing facilities, and set per hour of availability.
- Nodal pricing revenue reflecting line losses and congestion costs: this was set equal to (the expected value of) the difference between the prices that consumers

for these Accounts to become effective upon Transener's privatisation, and SE 274 (26 August 1994) channelled congestion revenues from the Apartamientos Accounts into the Salex Funds.

[70] Chisari et al 2001, p. 699.

pay at demand nodes and the (typically lower) prices that generators receive at supply nodes, aggregated over all the nodes on the network.

Since nodal prices would fluctuate unpredictably, the regulation fixed this element of the revenue entitlement on a constant monthly basis for five years ahead. Together with the other two fixed elements, this stabilised the transmission company's income, and removed any incentive for it to restrict capacity in order to increase revenue by increasing the differentials in nodal prices. For the first period 1993-98, Transener's allowed annual revenues from these three components were connections $12m, capacity $35m and nodal prices $55m, total $102m.

The capacity charges were to be prorated among customers each month using the 'area of influence' methodology. This was also used in the allocation of expansion costs among beneficiaries (see below).

The differences between estimated and realised charges for nodal price differences were accumulated in Apartamientos Accounts (variously translated as Compensation, Separation or Deviation Funds). CAMMESA administered these Accounts, one for each transmission company. If actual nodal pricing revenues fell below the projected level in any month, they would be made up from the Fund, or from subsequent surpluses, or if necessary the capacity charges would be increased to provide the required revenue. If actual nodal pricing revenues exceeded the projected level in any month, there was provision for the capacity charges to be reduced so as to keep the balances on the Apartamientos Accounts at a low level.[71]

The total revenue from these three sets of transmission charges was calculated to be sufficient to operate and maintain (but not to expand) the existing transmission system.[72] The fixed nature of the allowed revenues, as opposed to a cost-of-service arrangement, provided an incentive to efficiency. In addition, penalty payments and (later) credits related to quality of supply encouraged reliable operation. There were also fees for supervising the construction and operation of new lines by others.[73]

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[71] The detail of this provision changed over time. Initially it was set on a six-monthly ex ante basis, which could be revised after the first three months if significant deviations were observed. Resolution SE 147 (17 May 1994) changed it to a one-month ex-post basis.

[72] There was and still is some ambiguity as to whether or not the allowed transmission revenue included the obligation to renew or replace existing lines at the end of their lives. The intention of the transmission privatisation team was that the transmission company should make known the need for such investment at an appropriate time so that users could propose a replacement under the normal expansion process. However, the assumption of at least one group advising a bidder for Transener was that the transmission company had an obligation to replace and that allowed revenues had to cover the cost of replacement. The transmission tariff review in 1998 and subsequent licence modifications did not resolve the issue. Since transmission lines can last for several decades this has not been a significant issue in practice, but may be increasingly so in future.

[73] The transmission company remained responsible for the quality of service provided by independent transmission companies within its own grid, and was liable for penalties for their failure to meet prescribed service standards. The supervision fees were intended to enable the Transmission company to discharge its supervisory responsibilities. They may have been set at a generous level, though this also helped to minimise opposition to the introduction of competition.

3.4 Performance of existing system

The structure and evolution of these charges for the existing transmission system is largely beyond the scope of the present paper.[74] However, in general this aspect of regulation seems to have worked well. It has improved quality of service and provided sufficient revenue for line maintenance.[75] It has also encouraged greater efficiency. For example, operation and maintenance costs were reduced to one third of the pre-privatisation rate and to half of the actual 1992 costs. The number of faults per 100 km of line reduced from about 1.5 in 1992 and 1994 to an average of 0.55 from 1995 to 2002.[76] Transmission forced outages fell from 1000 hours in 1992 to 900 in 1993, 650 in 1994 and 300 in 1995.[77] Average recovery time when a tower line collapsed was reduced from about 1½ days during 1981-1992 to about ½ day during 1993-2003.[78]

4. Regulation of transmission expansion

4.1 The development of thinking

The construction and initial operation of new lines, and other transmission capacity such as substations etc, could be put out to tender. This would ensure productive efficiency. Moreover, the winning bid price could be used to obviate the need to set a further price control. However, there still remained the question: how to determine which new lines and substations should be built, and how to ensure that they (and no others) were built?

The solution emerged from active discussions within the transmission privatisation team. One initial view was that pricing and investment were separate regulatory issues. On the pricing issue, a price cap would have incentive properties, but there were also questions of allocative efficiency and rate structure: how to allocate transmission costs among users so as to encourage efficient use of the existing network?[79] There were also questions of rate level. Other contemporary discussions in the US and UK envisaged that charges based on nodal spot prices (more precisely, on the differences between them) would send efficient short term signals to market participants and would just recover efficiently incurred transmission costs. It was becoming apparent, however, that in practice such charges would recover only a proportion of total costs, perhaps as little as 20 to 50 per cent.[80] Additional (or 'complementary') charges would be needed to recover the balance of the transmission costs. Economic theory suggested that setting such complementary charges in proportion to the benefits received by users would avoid or minimise any welfare loss due to the charges being above the level indicated by nodal spot prices.

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[74] For exposition and discussion, see Bastos and Abdala 1993/6, Sanz 2004, Estache and Rodríguez-Pardina 2003 and Gómez-Ibáñez 2003.
[75] Pollitt 2004, pp. 16, 20.
[76] Transener slide presentation 2003, Sanz 2004.
[77] Estache and Pardina 2003, Table 1.
[78] Source: Transener slide presentation 2003
[79] Pérez Arriaga 1992 a,b, Abdala 1994
[80] Pérez-Arriaga and Rubio 1995. There was also the problem that relating a transmission company's income to nodal charges gave it perverse incentives to increase congestion.

On the investment issue, the conventional micro-economic representation of regulation was for the regulator to choose generation and transmission to maximise consumer utility less the sum of generation and transmission costs. But this was central planning and therefore unacceptable in Argentina. It was equally undesirable to let the transmission company make the investment decisions. The solution was to recognise that if transmission costs were charged to beneficiaries, then an equivalent regulatory objective function, more appropriate to a competitive market, was to choose network reinforcements so as to maximise the sum of net benefits to consumers and generators. This suggested what subsequently became known as the Golden Rule: the regulator should check that total cost of generation plus transmission plus cost of unserved energy would be lower with a proposed transmission expansion than without it.

This provided a criterion for appraising proposed transmission investments. But it still left unresolved the question of who should propose them and what the inducement should be. The key was the proposed basis for charging. If the cost of new investments were charged to those who used them (the beneficiaries), then these users would have the incentive to identify, propose and accept investments that yielded prospective net benefits to them, and to reject those that did not. There was no need for incumbent transmission companies to determine new investment – indeed this would be positively undesirable. However, they could have a role in providing information, in ensuring that expansions of their systems were properly done, and in bidding to construct, operate and maintain the expansions decided upon by users.

This enabled a significant switch of emphasis in transmission investment planning compared to the pre-privatisation approach, and indeed compared to transmission regulation elsewhere. Two main kinds of investment proponents were envisaged:

> "the expansion of the network must be initiated by the requirements of its users:
> - Generators located in export areas where some available capacity is not dispatched because of transmission constraints: they need the transmission network expansion to transport their surplus to other areas.
> - Distributors and Large Users located in import areas where transmission constraints do not allow economical generation: they need the transmission network to buy economical generation and avoid failures due to generation deficit."[81]

The new approach required a mechanism to identify the beneficiaries of any investment, calculate the charges that would apply to each beneficiary, and aggregate (e.g. by voting) the views of the beneficiaries. It was also necessary to specify the quality of supply that the users had to ensure. At the time these seemed relatively straightforward tasks, though in practice they proved somewhat controversial.

From this perspective, there was arguably no need for a subsequent regulatory application of the Golden Rule, which still had overtones of central planning. But at the time it seemed as though "planners' data" and "companies' data" were quite different, so that both mechanisms might be needed. And since central planning was still the predominant

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[81] Sanz 2004, p. 4

way of thinking, a check of this kind served to reassure the industry, politicians and customers.

For major transmission network expansions, then, the onus for action was put firmly on the users of the network, not on the incumbent or the regulator. This was not an ideological or ad hoc decision: it was the final and perhaps most imaginative and bold part of a consistent approach to the design of electricity privatisation in Argentina. Transmission was seen as a critically important component of the future electricity sector, and the need for improved efficiency was paramount. The country could not afford to continue to squander resources on politically attractive but uneconomic expansions. In the particular circumstances of Argentina at the time, and given previous experience and likely future conditions, the conventional approach to regulating incumbent transmission companies was likely to continue such problems. Such regulation was not a credible way to improve decision-making and resource allocation. Instead, maximising the scope for competition and market discipline generally, and giving users the responsibility to determine expansions when faced with the costs involved, would minimise the scope for political influence and more likely achieve the goal of improved efficiency.

What about externalities? Was there a case for central planning because 'the whole is not the sum of the parts'? As regards externalities between parts of the system but within the system as a whole, identification of the users would attempt to include all those affected by any proposed expansion (and in a radial system this was less problematic than in a meshed system). Moreover, the Secretariat of Energy and the system operator CAMMESA would have a continuing role to oversee the efficiency of the system as a whole.[82] As regards the external impact of the system (e.g. on employment, regional development, distribution of income, etc.), past experience suggested that using central planning to take account of such considerations had been the cause of considerable cost and inefficiency, as documented above.

4.2 Regulation of expansions of transmission capacity

Annex 16 of the Market Regulations (per SE 137/1992) provided for three different methods for the construction and operation of new transmission lines for public use: Contract Between Parties, Minor Expansions, and Public Contest.

It was envisaged that the Contract Between Parties method would be used where one or a small number of parties needed additional capacity that would primarily be used by them alone. An example would be a short extension to connect a new wholesale customer to

[82] The regulations on 'Interconnection and use of the transmission grid' (Annex 16, Article 17) provide that a transmission company has to operate its grid under conditions set by CAMMESA in fulfilment of norms laid down by the Secretary of Energy under Article 36 of Law 24065. CAMMESA's functions include not only economic dispatch of generation and transparent administration of the market, but also coordination of the centralised operation of the system in order to guarantee security and quality of supply. In consequence, CAMMESA is indirectly involved in approving the technical feasibility and operating conditions of transmission expansions. It also has to approve applications for access to the transmission system by new generation and demand. (Annex 16, Article 3)

the high voltage system. The Minor Expansions method was provided for small investments, where the value was not large enough to pose a threat of uneconomic behaviour or to warrant a more extensive procedure. It was expected that the Public Contest method would be used for the most significant investments, where a larger number of generators and/or distribution companies needed to expand the system for the benefit of many parties – for example, by a new line or transformer. A method of resolving the different interests of the parties would then be needed.

In addition, Article 31 of the 1992 Act enabled the Secretary of Energy to authorise a generator, distributor or large user to construct a transmission line at its own cost and for its own private use. The government was reluctant to use Article 31, preferring that new facilities should be publicly available on an open access basis. This was an issue in only one case.[83] Later, the government position relaxed slightly.[84]
The three methods may be summarised as follows. [85]

<u>Expansions of transmission capacity by Contract between Parties</u>

One or more parties wishing to expand the transmission system may agree a contract for Construction, Operation and Maintenance (COM)[86] with the Transmission Company in that area, or with an independent transmission company. On requesting an expansion the applicants must provide relevant technical information so that the Transmission Company and ENRE may satisfy themselves that the expansion complies with the regulations. The Transmission Company must pass the request to ENRE, with its own views, within 30 days. ENRE must organise a public hearing within another 30 days. If there is no opposition to the request, or if ENRE deems any opposition not well founded, ENRE authorises the project and issues a Certificate of Convenience and Public Necessity.[87]

Operation and Maintenance (O&M) charges for expansions of transmission capacity brought about by Contract Between Parties are set according to the regulatory regime in

[83] An Australian company wished to build a 202 km 220 kV line from Tucumán to its gold mine in the Andes Mountains. Some wished to use this line to supply a small residential demand in that area, which had previously been served by an isolated generator. The mining company argued that the penalties accompanying provision of such residential service would unduly constrain use of the line for mining purposes. After much discussion, it was agreed that the line would provide local supply without such penalties, and the line was approved for construction under Article 31. Other lines under Article 31 were typically under 20 km in length, although there were two 50 km lines (one at 500 kV, the other at 132 kV) connecting Agua del Cajón power plant to El Chocón substation.
[84] Resolution SE 179 (8 May 1998) clarified and liberalised the conditions under which such authority would be granted.
[85] There have been some changes over time. The latest version of The Regulations (Los Procedimientos) is Anexo 16: Reglamentaciones del Sistema de Transporte, CAMMESA, version 1 June 2003.
[86] Internationally this is also often called a Build, Operate and Maintain or BOM contract.
[87] The Spanish word “Conveniencia” is conventionally translated as Convenience in this context. However, the word has the connotation of ‘advantageous’ rather than merely ‘convenient’. The Certificate is thus intended to confirm the beneficial nature of the expansion in question.

force for existing installations.[88] Under no circumstances may the costs of amortising the new investment be transferred to other users.

Minor Expansions of transmission capacity

A Minor Expansion is one that does not exceed a specified value. To date, that value has been $2 million in the case of Transener's 500 kV system. A Minor Expansion is the responsibility of the transmission company. The company may agree the amortisation with the direct users of the expansion in a contract between parties. Alternatively, it may request ENRE to authorise the investment and determine the proportions in which each beneficiary should contribute to paying for it.[89]

Expansions of transmission capacity by Public Contest

A party or group of parties may request an expansion of transmission capacity by Public Contest. These so-called 'proponents' apply to the Transmission Company that holds the concession in the area of the expansion.

The proponents must provide similar technical information as for the Contract between Parties method. Initially, the request had to be accompanied by an offer of a COM contract from a transmission company or from a prospective independent transmission company, with a proposed constant annual 'fee' (called a canon) over an amortisation period approved by ENRE.[90] Later, there was provision for specifying a maximum acceptable fee instead of an actual proposal.[91] There was also concern about the duration of the amortisation period.[92]

The Transmission Company has to ask the Dispatch Organisation (OED, part of CAMMESA) for a technical study to identify the "beneficiaries" of the expansion and the

[88] This is the case regardless of whether O&M is carried out by the incumbent Transmission Company of the area or by the new constructor becoming an Independent Transmission Company supervised by the incumbent Transmission Company. In all cases the new line, after construction, is treated like "an existing line" in the sense that investment costs are not included in the tariff.
[89] Usually these minor expansions are radial and only one or two participants are the possible beneficiaries, so negotiations are between the only interested parties. If the situation is not clear, Transener or any other party involved can ask ENRE to identify the beneficiaries using the Area of Influence Methodology. This enables negotiation to continue, concluding if successful in a contract between parties.
[90] Decree 2743/92, Annex III (the Annex 16 to the MR), Title III, Articles 15, 22, 27.
[91] In 1994, as discussed below, the proponents were allowed to specify instead a maximum annual canon that they would require as a condition of proceeding.
[92] The reform team envisaged an amortisation period of 15 years; this was written into the contract for the first Yacyretá line from Rincón to Resistencia, and also used for the Fourth Line, but only after the transmission company had proposed a period of 30 years (see below). The Secretariat of Energy became concerned that ENRE might allow longer periods in order to stimulate expansions. Resolution SEyT 105/96 (Annex I, Art.15) provided that the proposed canon should be for 15 years but that ENRE could change it only if could demonstrate that this was in the (economic) interests of users. "I specified a maximum period of 15 years to prevent the presentation of projects that looked cheap in the short run but would be expensive and unsustainable in the long run. Columbia, Panama and Peru did not do this, and transmission cost in Peru has now reached about $8/MWh." (R Sanz, personal communication.) In the event, amortisation periods have typically been less than 15 years, as noted in Part Two of this paper.

proportion in which each beneficiary would have to share the costs of amortisation. CAMMESA has 45 days in which to carry out this study and send it to the transmission company. Within 60 days of receiving a request, the Transmission Company has to apply to ENRE for the Certificate of Convenience and Public Necessity. This application must be accompanied by its own report on the technical feasibility of the request and by the technical study made by CAMMESA. ENRE may only consider a request where the proponents represent at least 30 per cent of the "benefits" that the expansion would bring in its "area of influence". It uses CAMMESA's study for this purpose.[93]

ENRE has to check that the present value of the total costs of investment, operation and maintenance of the Electricity System as a result of the expansion would be less than it would be without such expansion, where the costs of operation include the value of energy not supplied to the market. (This is known informally as the Golden Rule.) In making this evaluation the cost of investment, operation and maintenance of the expansion is taken to be as specified in the request.

ENRE has to publish the request for expansion, the amortisation period, the proposed annual fee, and also the beneficiaries and the proportions in which they would share in the payment of the proposed fee. Within 30 days of receiving the request, ENRE has to arrange for a public hearing.

In the event of opposition by 30 per cent or more of the beneficiaries of the expansion, ENRE must reject the expansion request. If in ENRE's judgement there is a lesser but nonetheless well-founded opposition to the request, it may seek the opinion of independent consultants, and decide the issue within 90 days. If there is no opposition, or not sufficient to change the decision, ENRE must approve the request, the amortisation period, the annual fee, the annual coefficients, the proposed coefficient on penalties[94], the beneficiaries, and their participation in the payment of the fee. At the same time ENRE must issue the Certificate of Convenience and Public Necessity. This enables the transmission company to define the terms of the required Technical Licence, which it must do within 30 days.

Having obtained ENRE's authorisation, the proponents must arrange for a public tender to construct, operate and maintain the proposed expansion. The tender and contract documents, and the award of the winning tender, require the previous approval of ENRE.

> If the lowest fee bid in the public tender is not below the offer in the COM contract accompanying the expansion request, then that initial contract proceeds. If the lowest fee bid is greater than or equal to 85 per cent of the fee in the expansion request, the lowest bidder and the initial bidder both have an opportunity to improve their bids within 72 hours of the Public Contest (with the lower of the subsequent bids winning). If the lowest bid is less than 85 per cent of

[93] CAMMESA's interpretation of "beneficiaries", "benefits" and "area of influence" has been controversial and is discussed below.

[94] This maintains or increases the penalties in force on the new line during the amortisation period, relative to the penalties in force for the concession area of the Transmission company.

the initial bid, ENRE will authorise confirmation of the COM contract with the lowest bidder in the Public Contest.[95]

Transmission expansions that take place by means of the Public Contest are financed by all those parties who are identified as beneficiaries in the area of influence of the expansion. In practice, this has meant in proportion to the shares of the beneficiaries in the area of influence, as determined by CAMMESA. After the expiration of the amortisation period of the COM contract, the annual remuneration is according to the remuneration regime applicable to existing installations of the incumbent Transmission Company.

Transener remains responsible for the compatibility of the high voltage system and for the technical supervision of a COM contract connected to this system. For this, the winning concessionaire has to pay Transener a fee equal to 3 per cent of total construction costs during the construction period, 4 per cent of transmission revenues during the 15 year amortization period, and 2.5 per cent of transmission revenues thereafter. [96]

Beneficiaries and the Area of Influence

The method used to determine beneficiaries and the area of influence is evidently important and has attracted considerable attention. The Regulations specify that CAMMESA should use the area of influence methodology. In practice, CAMMESA has determined who are the 'beneficiaries' of the line, and its 'area of influence', by using a simulation model based on the model it uses to set nodal prices (see above).[97] A generator is a beneficiary if an increase in its output (with a corresponding increase in consumption at the 'swing bus' in Buenos Aires) would increase the flow along the new line. A distribution company or large user is a beneficiary if an increase in its consumption (with a corresponding reduction in consumption in Buenos Aires) would increase the flow along the new line. Both are simulated in normal conditions of operation. The 'area of influence' of the new line is the set of these beneficiaries. CAMMESA then uses a more elaborate series of simulations to calculate the 'participation' of each beneficiary in the expansion. The voting share of each beneficiary is the weighted average of its expected participation over the first two years of the line's operation.

5. Early experience

5.1 Early transmission developments

[95] Annex 16

[96] Annex 16 to the Market Regulations, Chapter 2, Title V, Article 32.

[97] The model used by CAMMESA has to be approved by the Energy Secretariat (including the source code in case it is not a commercial package) and cannot be changed, modified or updated by CAMMESA without specific authorisation of the Secretary of Energy.

In 1992 a competitive tender was issued to link Yacyretá power station, jointly owned by the governments of Argentina and Paraguay, with the Argentine high voltage network.[98] This was a Construction, Operation and Maintenance (COM) contract for a 267 km 500 kV line with 850-900 MW capacity, to extend the transmission network from Resistencia to Yacyretá's local substation Rincón. An international consortium called Yacylec SA won the tender with a monthly fee of $2.38 m, beginning in September 1994.[99] This tender also included the 3.6km triple circuit connection between Yacyretá and Rincón. In October 1994 further competitive tenders were issued for connections between Rincón and Salto Grande to the south (506 km), and Rincón and San Isidro to the northeast (80 km), both of which contracts were won by the independent contractor Litsa. These two lines commissioned in 1996.

In 1993, just before Transener's privatisation, Hidronor had initiated two 6 km connections (completed by Transener in 1993 and 1994) between Piedra del Águila and its local substation. Power station Loma La Lata constructed a 37 km connection to the system in 1994, on the basis of a Contract between Parties, and decided to operate the line itself.

Thus, by the end of 1994, three major high voltage lines totalling 853 km had been successfully put out to competitive tender, and several connections totalling 60 km had been made to the high-voltage system. The arrangements for Argentine transmission expansion seemed to be working. But the situation was more complex in Comahue, where congestion was developing on the link with Buenos Aires, which had implications for the regulation of both existing and new transmission.

5.2 The Salex Funds

As explained above, the Market Regulations provided for Transener to receive projected rather than actual differences in nodal prices, insofar as these were due to transmission losses. Any continued surplus of actual over projected nodal pricing revenue would initially accumulate in the Apartamientos Accounts, and then be used to reduce capacity charges.

The actual differences in nodal prices reflected both transmission losses and congestion (the latter being when local prices obtained). However, the allowed revenue calculations provided only for differences in losses, and any differences due to congestion would go

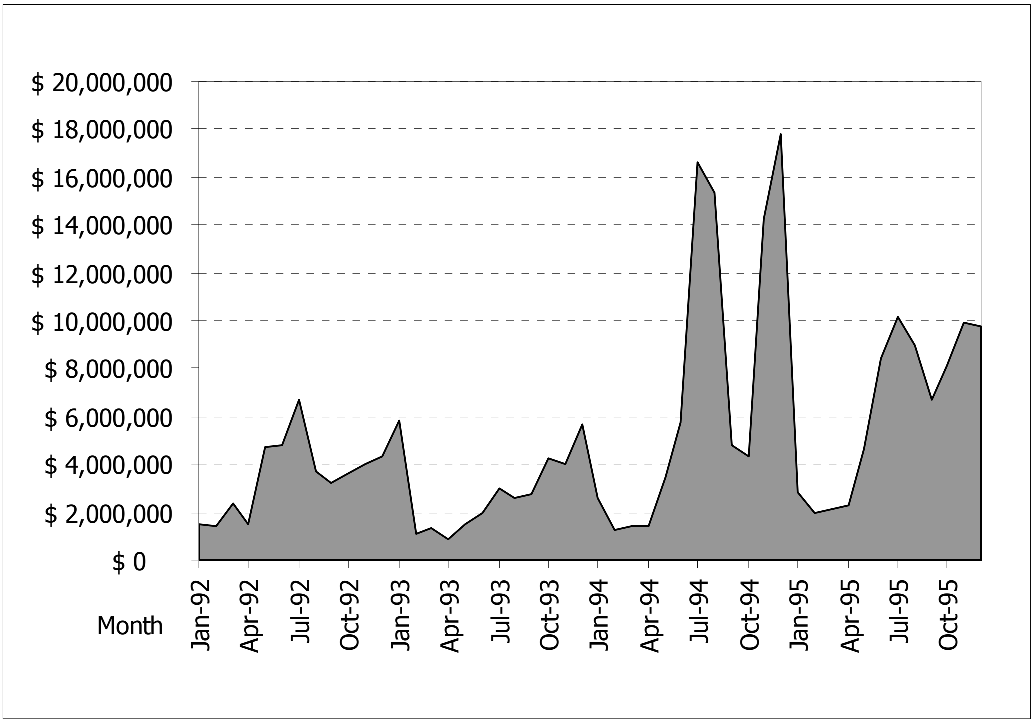
[98] Although the two governments jointly own Yacyretá via Entidad Binacional Yacyretá (EBY), transmission expansions were considered as "non-shared" investments. More than 95% of energy produced by Yacyretá is injected into the Argentine system, which committed to buy the energy, so transmission expansion was mainly a domestic issue for Argentina. An entity named UESTY (Special Unit for Yacyretá Transmission System) was created within the Energy Secretariat (Presidential Decree 1174/1992). This entity formally called for the connection of Yacyretá to the local substation at Rincón, and the construction of the lines to Resistencia, Salto Grande and San Isidro. The expansions were classed as Public Contest rather than Contract Between Parties because competitive tenders were used, and to ensure that if the lines were subsequently used for other purposes then other users would pay their share. This proved appropriate when exports to Brazil later changed the direction of flow and paid part of the canon.

[99] Transener was in course of privatisation during the tender and did not bid.

straight to the Apartamientos Accounts. This was not an issue when congestion was negligible. From January 1992 to June 1994 the actual revenue from nodal price differentials (losses plus congestion) averaged $3m per month, and did not exceed about $6m at maximum.

In winter 1994, rainfall was high so hydro output was higher than in previous years. In addition, open cycle gas turbines had begun to be built in Comahue from 1993 onwards, as discussed shortly. The combination of these factors meant that the transmission lines from Comahue to Buenos Aires became unusually full, causing higher than projected marginal losses and line-loss revenues, and most importantly causing transmission constraints and local prices. In July 1994 revenue from nodal price differentials shot up to over $16m per month and stayed at nearly that level in August. (See Figure 2) The net balance in Transener's Apartamientos Account, which had been negligible in April and May 1994, reached $17.3 m in July and $26.6 m in August 1994.

Figure 2 Transener revenue from nodal price differentials (losses plus congestion)



Since high levels of congestion revenue could well continue to obtain in future,[100] the question arose what to do with such congestion revenue. It was obviously questionable whether it was appropriate to use it to reduce capacity charges. The amount collected

[100] In fact, monthly revenue from nodal price differentials was to reach a similar $16 m level in November and December 1994, and the cumulative balance in the accounts was over $40 m in December 1994, and over $100 m eighteen months later.

from nodal prices in the month of July 1994 alone was sufficient to cover the whole of Transener's allowed remuneration for two months, of which the capacity element was only one third. Applying the entire nodal revenues to reduce capacity charges would have meant setting negative capacity charges, not merely reducing them or even setting them at zero. It did not seem desirable to undermine in this way the principle of making capacity charges.

At one time the Secretary of Energy was reportedly considering the possibility of applying the congestion revenues elsewhere. But would it be any more desirable for such funds to be appropriated and spent by some government or regulatory planning agency?

A more attractive alternative, which the Comahue generators naturally supported (although their first preference was to return the funds to themselves), was to make the excess congestion revenues available for transmission expansion in the same corridors that generated them. This had the economic advantage of facilitating new transmission investment where it was most needed, thereby aligning such investment more closely with price signals. In the new system, transmission was perhaps more risky than generation: in a changing and mainly hydro system demand was volatile, getting Public Contest support was more bureaucratic and required cooperation between rivals, and the entry of new generators could reduce the benefits to the proponents. Extending the market would facilitate competition in generation. It also had the advantage that the use of these funds would be contingent on decisions by market participants (primarily generators) who would be backing their judgements with a willingness to pay via the Public Contest method.

By Resolution 274 of August 1994 the Secretary of Energy instructed CAMMESA to apply the cumulative balances of the Apartamientos Accounts at the end of August so as to reduce the transmission charges for the use of the lines (i.e. the capacity charges).[101] He then specified that, in future, revenues from nodal price differentials would accrue to the Apartamientos Accounts only insofar as they derived from (unexpectedly high) transmission losses. Revenues from nodal price differentials deriving from congestion (i.e. local prices) should be put into so-called Salex Funds, one for each of seven transmission corridors.[102] These Salex Funds could be used to reduce the cost of transmission expansions using the Public Contest method. [103] However, to be eligible for

[101] Resolution SE 274 (26 August 1994), Article 5. Transener had $26.7m in its Apartamientos Account at the end of August 1994, whereas the monthly transmission capacity charges totalled $2.6m/month. The monthly charges were reduced to zero until the amount available was exhausted, which took until March 1995. (It might have lasted until June 1995, but in summer 1994/95 the amounts collected by nodal prices were lower than committed to Transener by about $1.2m/month, hence this deficit was also a call on these funds.)

[102] The corridors were defined in terms of substations. More accounts were created later, to reflect congestion in different directions, or congestion revenues accruing after particular investments. CAMMESA's Annual Report 2002 shows the evolution during that year of the Salex Funds for each of 11 accounts, established at various times between December 1994 and July 2001. The aggregate balance in the Comahue – Buenos Aires corridor accounts is an order of magnitude greater than in any other corridor.

[103] Annex 16 section 2 iii Article 15 of the Market Rules was modified to provide that applicants may apply to ENRE, who may assign uncommitted funds from the relevant Corridor of the Salex Fund.

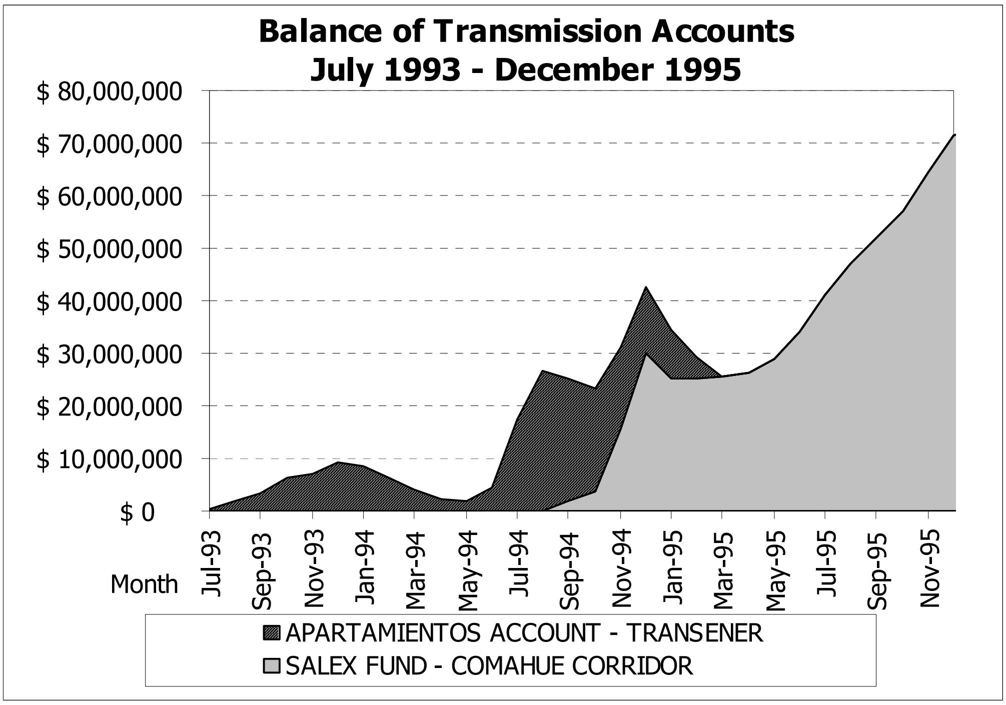
support, the expansions had to produce reductions in the transmission constraints that generated local prices in the corresponding corridor.[104]

Resolution SE 274 explained that its purpose was to ensure economic signals.

> The practical effect of doing this is to give adequate direction to the funds originating from local pricing towards the expansion of transmission capacity. It is necessary to remove constraints on the free dispatch of generation, and necessary to give precision to the use of the funds derived from local prices that remain in the Apartamientos Accounts.

Figure 3 shows the build-up of the Salex Fund for the Comahue corridor. The potential contribution of the Salex Funds soon became an issue in the Fourth line debate.

Figure 3 Apartamientos Account and Salex Fund 1993-5



5.3 The Fourth Line

On 2 September 1994 two generators from Comahue - the owners of the hydro plants El Chocón and Alicurá – applied for an expansion of transmission capacity by Public Contest.[105] They wished to construct a new 500 kV line, of length nearly 1300 km, from

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[104] This requirement implies, inter alia, that 500 kV lines and capacitors could be eligible for the Salex Funds but transformers and 132 kV lines are unlikely to be eligible. In the event, there have been five applications of Salex Funds involving transformers, only two of which seem to be justified in terms of reducing congestion.

[105] Transcript of public hearing 17 February 1995, attached to ENRE Resolution 49/1995 of 28 March 1995. See also Galetovic and Inostroza, 2004, pp. 13-18.

the Piedra del Águila hydro plant in Comahue to the edge of Buenos Aires. This was the famous Fourth Line. (See Figure 1) At that time the proponents represented just over 30 per cent of the beneficiaries of the line.[106] They offered a Construct, Operate and Maintain (COM) contract with an annual fee of $54.6m for the first three and a half years and $61.4m for the remainder of the 15 year period. The proposed independent transmission operator was a company called Tenasa.[107]

The public hearing was held on 17 February 1995. Two other hydro generators from Comahue (the owners of Piedra del Águila and Cerros Colorados) and a thermal generator (Central Térmica Alto Valle, in the same ownership – Dominion of the US - as Cerros Colorados) opposed the project. Since they represented some 34 per cent of the votes this sufficed to veto the project. Two other generators later joined them, bringing the opposition votes to over 50 per cent. ENRE formally rejected the application on 28 March 1995.

The outcome of this vote was a surprise and disappointment to many parties. With increasing demand in Buenos Aires and increasing generation in Comahue, and with increasing signs of congestion in the corridor, there had been a long-standing expectation that the fourth line would and should be built after privatisation. ENRE later described the Fourth Line as "a work planned by the public undertaking Hidronor in the 1980s and ever since those days considered necessary by the industry".[108]

But the matter was not left there. A series of negotiations between the proponents and initial opponents of the project secured two modifications of the Public Contest procedure and brought about consensus. On 7 May 1996 a larger group of generators made a new application to construct the same line. This time the proponents accounted for 82 per cent of the votes, so there was no possibility of 30 per cent objecting. On 25 September 1996 ENRE held a second public hearing. Only one generator opposed the project, accounting for 5.5 per cent of the votes. ENRE did not accept this objection. On 24 October 1996 ENRE approved the requested transmission expansion and the maximum annual fee of $43.67 m proposed by the initiators (which assumed a contribution of $80m from the Salex Fund), and issued the Certificate of Convenience and Public Necessity.[109] On 22 May 1997 ENRE issued a call for tenders. These were submitted on 27 October 1997. ENRE announced the winning bidder on 12 November 1997, with an annual fee of $24.52m plus the $80m Salex contribution. The very competitive nature of this bidding process is discussed further below.

The Fourth Line went into operation in 1999. It was a particularly large and important investment: at 1300 km it increased the line length in the whole 500kV transmission system by one fifth and increased power transfer capacity on the Comahue – Buenos

[106] Later, on 24 November, they were joined by Turbine Power Co, which had about 2 per cent of the votes.
[107] Mr Iglesis for the proponents explained to the Public Hearing that Tenasa had initially proposed a duration of 30 years, and that the proponents had been able to negotiate the period down to 15 years without any increase in the canon.
[108] ENRE *Annual Report 2002*, p. 49
[109] Resolution ENRE 0613/1996, 24 October 1996. For earlier stages see also Resolutions ENRE 0441/1996 and 0525/1996.

Aires link by nearly two fifths. It had about 2600 pylons, employed over 3000 workers at its peak, and cost some $250 million.[110]

6. Criticisms

6.1 ENRE's criticisms of the Public Contest process

ENRE is understood to have been disappointed by the initial rejection of the Fourth Line, and indeed concerned about the Public Contest method itself. Its *Annual Report 1994/5* emphasised and supported the profound innovation of the public audience concept (which went beyond transmission expansions).[111] At this stage it was inclined to represent the fourth line problem in terms of the (limited) perceptions of the beneficiaries. It urged on them the benefits of reinforcing weak or congested lines. They should address themselves to the advantage of any proposal, quantify its costs of implementation and accept their participation in paying for it. There was also a remark about the importance of correctly identifying the beneficiaries of an expansion, that some interpreted as a suggestion of the need for change in the mechanism (see below).

In its *1996 Annual Report*, after the line had been approved, ENRE expressed concern about inadequacies in the Rules.[112] It noted that this was the first real test of the new system of expansions (other earlier lines involving Yacyretá being exceptional), but cited several difficulties:

a) "The methodology for determining the beneficiaries, based on the criterion of areas of influence… gives rise to inequitable situations that may be conducive to failure, as happened with the first Public Hearing convened for this project. Disparities manifest themselves when a method based on the application of engineering design criteria [the area of influence method] is compared with another that defines beneficiaries on the basis of economic considerations."[113]
b) The availability and use of the Salex Funds should be clearer.
c) The Rules indicate that the proponents will stand in for the Comitente [a representative of the proponents] in carrying out the work, but in practice the extent of their rights and obligations is not clear.
d) However well the law establishes that competitive actions should be promoted, it would still fail to specify precisely the extent of monopoly that has been granted

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[110] Sources: Galetovic and Inostroza 2004; *Argentina in the Third Millenium*, Universitad Argentina de la Empresa (UADE), Julio Moyano Comunicaciones S A, Buenos Aires, 2000, p. 326.
[111] ENRE *Annual Report 1994/5*, ch. 5, esp p. 59.
[112] What it called "the prolonged delay" reflected, essentially, "the difficulties that necessarily confronted all the participants involved, including ENRE, in order to arrive at an adequate and satisfactory interpretation of the rules in view of the number of gaps and grey zones encountered." ENRE *Annual Report 1996*, pp. 44-46.
[113] This comment seems to reflect internal ENRE studies that were not made public, as well as discussions such as at the first public hearing on the Fourth Line, where Mr Granier and Mr Ponzano, on behalf of ESEBA Generation (Central Piedra Buena plant) and ESEBA distribution company, respectively, talked about the differences between the implications of technical and economic studies, and rejected the proposal because in their cases the economic benefit was negative.

to the transmission companies and the real possibilities of introducing competition.

e) Some grey areas have been detected between the duties of the State, specifically ENRE, and the rights available to the proponents of an expansion.
f) It would be helpful to establish more precisely the rights and obligations of the proponents and beneficiaries, including the role of ENRE with respect to the Salex Funds.
g) It would be advantageous if the proponents aimed in advance at a higher quality of service, as a means of improving the system.
h) "The desire to give the concept of open access an excessively judicial/literal meaning, when it deals with an economic criterion concerning the introduction of competition in a medium that is technologically conducive to natural monopoly, has led to controversy and sterile discussions."

ENRE explained why these numerous difficulties obliged it to intervene repeatedly, though each intervention was motivated by appeals and disputes. To avoid these ambiguities it was necessary to make the rules more precise. But in spite of these obstacles, it had been possible to create a strongly competitive atmosphere that had led to a fee of $24.5 millions against a maximum fee, fixed by the interested parties, of $43.67 millions. "If nothing else, this alone justified the active and firm participation of the Regulator in the process."

With the exception of the first point about the methodology for identifying beneficiaries, most of the difficulties that ENRE cited seem to be essentially transitional ones relating to process, reflecting teething troubles with the introduction of competition. They seem par for the course in modern utility regulation, and ENRE seems to have responded appropriately. [114] They are hardly a criticism of the Public Contest method itself.

6.2 Other criticisms of the Public Contest method

The earliest economic critique of the transmission expansion method predates the Fourth Line proposal.[115] A report for the Ministry of Economics identified a variety of concerns about institutional features that could delay investment.[116] A World Bank note, co-

[114] Galetovic and Inostroza 2004, pp. 15-17, have described the struggles between competing construction bidders, the resistance and conflicting roles of the incumbent Transener, and the important contribution of ENRE in enabling competition to take place.

[115] "The mechanism for capacity expansion misallocates the costs of financing new investment, as it implicitly ignores basic welfare effects, specially on the demand side. This, in combination with the ad hoc public hearing procedure adopted, will result in deviations from the optimal investment path in transmission." (Abdala 1994, p. 12)

[116] "In Argentina, the institutional framework decentralizes the network expansion decision and financing to generators and distributors. Much needed investments (construction of a fourth transmission line linking the main generation center to the main load center, the city of Buenos Aires) have been retarded by many years. Informed commentators (e.g. Spiller and Torres 1996) have attributed this delay to institutional features: difficulty in coordinations, free-rider problems, inappropriate measure of benefits, etc. – and have suggested remedial measures to foster transmission investments by groups of users." Leautier 2001, p. 45. The author adds in a footnote "Spiller and Torres (1996) observe that: 'market forces play little role in defining who will bear the costs of [transmission investment]; instead it is CAMMESA who allocates

authored with a former senior economist and later adviser at ENRE, suggested that the Area of Influence method excluded the demand side and was likely to result in suboptimal decisions.[117] ENRE commissioned academic research by Chisari et al into incentives for transmission investment; the resulting study concluded

> "While the transformation of the Argentine electricity market in the last decade has positively affected generation and distribution performance, most agree that current regulation has failed to spur needed investments in high-tension transmission. The lack or delay of such investments arises from problems in the willingness-to-pay revelation under the Public Contest mechanism." [118]

The consultants NERA, commissioned by the Secretary of Energy to review the industry, concluded "… the expansion of transmission has been a major problem in Argentina. The development of the fourth Comahue line was delayed for several years." [119] NERA diagnosed the main problems as the absence of transmission rights and the use of the area of influence method.

Some of these writers were sympathetic to the idea of users determining transmission investment.[120] Nonetheless they identified limitations in its particular application in the design of the Public Contest payment mechanism.[121]

Most subsequent authors seem to have based their critical conclusions on one or more of the above analyses. They focus in particular on the initial rejection of the Fourth Line. One review cites Abdala and Chambouleyron and the World Bank note[122], two authors

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capacity charges based on a methodology which does not capture all the economic benefits of expansion [i.e. does not fully value the substitution effect].' "

[117] Estache and Pardina 1996, p. 4.

[118] Chisari et al 2001, p. 713.

[119] NERA 1998, p. 53. The report claimed that a veto provision in the Public Contest method "was used in the Comahue case to block development for four years." This figure has been repeated elsewhere: "Difficulties with the Argentine Expansion Scheme: the Fourth Line was delayed by four years …" Woolf 2003b.

[120] E.g. Abdala 1994, Spiller and Torres 1996; also Abdala and Chambouleyron 1999, Abdala and Spiller 2000, Abdala 2004.

[121] "Prolonged congestion in power transmission in Argentina indicates that the BOM and private contract procedures can lead to nonoptimal investment: … the BOM procedure … has conceptual flaws, and the veto safeguards are insufficient to prevent unfair and inefficient outcomes." Abdala and Chambouleyron 1999, p. 3. "The rule [for allocating costs] is flawed as cost allocation is based on an elementary measure of power flows. Hence it does not take into account externalities or users preferences, and produces unfair results that distributors are not willing to accept. Veto safeguards to protect those receiving negative externalities or those who had to bear a share of investment costs larger than their willingness to pay are insufficient, and there are no provisions for compensation mechanisms." Abdala and Spiller 2000, para 3.1.1.

[122] "Evidence points to a failure to correct regulatory obstacles that prevented expansion of the transmission system." "… the only two transmission expansion proposals to come before ENRE in the mid-1990s were blocked by beneficiaries that rejected the proposed transmission charges (Abdala and Chambouleyron 1999). Private contracts for individual lines linking particular industrial customers or communities to the grid were approved by ENRE, but these did not solve the larger congestion problems plaguing the 500-kilovolt lines that interconnect the national grid (Abdala and Chambouleyron 1999)." Bouille et al 2002 pp. 31-2, 46. (The cited paper does not in fact refer to the two proposals in the mid-1990s.)

cite the NERA report and Chisari et al.[123] One survey comprehensively cites most of these articles.[124]

The Fourth Line experience is evidently still a major regulatory concern. ENRE found it appropriate to open the transmission chapter of its latest annual report with a critical remark along similar lines.

> "… The signalling mechanism directed at incentivising those interested in expansions seems not to have completely met the demand and, furthermore, is not immune to certain opportunistic behaviours (of the free-riding type) by the agents. In the past these limitations have delayed and/or impeded the realisation of expansion projects of an important magnitude."[125]

Transener expressed concern about the apparent lack of coordinated planning:

> "in our brief experience of 30 months operating the system, we believe that a certain degree of planning for the future is essential so that there is no lack of coordination in the expansions and thus over-investment."[126]

Other concerns included overloading of the transmission lines with implications for reliability, capricious and unfair penalties for outages, the inadequate incentives on distribution companies to participate in the transmission expansion process, inadequate arrangements as between Transener and CAMMESA, and undue restrictions on transmission companies.[127] There is also a view that

> "a backstop is needed in case the market fails to propose some expansion projects that are clearly needed, so that they can be implemented on a regulated basis, while still preserving the benefits of the competitive bidding process that has done so well to bring construction costs down."[128]

In contrast, there are few supporters of the approach. Nonetheless, generators liked the control over their costs that the method provided, and the relative lack of dependence on uncertain government actions.[129] It is said to encourage more widespread information

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[123] "Some of the coordination methods developed in Argentina did not work well, particularly voting by beneficiaries." Gómez-Ibáñez 2003, p. 324, citing Chisari et al 2001 and NERA 1998. "There is widespread acknowledgement of the shortcomings of the scheme" Woolf 2003a, p. 272, also citing Chisari et al 2001 and NERA 1998.

[124] It says that "The Argentine system implemented an untried model of transmission expansion, which proved controversial" and claims that "a social benefit analysis [of the Fourth Line] would have indicated that it was clearly in the national interest." Pollitt 2004, pp. 21, 10.

[125] ENRE *Annual Report 2002*, p. 49. The comment continues: "Thus, for example, when it was proposed to build the Fourth High Voltage Line from Comahue – a work planned by the public undertaking Hidronor in the 1980s and ever since those days considered necessary by the industry – the proposal did not succeed in satisfying the requirements of the Procedures for approving its construction. Recently in 1997 agreement was reached between the parties that promoted it, and the project was available for commercial use two years later in December 1999."

[126] Statement of Jose Luis Antúnez of Transener, quoted in ENRE, International Seminar on Restructuring and Regulation of the Electric Power Sector. Buenos Aires, November 1995, p. 64.

[127] Woolf 2003a, pp. 262 – 276. It is believed that Transener and other transmission companies share these concerns.

[128] Woolf 20003a, p. 276.

[129] Mr E Badaracco, chairman Endesa and chairman of Association of Generators, personal communication, 1 December 2003

about the state of the transmission system and to facilitate the financing of transmission investments.[130] Some argue that the Argentine approach of putting the construction of transmission lines out to tender yields lower tariffs than would conventional regulation; they claim that the fee for the Fourth Line would have been 61 per cent higher if the traditional regulatory approach had been adopted.[131] Others who acknowledge problems with the specific implementation of the approach nonetheless see coalitions of users – via regional boards - as being part of the solution.[132]

Part Two of this paper examines the debate on Public Contest design issues such as the definition of beneficiaries, the case for transmission rights, quality and reliability of service, penalties for outages, incentives on distribution companies, and central planning, along with associated policy developments. The remainder of this paper examines the continuing and central allegation that limitations in the Public Contest method unduly delayed the much-needed Fourth Line.

7. Evaluation of criticisms

7.1 Was the Fourth Line unduly delayed?

What evidence can be marshalled on the subject of the delay to the Fourth Line and the cost that such delay involved? It is first worth clarifying the extent of the delay. It was not "many years" or "four years". It was just over a year and a half.[133]

Moreover, it seems that at least part of this delay – and certainly part of the delay both before and after the second hearing - had nothing to do with the Public Contest method per se. It reflected transitional problems and uncertainties, particularly concerning the role of the incumbent Transener, rather than any problem as between the participants.[134]It has been argued that this latter delay was not an ongoing problem and should not be a cause of concern.[135]

In the context of transmission planning generally, a year and a half is not unduly long. "The time taken to obtain the necessary siting, planning and environmental consents is

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[130] Roark, personal communication, see Part Two.
[131] Galetovic and Inostroza, 2004. The subtitle of their paper is "why bidding is (much) better than regulating".
[132] Abdala and Chambouleyron 1999, Abdala and Spiller 2000.
[133] One year 8 months from first to second application, one year 7 months from first to second public hearing.
[134] For example, initial negotiations between GEEAC and Transener on the technical aspects of the project took about three months to resolve, before ENRE was able to call a public hearing. (Galetovic and Inostroza 2004, p. 15) Presumably the failure to agree these aspects before the first public hearing was the cause of this part of the delay. See Galetovic and Inostroza 2004 for further examples, ENRE *Annual Report 1996* just cited, and various remarks in the ENRE resolutions on this case.
[135] "The delay once the project had been approved was not the result of intervention by the beneficiaries, but a reflection of a struggle between transmission firms. Nonetheless, this delay made it possible to fine-tune the regulation, by satisfactorily solving the conflicts of interest raised by Transener participation. The final outcome of the auction shows that this delay was the price paid for refining the regulatory mechanism, and therefore should not be repeated in the future." Galetovic and Inostroza 2004, p. 22

inherently long. It is seldom shorter than two years and can take as long as 10 years for a major project."[136] This is the case in the UK, for example.[137] Other studies have made similar assumptions.[138]

7.2 Was the Fourth Line economic? Evidence from contemporary modelling

Concern about delay to a 'much needed investment' presumes that the investment was in fact economic. However, evidence – or the lack of it – from contemporary modelling suggests legitimate room for doubt here.

1) The generators each did their own modelling, and the models gave different results. Modelling calculations at the time were very sensitive to assumptions made, not least with respect to future hydrological conditions and the appropriate discount rate or cost of capital in those early uncertain days. The representative of those Comahue generators initially voting against the project explained in some detail at the first hearing that they had no objections to expanding capacity, but their own modelling calculations, made with the help of international consultants from Madrid, showed that it was simply not a profitable investment for the generators as a whole, and that it had a negative net present value even for the generators who proposed it.[139]

2) Contrary to some suggestions, when the project was brought forward in 1995, ENRE did not "determine that the benefits in lower electricity prices made the line in the public interest" [140]. ENRE never took a formal view on this. Presumably, since the 1995 proposal was voted down, ENRE did not need to calculate whether it passed the Golden Rule of having a positive net present value. Whether ENRE actually made or saw any calculations, and if so what they showed, is unknown.

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[136] Woolf 2003a, p. 518. "The period in Norway is of the order of 7 years." (fn 1 p. 581) "The process for a relatively short line outside Washington DC started in 1976 and was completed in 1992." (p. 18)
[137] Assuming no public enquiry is necessary it typically takes from one and a half to two and a half years to progress from beginning to identify system need and technical options to securing central and local consents. Exceptionally it can take much longer: the 75 km Second Yorkshire Line over the North York Moors took ten years to complete this process, plus another three and a half years to build. (National Grid Company, personal communication)
[138] E.g. Joskow and Tirole 2003, who assume in one analysis that acquisition of transmission siting permits plus actual construction will take ten years. They comment "Transmission lines do not take very long to build once they have obtained siting permits. However, for major new transmission corridors, the permitting process can be very lengthy." (p. 56, fn. 30) They also say that transmission investments "are particularly vulnerable to pre-emption strategies due to their long lead times". (p. 57 fn. 31)
[139] Transcript of public hearing 17 February 1995, attached to ENRE Resolution 0049/1995 of 28 March 1995, testimony of Mr Turri representing Piedra del Águila, Cerros Colorados and Central Térmica Alto Valle. A representative of another generating company has also confirmed to us that the calculations were very sensitive to assumptions made, particularly growth of demand, and in some cases the net benefit was negative.
[140] Gómez-Ibáñez 2003, p. 314

3) ENRE did not in fact have the resources to do its own modelling of the net present value calculation. In 1996, when it did need to do the calculation, it contracted out the modelling to a group at the University of San Juan. The University did not have a technical model designed for this purpose, and some questioned the adequacy of the resulting calculations. For example, it has been said that it included the increased consumer surplus from lower generation prices in Buenos Aires, but not the lower producer surplus for the generators. ENRE did not circulate the study widely, and we have not yet been able to assess it.[141]

4) In 1996 senior staff members at CAMMESA made unofficial and unpublished calculations related to the new line.[142] They used CAMMESA's own model, which was the most informed and authoritative then available, based on actual reported costs and up to date system data. They found that whether the net benefits were positive or negative was very sensitive to the assumptions made. The case for the investment was at best borderline.

5) Several crucial factors changed from the time of the first hearing to the second, including the demand in Buenos Aires, the generation capacity and output in Comahue, and the load factors on the existing transmission lines. All these factors were greater in the year preceding the second hearing in September 1996 than in the year preceding the first hearing in February 1995. Hence the economic case for construction in late 1996 was stronger than it would have been in early 1995. If the case was borderline in 1996, and the net benefit in many scenarios negative, this casts even more doubt on the viability of the case in 1995.

6) In these circumstances, a deferral could have increased the net value of the investment, even at a given construction cost. To assess this properly would need more detailed study. However, in more formal economic parlance, the inclusion of an option value for waiting might well have shown an advantage in deferring the investment from 1995 to 1996.[143]

The evidence – or the lack of it – from these various modelling sources does not provide tangible reasons to assume that the Fourth Line was indeed economic from an aggregate (or social) perspective when it was proposed in 1995. If anything, it casts considerable doubt on this assumption.

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[141] Whether ENRE could have produced a study showing that the proposal did not pass the Golden Rule is an interesting question. For various reasons, the main parties concerned (government, politicians, Comahue generators, Transener, the Buenos Aires distribution companies) were supportive of the line. (Government and politicians responding to pressures from provinces, Comahue generators to avoid lower revenues caused by congestion, Transener to increase its business, and the distribution companies to improve their quality of service.) It would have been a bold regulatory agency that vetoed such a decision.

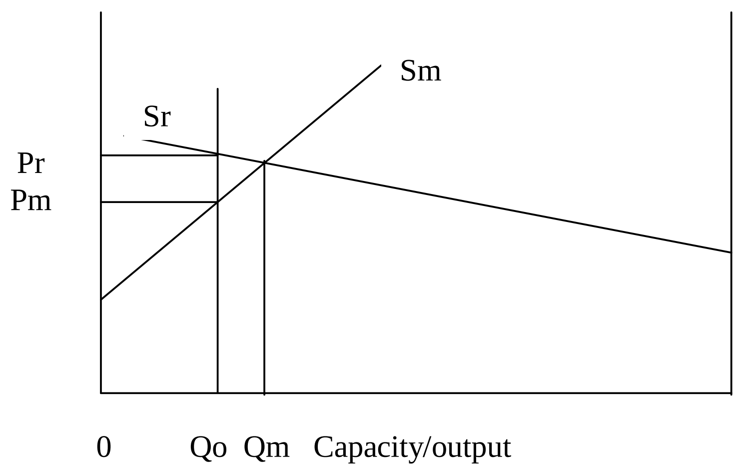
[142] These were unofficial and unpublished calculations because, although CAMMESA did the calculations of participation using its own model, it was the role of ENRE, and not CAMMESA, to evaluate the economic case for a transmission investment.

[143] I am indebted to Omar Chisari for this comment. The borderline nature of all these calculations also suggests, incidentally, the weakness of the case for building the Fourth Line a decade earlier, even though it was reportedly "considered necessary by the industry" ever since the 1980s.

7.3 Estimating congestion benefits

It is possible to make a simple estimate of the benefit of the Fourth Line in terms of reducing congestion, using essentially the same diagram as in NERA (1998).[144] Let Sm denote the supply curve from generators in Comahue and Sr the supply curve from the rest of the generators in the system. Assume the total demand is given, and equal to the distance between the two vertical axes in Figure 4. In the absence of transmission constraints, and assuming cost-related pricing and no transmission losses (or assume the supply curves are net of transmission losses), then generation will be allocated between the two sets of generators so as to minimise total cost. This means that Comahue generators will produce quantity Qm, and other generators will produce the remaining output. There will be a uniform system price equal to generation cost at the margin, which will be the same in both sectors of the market.

Figure 4 Evaluation of benefit of additional transmission capacity



Now suppose that there is a transmission constraint from Comahue at quantity Qo less than Qm. Output from Comahue will be limited to Qo, a reduction of (Qm – Qo) = ΔQ from the unconstrained level. Output by other generators will be greater by the same amount. Local prices will apply, namely Pm in Comahue and Pr in the rest of the system. Let ΔP denote the price difference (Pr – Pm). This represents the value at the margin of an increase in transmission capacity between Comahue and Buenos Aires.[145]

[144] Joskow and Tirole 2004 use a similar diagram, with a net demand curve instead of a supply curve in the rest of the system.

[145] The value of the additional capacity needed to remove the transmission constraint entirely is the area of the 'welfare triangle' given by ½ x ΔQ x ΔP. However, it may not be worthwhile to remove congestion entirely.

In the simplest case, it is economic to build additional transmission capacity if and only if this benefit exceeds the cost of construction and operation. In practice, of course, further adjustments need to be made for changes in demand and supply over time, and benefits and costs need to be discounted over the life of the investment. But an initial calculation looking at value at the margin will shed some light on the order of magnitude involved.

7.4 Congestion revenues and benefits of the Fourth Line

With local pricing, the congestion revenue equals (Pr – Pm) times quantity Qo. Table 4 shows the Salex congestion revenues obtaining in the Comahue corridor in each year since the Fund was set up 1994, together with the annual flow on that corridor and the implied average congestion price differential (excluding transmission losses) in each year.

Table 4 Congestion revenues, Comahue corridor[146]

Year Year	Salex Revenue $m	Energy GWh/yr	Price difference $m/Wh
1994 (4 mos)	29.95	6256	4.79
1995	41.59	16548	2.51
1996	39.77	13942	2.85
1997	18.07	14260	1.27
1998	15.78	11542	1.37
1999	8.66	10517	0.82
2000	51.44	16684	3.08
2001	47.62	19707	2.42
2002	56.42	17697	3.19
2003	22.79	17487	1.30
(Total	332.09	144,640)	
Average	35.59	15503	2.295

The Fourth Line increased existing peak capacity (after the installation of the capacitors) by 1225 MW (ΔQ), from 3375 MW (Qo) to 4600 MW (Qm). That is an increase of $\Delta Q/Q = 1225/3375 = 0.36$, or just over one third. The average value of congestion during the whole period was nearly $36m per year. On that basis, the average value of the additional transmission capacity provided by the Fourth Line was 0.36 x $36m = $13m per year.

The calculation is sensitive to the parameters in Table 4, which evidently varied considerably over the period. During the early period September 1994 to December 1996, the congestion revenue to the Salex Fund averaged $48m per year. However, this was mainly before the new capacitors took effect in October 1966. During the middle period 1997 to 1999 the congestion revenue averaged only $14m per year. Surprisingly,

[146]Source: CAMMESA's annual and monthly reports and Mercados Energéticos

congestion revenue then increased to an average of $52m in the later period 2000 to 2002 after the Fourth Line came into effect in December 2000.[147]

Several factors explain this. Usage on this corridor was very sensitive to weather conditions, which determined the availability of hydro electricity. For example, 1995 to 1997 were relatively wet years, while 1998/99 was an exceptionally dry year (see Figure 6 below). Another factor is that demand in Buenos Aires was generally increasing over this period (though it fell after the crisis). A third factor is that building the Fourth Line itself stimulated the building of more generation capacity in Comahue (discussed below). In fact, the corridor became as congested after the Fourth Line was built as it had been before.[148]

To provide a range of values for the benefit of the Fourth Line capacity, repeat the above calculation with the average value of congestion ranging from $14m (per the middle period 1997-99) to $52m per year (per the later period 2000-02). Multiplying by 0.36 puts the calculated benefit of the Fourth Line in the range $5m to $19m per year. To put this in perspective, the benefit assumed by Chisari et al (2001) was a cost reduction of $6.1m per year, at the lower end of the above range.

7.5 Congestion costs and benefits of the Fourth Line

These are very rough calculations, but they suggest that the congestion benefits of the Fourth Line at the time it was built might be about $13m per year, or at any rate in the range $5m to $19m per year. This is very considerably less than the first proposed annual fee of nearly $60m. Following the second vote, that fee was eventually reduced to $24.5m after the bidding competition, to which must be added the annualised value of the $80m Salex contribution, say $11.2m per year[149], making a total cost of nearly $36m per year. Even so, the annual cost of the Fourth Line was still three times its estimated average annual congestion value, and double the top end of the estimated range of such benefits.[150]

It may be more familiar to express these benefits and costs in terms of $/MWh. The third column of Table 6 shows that, over the whole period 1994 to 2003, the average congestion price differential (excluding transmission losses) was $2.295/MWh. It ranged from $0.82/MWh in the dry year 1998/99 to $3.19/MWh in the recent year 2002 (and somewhat higher in the initial part year 1994). Taking the groups of years used earlier, it

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[147] These calculations exclude the most recent year 2003, which is more significantly affected by the distortions induced by policy following the economic crisis.

[148] The average load factor was about 50% during 1994 – 99, and 48% during 2000 – 2003, per Figure 5 below.

[149] $80m recovered over 15 years at 12% discount rate is $11.15m per year.

[150] Is there an additional value of improved reliability of supply? Part Two of this paper calculates that if the new line were used purely for this purpose, its value would have been at most $9m in 1999, and in other years less than that. This value depends on not using the line to relieve congestion: to the extent that it is used to reduce congestion then the reliability benefits are reduced, and conversely. So the line does not provide any net increased value associated with improved reliability.

was $1.17/MWh in the middle period 1997-9, $2.87/MWh in the recent period 2000-02, and $3.03/MWh in the early period 1994-96. The broad range is $1 to $3/MWh.[151]

Assume that on average the Fourth Line would increase the previous throughput of the line in direct proportion to the increase in capacity. During the five years 1995 to 1999 preceding the construction of the Fourth Line, the energy transmitted from Comahue to Buenos Aires averaged 13,362 GWh per year. Assume the increase would be 0.36 x 13362 GWh = 4810 GWh.[152] Dividing this into the annual fee, this yields an average cost of $58m/4810 GWh = $12/MWh for the first proposal, and $36m/4810 GWh = $7.5/MWh for the second proposal.

In other words, congestion benefits are in the range $1 to $3/MWh compared to an initially proposed cost of $12/MWh and an outturn cost of $7/MWh. Once again, the costs are significantly higher than the benefits.

7.6 Possible long run benefits of the Fourth Line

The above calculations of the value of the Fourth Line reflect the degree of congestion on the line around the time of its construction. This in turn reflects the extent and location of generation and transmission as they happened to be at that time. They might be considered short-run benefits. Is it possible that the line would be more valuable, and even economic, if the transmission and generation system were fully adjusted, with generation in the most economic locations and an optimal extent transmission capacity? Such benefit might be considered long-run. This might mean a line more fully loaded (and therefore more congested) when the expansion took place than it actually was in 1999.

A way to approach this is to ask where it was most economic at that time to locate generation. Was it more economic to generate electricity in Comahue, where the gas was found, and then to transmit it to Buenos Aires, or to transport gas from Comahue to Buenos Aires and generate electricity there? The difference in cost between electricity generated in Buenos Aires, and electricity transmitted there, indicates the long-run value of transmission capacity, against which can be compared the cost of constructing and operating it.[153]

Table 5 sets out the costs of gas and electricity generation, based on conditions typically obtaining during 1997/98. Generation costs refer to an 800 MW CCGT plant running at 85% load factor, construction cost $420/kW with output priced to yield a 10% internal rate of return.

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[151] The averages in the early and recent periods are in line with assumed average congestion charges of about $3/MWh used by consultants in evaluating generation businesses in Comahue. Source: Mercados Energéticos.

[152] In fact the average flow over the subsequent three years 2000 to 2002 was 18029 GWh, an increase of 4667 GWh.

[153] The recent calculations of Chisari and Romero (2004) show the relevance to the Fourth Line decision of transporting gas to Buenos Aires and building gas-fired stations there.

Table 5 Costs of gas and electricity generation 1997/98

Location	Cost of gas	Cost of electricity
Buenos Aires	$1.90/MBTU	$25.71/MWh
Comahue Basin	$1.35/MBTU	$21.89/MWh
Cost differential		$3.97/MWh
Less transmission losses 5% BA price		$1.29/MWh
Net differential		$2.68/MWh

On this basis, the long run benefit of the Fourth Line would be
1225 MW x 8760 hrs/yr x $2.68/MWh = $29m per year. This is about double the central estimate ($13m/yr) of the short-run value of additional transmission capacity calculated above. It is also above the upper end ($19m/yr) of the range of short-run benefits. But it still falls well short of the lowest cost ($36m/yr) of constructing the Fourth Line.

In the light of all these considerations, it seems difficult to argue that the Fourth Line expansion was economic, either when it was proposed in 1995 or 1996, or when it was constructed in 1999, or at any time subsequently. It is almost certain that it was not economic in the conventional sense of creating benefits to consumers and producers that exceed the costs of achieving them.

7.7 Costs of delay

This puts in a quite different light the claim that the Public Contest method failed because it delayed an important economic investment. If the Fourth Line was not economic, then any delay would have been beneficial rather than costly.[154]

There were two main savings from delaying the investment. At the very least, the value of deferring the final total cost of $250m by a year and seven months was 19/12 x 10% x $250m = $40m. There was also a further saving to the extent that delay enabled the initial cost to be reduced to $250m. It has been calculated that the net present value of the first proposed fee (at 10% interest rate) was $370.1m.[155] Some might argue that competition would have been just as effective under the first proposal as under the second, and that the same outcome would have resulted. Others might argue that competition was relatively ineffective at the time of the first vote, was unlikely to have brought the cost down very much, and was made more effective by the steps taken between the first and

[154] Other authors reach a similar conclusion, arguing that the reduced cost of the second proposal made the difference. “In the auction for the fourth Comahue line decisions taken by the beneficiaries prevented an expensive project from being carried out. In that sense, the evidence reviewed suggests that the length of the process, which some analysts blamed on the veto wielded by several beneficiaries, merely reflected the fact that the project being proposed in the first request was not economically profitable. … In any event, the result of the auction shows that the supposed costs of postponement were clearly outweighed by its benefits.” Galetovic and Inostroza 2004, pp. 21-2.
[155] Galetovic and Inostroza 2004, p. 18.

second proposals[156]. On the latter basis, there was an additional value of delay equal in the limit to the difference in cost between the initial bid of $370m and the winning bid of $250m, namely $120m. Depending on the view one takes of the competitive situation, the value of the delay would be somewhere in the range $ 40m to $160m.

In contrast, the present calculation suggests that the cost to users in terms of continued congestion for 19 extra months was of the order of 19/12 x $13m = $21m. The plausible range might be 19/12 x ($5m to $19m) = $8m to $30m.[157]

The net benefit of delaying the Fourth Line thus seems to have at least $10m and conceivably as high as $150m. To have rejected the first proposal for the Fourth Line surely indicates the success of the Public Contest method rather than its failure.

There were additional less quantifiable benefits associated with delay. For example, it reduced uncertainty, or at least risks, about construction cost. It allowed time for further reflection. It also provided a clear demonstration that the new method required persuasive evidence to justify substantial transmission expansions. An unsubstantiated recommendation by an incumbent transmission company, or a regulator or minister, would no longer suffice. Even proposed expansions whose benefits were taken for granted could nonetheless be rejected. Given the previous history of over-expansion, this was surely a significant merit in terms of encouraging more realistic appraisals of transmission projects in future.

7.8 The study by Chisari, Dal-Bó and Romero (2001)

Several commentators base their criticisms of Argentine transmission regulation on the calculations by Chisari et al (2001), implying that this study has established that inadequacies of the Public Contest mechanism did indeed delay the economically beneficial Fourth Line project. This is an important and influential study, which certainly explains why the Public Contest mechanism *might* delay an economic project. But does it establish that deficiencies in that mechanism *actually did* delay the Fourth Line, and does it show that the Fourth Line *actually was* economic?[158]

The authors were commissioned by ENRE in 1996/97 to examine and explain why there was not more investment in transmission under the new arrangements. To this end, they built a simulation model of the national electricity system, and used it to analyse the voting behaviour of the market participants under the Public Contest mechanism. They used several examples from this model to identify flaws in that mechanism. In summary, these flaws are the exclusion of consumers from the mechanism, the exclusion of market participants in the 'swing bus', the assignment of votes and fees based on usage rather than profit, and the possibility of strategic vetoes on expansion. Their comment cited

[156] E.g. Galetovic and Inostroza 2004, as discussed below.
[157] In a fully adjusted system, the cost of delay might have been as high as 19/12 x $28m = $44m, but in the mid-1990s the system was far from being fully adjusted: the load factor (for example) and the value of expansion were correspondingly lower.
[158] This section draws on the paper itself and also on helpful clarifications by Omar Chisari and colleagues.

above, that "most agree that current regulation has failed to spur needed investments in high-tension transmission" is most plausibly to be understood as a description of the prevalent view that they were asked to explore, not as a summary of their own conclusions. However, the authors did conclude that "The lack or delay of such investments arises from problems in the willingness-to-pay revelation under the Public Contest mechanism."

This paper is an innovative, careful and valuable piece of research. The authors were among the first to analyse publicly, and from an economic perspective with detailed and realistic calculations, how the Public Contest mechanism might work.[159] Their examples showed, amongst other things, that votes based on usage could be different from votes based on benefit. They suggested that there were circumstances such that "under the Public Contest mechanism, desirable expansions may not be constructed while undesirable ones may".[160] It was not simply, as some conjectured, that there was necessarily a divergence between private and social benefit. The specific design and application of the mechanism could distort the outcome in a way that was not previously appreciated or at least not fully understood. The simulations also revealed additional competition policy problems associated with joint ownership of generation and distribution companies in different areas.

The authors calibrated their model against available data from the Argentine electricity system around the year 1997, and took the proposed Fourth Line as an example. This increased the potential relevance of the results, and raised important questions. However, for several reasons the results need to be treated with care.

First, the authors themselves emphasised the limitations of their modelling. They also noted that their objective was not to appraise the actual situation rigorously, but to present some situations where the results of the process were not optimal. These were "not necessarily realistic for the Argentina case". [161]

Second, the limited representation of investment options in the model may have distorted the economic solution and the views attributed to beneficiaries and overemphasised the importance of the exclusion of users in the 'swing bus'. For example, consumers and distribution companies in Buenos Aires were assumed to benefit from a new transmission line because it would reduce the price of electricity in that city, so it was assumed they would have voted for it if they had the chance. However, this implicitly assumed that generation capacity was given, and that the choice was between a new line and no line. In

[159] Before that, CAMMESA had made some unpublished studies at the time of drawing up the rules for the mechanism. Abdala 1994 had pointed out, among other things, the importance of considering the demand-side in the cost allocation rule, and also proposed examples of rules based on welfare analysis, rather than on electricity flows, but these were more rudimentary and hypothetical examples.

[160] Chisari et al 2001, p. 714

[161] "The results here presented do not reflect in a precise way reality, or the results of the original model, and constitute only examples." "A rigorous study of the social benefits of an extension of the lines between Comahue and Buenos Aires is not the aim here, instead, the objective is to present some situations, not necessarily realistic for the Argentina case, in which the decisions arising from the voting process are not optimal solutions." Chisari et al 2001, fn. 9 p. 704 and p. 709.

fact, however, an alternative way of meeting increasing demand in Buenos Aires was to transport gas there from Comahue, and to increase generation capacity in Buenos Aires. If this were more economic than transmitting electricity, prices in Buenos Aires would decrease even more if the new line were *not* built, so users in that city would be better advised to vote *against* the line, not for it. In other words, if the possibility that the Fourth Line was not the most economic investment had been included in the model, then the exclusion of users in the 'swing bus' might not have been critical at all.

Third, any claim that deficiencies in the Public Contest mechanism were responsible for the failure of the 1995 vote implicitly rests on the assumption that the Fourth Line was economic, and would have attracted sufficient support in the absence of those deficiencies. However, the authors did not show – nor did they claim to show - that expanding the transmission system by the Fourth Line would have been economic in 1995. Since the foregoing discussion has cast doubt on this assumption, it is worth looking at what the numbers in this study imply about the economic nature of the investment.

Under very simplified assumptions the authors calculate that the Fourth Line would have a present value of about $112 m.[162]. This was calculated as the present value of an annual cost reduction of $6.1 m, summed over 50 years at 5 per cent discount rate. The authors continue "In this context it would be optimal to carry out the investment if the costs were below 112 million pesos and reject the proposal if its cost were above that figure."[163] They discuss the implications of the cost being above or below $112 m. But they do not say what the cost of the investment actually was, so they do not reach a conclusion on whether the investment was economic.

According to ENRE the eventual cost of the Fourth Line as a result of the competitive tender was about $250 m. This is more than double the critical figure of $112 m, above which the authors suggest it would be optimal to reject the proposal. Even this understates the differential, because of the different time periods and discount rates used. The Fourth Line benefits were summed over 15 years and ENRE has typically used a discount rate of about 12%. If for comparability the assumed annual benefit of $6.1m is summed over 15 years at 10% as in other studies, the total benefit amounts to only $47m. This is less than one fifth of the eventual cost.

The cost of the original proposed construction was of course much greater than $250m. A direct comparison of annual costs and benefits facilitates more direct comparison with the original proposal. The annual fee proposed in 1995 was $54.6m increasing to $61.4 m. This is an order of magnitude greater than the annual benefit of $6.1m assumed in the study by Chisari et al.

[162] "Let's suppose, in an unrealistic way, that the electric system maintained the structure, costs and levels of demand of the second year until the end of time. If we assume the extension will work properly for 50 years and the discount rate is of 5%, then the social benefits of the investments in the line Comahue – Buenos Aires would be close to 112 million pesos." Chisari et al 2001, p. 709
[163] Chisari et al 2001, p. 710.

To the extent that weight can be placed on the assumptions in that study, they are consistent with our own calculations made above, and suggest that the Fourth Line expansion was *not* economic, either at the time it was first proposed or later.
If the Fourth Line was essentially uneconomic, the main challenge is not to explain why it was initially rejected and delayed. Rather, the challenge is to explain why it was proposed in the first place, and then why it was accepted on the second vote. The following sections attempt to answer these questions.

8. Fourth Line: background to first proposal

8.1 Developments in Comahue generation

In order to better understand the Fourth Line experience and its significance, it will be helpful to provide some historical and contemporary context for the proposal and debate.

During the State-owned period, Hidronor built transmission lines from Comahue to match construction of its hydro generating stations there. In 1974 and 1976 it built the First and Second lines (2 x 1000 MW) to transmit 1700 MW, its capacity available for export (equal to the full installed capacity of its Comahue generation net of local demand).[164] In 1986 Hidronor built Alicurá 1000 MW station and added the Third Line, also 1000 MW. Almost all of this generation capacity was hydro, used mainly for peaking, so the line was far from fully utilised: Figure 5 shows that, under typical rainfall conditions, the average load factor would have been 21% in 1983, 23% in 1987.[165]

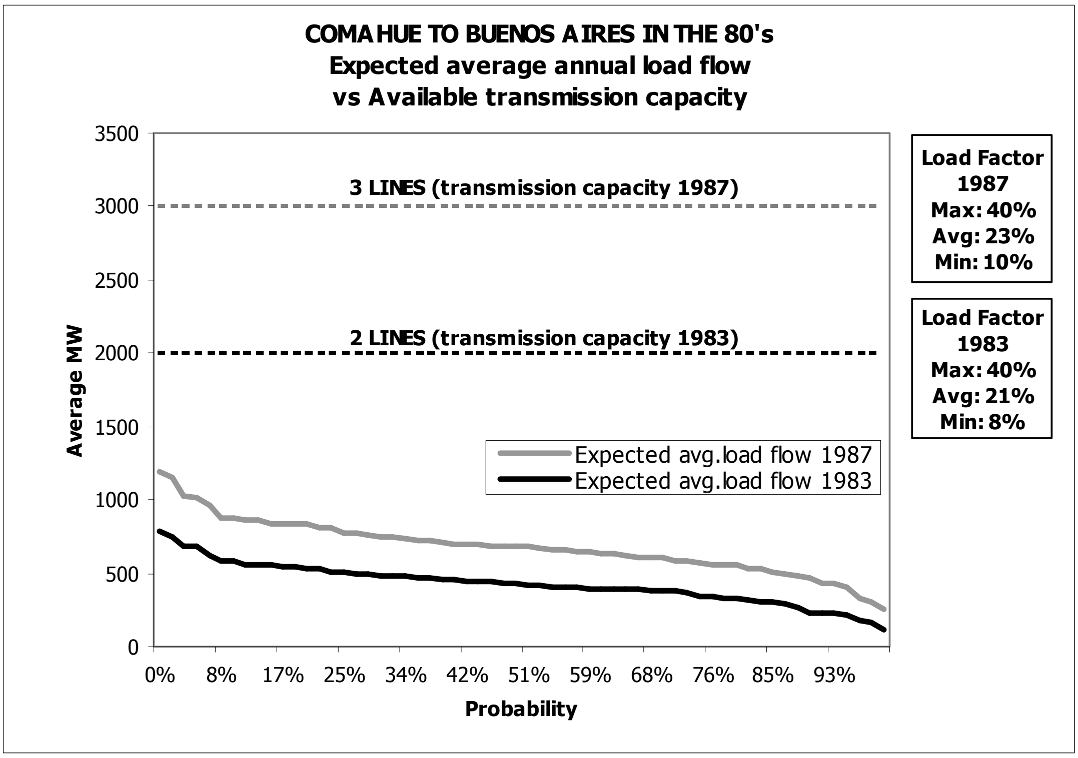
Hidronor then began a new hydro station Piedra del Águila 1400 MW, which was still in course of construction at the time of privatisation in 1992/3. In parallel, the company planned (and had begun to purchase materials for) a corresponding extension of transmission capacity via the 1000 MW Fourth Line.[166]

At about the same time, another development in Comahue, more ominous for the hydro generators, was the building of new open-cycle gas turbine generation plant using waste (flared) wellhead gas from the Comahue basin. Some of these generators declared variable cost of zero, all ran at base load. The first of these generators appeared in 1993; by 1995 their capacity amounted to 915 MW.[167] There was plenty of spare transmission capacity at off-peak times, but at peak hours the gas plant competed with the hydro plant.

[164] Hidronor's generation capacity comprised Chocón 1200 MW, Arroyito 120 MW, P Banderita 450 MW plus thermal 50 MW, total 1820 MW, less local demand 120 MW, net 1700 MW capacity available for export.
[165] Source: Mercados Energéticos. Similarly, Alicurá was designed for a plant load factor of 25%.
[166] A 1000 MW line would suffice to transmit the increased output from Piedra del Águila because environmental constraints forced that station to be dispatched at base load, which averaged only 600 – 700 MW.
[167] Filo Morado (3x20) 60 MW, Central Loma la Lata (3x125) 375 MW, Capex (5x45 + 1x130) 355 MW, Termo Roca 125 MW, total 915 MW.

The lines became congested and constrained, and local prices were frequently declared in Comahue, often much lower than in the main system.[168]

Figure 5 Average expected load factors Comahue to Buenos Aires 1980s



At the time the first hydro stations were being privatised, in mid-1993, the concept of local prices was itself novel. The possible extent and implications of these generation developments and their interaction with the operation of the transmission system were unclear, not least to the bidders.[169] It was explained to the bidders that if more transmission were needed to reduce such congestion, then a new line could be proposed and built, and indeed this was expected. In simple terms, this would reduce the number of times that the Comahue corridor would be constrained and that local prices would apply. This would therefore increase the revenues of the Comahue generators (and reduce the prices paid by Buenos Aires distributors). In calculating what to bid for the hydro

[168] For example, Table 4 above shows that in the last four months of 1994 the average price differential after taking account of transmission losses was nearly $5/MWh.

[169] For example, Southern Electric was putting together its bid for Alicurá. “Within a few weeks of the bid date, translating on my own, I discovered in a new 6-month system plan that the Comahue transmission system was expected to be ‘saturated’ for the entire summer of 1993-94, owing largely to the tornado limit. The tornado limit had not been mentioned by anybody we had talked with before. It was as if it had been an Easter Egg, hiding, waiting for one of the bidders to find it.” (J D Roark, personal communication, 2 July 2004) Note also that Transener did not commence operation as a privatised entity until July 1993.

stations, Southern Electric, for example, worked the Fourth Line into its projections and assumed (without analysis) that this would solve the congestion issues. But it had no capability to model congestion of the network or the effects of (e.g.) Piedra del Águila being commissioned. In June 1993 the company won the tender for Alicurá with a bid price of $178m that, in retrospect, was very high. (It was also some $50m higher than the second bid of $123m.)

8.2 Generators' deliberations on the Fourth Line

By about November 1993, after the sale of Piedra, generators in the area met to discuss building the fourth line. According to one account,[170] they had three main reservations.

- First was a concern about free-riding. This was not in the conventional sense. [171] Rather, if existing generators did build the Fourth Line to accommodate present hydro and gas-fired generation, what was to stop new (or existing) generators building more capacity in future in order to take advantage of the presence of the line? Moreover, a newer and more efficient plant would have priority in the merit order for dispatch, and would thereby avoid some of the dispatch risks to which older and less efficient plant was exposed. This led to investigation and advocacy of transmission rights (which emerged later, as discussed in Part Two of this paper).
- Second, some generators were concerned that the existing cost allocation rules were unfavourable to them and more favourable to others (including the initial proponents Alicurá). There was also some suggestion that ENRE had reservations about the general approach to transmission investment, and might be sympathetic to a change in the rules.[172]
- Third, generators were pressing the Secretary of Energy to use congestion revenues for investment in this corridor, which he later did in creating the Salex Funds in August 1994. Before this, there was uncertainty as what the policy might

[170] Manuel Abdala, at the time a consultant to the Comahue generators, personal communication, 9 May 2004. He suggests other concerns as well. "There were additional elements in the pre-hearing discussions among generators that were important for investor perspectives at the time. For instance, there was a big issue on who would guarantee canon payments on the fourth line. Those identified as beneficiaries at the time of the public hearing would be the guarantors of the canon payments, according to the procedure. This created even more concerns about free riding." Others do not recall the guarantee as a problem at the time of the first proposal; at the time of the second proposal this did become an issue but was dealt with.

[171] Any 'free riding' did not take the form of other parties obtaining free use of the new facility paid for by the initiators. After construction, the contributions of each beneficiary were re-calculated each month based on actual usage, and therefore any new users paid in proportion to their usage. Since actual usage was calculated as a rolling average of over the preceding 12 months, it might be argued that the arrangements moderated rather than eliminated 'free riding' in the conventional sense.

[172] In its 1994/5 Annual Report ENRE commented on the importance of correctly identifying the ultimate beneficiaries of an expansion (p. 59), and observed that, as some types of problems had become less serious, "the regulator is faced with challenges of greater complexity, like those corresponding to … the correct determination of the beneficiaries of transmission capacity expansions". (p. 93) Although the task of determining these beneficiaries, and of changing the rules, fell to CAMMESA rather than to ENRE, it was perceived that rule changes were under consideration, or at least that ENRE would argue for them. ENRE reportedly suggested at a public conference that more costs might be allocated to the demand side, which would favour generators generally.

be and, later, as to what level of contribution could be expected from the Fund to offset the costs of building the line.

In parallel with these group discussions, each generating company was running dispatch models to try to work out what its contribution to an expansion would be under existing rules, and also trying to evaluate the possibility of alternative rules being introduced. Delaying the Fourth Line decision might or might not resolve some of these issues, and might work to the advantage or disadvantage of particular beneficiaries. But no general consensus was reached.

Meanwhile, the generators hired engineering consultants to look for low cost ways of increasing the capacity of the existing system, with some success. On 7 September 1994 the Secretary of Energy reported that users of the Comahue – Buenos Aires transmission corridor (i.e. the Comahue generators), and in the system as a whole, had requested a revision of certain control equipment that was causing transmission constraints, and had presented studies showing that implementing such measures would increase transfer capacity in the corridor.[173] He asked CAMMESA to define the measures necessary to maintain the required level of reliability in the system.

CAMMESA recommended stabilisation devices in several power plants, not only in Comahue, which improved transmission capacity and reliability in several corridors (e.g. Yacyretá and the Northwest as well as Comahue). [174] Accordingly, the Resolution provided that the costs should be shared between all users of the 500kV system, to which end CAMMESA should charge the cost to the Apartamientos Account so that it would be paid by all beneficiaries in proportion to their payments of Transener's capacity charge.[175]

The generators also proposed the installation of capacitors on the existing lines, which (together with the new control equipment) could increase transmission capacity from about 2700 MW to 3300 MW. This was the first completed application of the full Public Contest procedure. In fact, a public hearing was held on this expansion the day before the

[173] Resolution SE 285 (7 September 1994).

[174] CAMMESA's Evaluation Project 285 examined a series of options and identified three investments that would be economic (as well as several that would not be), namely:
facilitating load-shedding, cost $1.1 m, annual benefit $0.9 m, payoff in 1.2 years
reducing load fluctations, cost $3.5 m, annual benefit $1.8 m, payoff in 1.9 years
installing capacitors, cost $31.4 m, annual benefit $6.6 m, payoff in 4.7 years.
The first two measures were those requested by the users. Source: R Sanz, CAMMESA slide presentation to CIER, May 1998. In the event, the actual cost was about double CAMMESA's initial estimate, mainly reflecting higher than anticipated costs of dealing with the effects of increased demand in the northwest corridor. The Apartamientos Accounts monthly balances show a total payment of $9.8 m, starting with a payment of $2m in February 1995 and concluding with a payment of $0.5m in September 1997.

[175] It was believed that Transener was not keen on this project since it obviated the need for other more substantial transmission expansions. The Secretariat of Energy, supported by CAMMESA, implemented the project as a special expansion in order to develop it quickly.

hearing on the Fourth Line. No opposition was registered, and ENRE subsequently approved it.[176]

The owners of Alicurá generation station eventually calculated that a new line would be beneficial to them, and on 2 September 1994 had proposed it. At the February 1995 public hearing, representatives of the proposing generators explained in their presentations[177] that in the short term they were seeking to increase the capacity of existing lines, and had already proposed stabilisers and capacitors, which had been agreed. But these measures alone would not suffice. That is why they were proposing to construct a new line. Piedra and other generators took a contrary view, and voted against. The Fourth Line was rejected, or at least deferred.

8.3 Private advantages of the Fourth Line

Given that the Fourth Line appeared to be economic, how could at least some generators find it profitable? Essentially, the answer is that perceived private costs and benefits differ from social or aggregate ones.

Beneficiaries would expect to pay the proposed cost of the line, about $58m annually with the first proposal. It was possible that competition for the tender could reduce this, but the extent of competition in construction was at that time largely unknown.

Beneficiaries would expect that the Salex Fund would be used to reduce the total cost they had to pay. At the time of the first hearing in February 1995, this amounted to $25m. The proponents calculated that if the Fund had been in operation throughout 1994 the total would have been $55m, and they projected it would grow to $45m by the end of 1998 and to increase by a further $15m per year during 1999 to 2001. But these were speculations. At the time, only $25m was known to be available. If the $80m available later is equivalent to a fee reduction of just over $11m per annum, assume that $25m would have been expected to reduce the fee by the same proportion, that is, by about $3.5m per year.

A final modification is that distribution companies in Buenos Aires accounted for about 6% of the votes and fees, so the generators would expect to pay 94% of the total fees. In sum, the generators would in aggregate expect to pay about 0.94 x ($58m - $3.5m) = $51m, less any (uncertain) reductions from competition in construction and higher Salex Funds in the near future.

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[176] ENRE reported on 25 January 1995 that five generators (including the two that initially opposed the Fourth Line) had filed a request with Transener to expand the capacity on the Comahue Buenos Aires corridor by two banks of capacitors in the Puelches and Henderson substations. The specified maximum acceptable canon (before the public tender) was $3.47m/month for a 12-month amortization period. (Resolution ENRE 40 - 2 March 1995). The hearing was held on 16 February 1995. The expansion was approved on 2 March 1995 and put out to public tender. (Resolutions ENRE 10/1995, 25 January 1995 and 40/1995, 2 March 1995). The result of the tender was $2.1m/month for 12 months (Res ENRE 155 – 17 August 1995). In this instance, the total cost of about $25 m was less than CAMMESA's estimate of $31.4 m (the third item per previous footnote).

[177] Testimonies of C Inglesis and L Caruso, Transcript of Public Hearing accompanying ENRE 0049/1995.

On the benefit side, the average value of additional (unconstrained) output from existing Comahue plant was calculated above at 0.36 x $36m = $13m. This was clearly far below the prospective cost of the expansion. However, the attraction to existing generators was not only the value of increasing their output, it was also, and indeed more importantly, the value of recovering the congestion revenue on their existing output. Admittedly this was a transfer payment, and in the past the revenues had been used to reduce the fees paid by all beneficiaries. But this was no longer the case, and whether or how far the beneficiaries would in fact benefit from the Salex Fund if it were not spent on capacity expansions was entirely unknown. So the interest in minimising this transfer well outweighed any interest in receiving it.

In the calculation just mentioned, if the expansion completely removed congestion, the beneficiaries would recover the average congestion revenue payment of $36m, plus the value of the additional output. If congestion were completely removed, the latter mght be valued at half the marginal congestion value (to reflect a welfare triangle), that is at ½ x 0.36 x $36m = $6.5m. The total benefit might then be $36m + $6.5m = $42.5m.

Some beneficiaries might have expected that congestion revenues would be above the average for the whole 1994 – 2002 period (which of course could not be known at the time). The average for the period September 1994 to December 1996 was $48m (see above) and on that basis the private benefit might be calculated as $48m + (1/2 x 0.36 x $48m) = $57m. This is above the private cost of $51m. On this basis at least some of the beneficiaries might have found the Fourth Line a profitable venture.

However, against this are certain other considerations. The extent of congestion over the next two years was not then known. As of early 1995, the two congestion spikes in mid- and late-1994 were exceptional (see Figure 2 above). It could not be assumed that the Fourth Line would completely remove congestion, since many feared that other generators would be encouraged to build new plant in Comahue (as indeed proved to be the case). Such new generators might also replace the existing ones in the merit order, thereby reducing the benefits to existing beneficiaries.

At least part of the benefits of congestion reduction would accrue to customers in the form of reduced prices system-wide, rather than to Comahue generators in the form of higher local prices. To estimate the extent of this, we ran some simple cases in a dispatch model. They indicated that, at a time when the difference between average system price and Comahue price was about $2.10/MWh, eliminating congestion in the Comahue corridor would reduce average price in Buenos Aires by at most $0.5/MWh and increase Comahue price by about $1.6/MWh. This suggests that, if the transmission expansion eliminated congestion, at most a quarter of the congestion revenue might accrue to customers, and the remaining three quarters to Comahue generators.[178] However, this calculation may be a significant overestimate. A study carried out for some of the

[178] Note that this calculation was in a market where prices were lower than in long run equilibrium. The proportion accruing to customers might be higher in the longer term.

generators in preparation for the second vote (see Table 5 below) calculated that fewer than 5% of the aggregate benefits would accrue to customers.

What other beneficiaries expected is unknown. But if customers or distribution companies took just 10 per cent of the $57m private benefit just calculated, this would eliminate any surplus to generators over the private cost of $51m. This is quite apart from any less optimistic projections of congestion revenue and the existing generators' share of this.

These calculations suggest that, although it is possible to envisage a set of parameters under which the Fourth Line would be a profitable proposal for the generators in aggregate, they would have found it easier to envisage scenarios under which they would vote against it. The situation may, however, be different for particular subsets of generators.

8.4 Differences of interest between generators

Why did the owner of Piedra del Águila hydro station take a different view from the owners of El Chocón and Alicurá?. There seem to be two important factors here: the rivalry between the owners of two of these companies, and the impact of their interests in generation plant other than the identified beneficiaries of this expansion.[179]

Endesa of Chile had taken a controlling stake in Costanera thermal station in Buenos Aires and El Chocón hydro station in Comahue.[180] Southern Electric of the US had won the tender for Alicurá hydro station and was initially expecting to win Piedra too. Endesa and Southern were jointly developing a strategy based on the Fourth Line, which they envisaged would be advantageous to them as significant and expanding generators. In addition, they created the independent transmission operator Tenasa with a view to developing a profitable independent transmission business. If Southern had indeed acquired Piedra, then Endesa and Southern together would probably have had sufficient votes to secure the Fourth Line. In the event, Southern did not win the bidding for Piedra (having belatedly come to a clearer recognition of the factors involved, as noted above). Endesa and Southern nonetheless continued with their Fourth Line strategy.

However, the leading partner in the consortium that won Piedra, namely Chilgener of Chile, had two concerns about this. First, Chilgener was a rival of Endesa in Chile. It was suspicious of the level of the fee offered by the proposed independent transmission company part-owned by its rival, and had no wish to pay an excessive transmission charge in order to assist a rival company in its commercial expansion.

Second, Chilgener had a significant ownership stake in Puerto thermal station in Buenos Aires and in a forthcoming gas-fired wellhead station at Loma La Lata in Comahue. The profitability of a new line depended critically on the detail of the scenarios assumed, including on the interpretation and knowledge of the transmission system (e.g. the effects

[179] We are indebted to Ruy Varela for these insights.
[180] Details of privatisations in Argentina are at http://mepriv.mecon.gov.ar/

of the tornado constraint mentioned above), and the extent of new entry by gas-fired generation in Comahue. However, in general the calculations suggested that hydro plants would mostly be winners and thermal plants would mostly be losers. Chilgener's prospective new thermal plant in Comahue had no votes as a beneficiary of the Fourth Line expansion, but Chilgener naturally took into account the potential impact on this plant when exercising its vote as owner of Piedra.[181]

In summary, the calculations were very sensitive to assumptions about the future and to other considerations, although generators as a whole were unlikely to find the Fourth Line profitable at the time of the first vote. However, the main proponents of the line had an additional reason to promote it: as a means of entering the transmission business. A main generation opponent of the line, while generally in favour of increased capacity on the corridor, was reluctant to support its rival's transmission activities and was less advantaged by the line in view of its thermal holdings, including in Buenos Aires. What then changed by the time of the second vote?

9. Fourth Line: analysis of the second proposal

9.1 Response to the 1995 vote

The result of the 1995 vote was unexpected and had a significant impact. The impact was not, as has been suggested, that the Comahue generators "hired engineering consultants to look for low-cost ways of improving the effective capacity of the existing lines", nor that "the government changed the funding rules to favor a new line" by creating the Salex Fund.[182] Both these actions indeed took place, but before the vote was taken. The prospect of increased congestion, and having to pay to increase transmission capacity, had already stimulated the generators to look for and discover more economic ways of achieving this.[183] Also, the Secretary of Energy had already decided that making the congestion revenues available for transmission expansion via the Public Contest method was a more sensible use of them than any other, and had issued a Resolution to create the Salex Funds.[184] Hence neither action was a response to a perceived inadequacy in the Public Contest method as revealed by the failure of the 1995 vote – if anything, they indicate faith in the effectiveness of this method.

It is nonetheless true that the failure of the 1995 vote stimulated generators to further action, and that the government responded. The generators who formerly opposed the expansion joined with the proponents of the extension to form the Group of Electrical Generators from Comahue Area (GEEAC) to explore how a line could be made economic and acceptable to all.[185] Amongst other things, they sought, and achieved, two modifications to the Public Contest rules.

[181] Chisari et al 2001 and especially Chisari and Romero 2004 make a similar point.
[182] Gómez –Ibáñez 2003, p. 315 ; Woolf 2003a, pp. 262, 267
[183] It is worth noting that these more economic options - load-shedding, stabilisers and capacitors - had been available and studied by Hidronor before privatisation, but not taken forward.
[184] Resolution 274 (26 August 1994), see above.
[185] For the avoidance of doubt, this was not at all because some of those who voted against the first proposal really favoured it but were attempting to free ride on the positive votes of others. They had

The first modification concerned the bidding process. As initially formulated, the rules required any proposal to be accompanied by a proposed fee. It has been argued that this gave a 'first mover advantage' to the transmission bid accompanying the proposal. [186] If the minimum bid from the competitive tender was between 85% and 100% of the initial bid, the initial bidder had the right to rebid to beat this. A potential competitor would have to bid less than 85 per cent of the initial offer to succeed outright. This could be a disincentive to other bidders. If so, the beneficiaries might be forced to pay up to 15 per cent more than the price that would otherwise be bid (or even more if competitors deemed it not worthwhile to bid at all).[187]

The modification enabled proponents, if they wished, to specify a maximum acceptable fee in the application for a Public Contest.[188] The proposed project would then go ahead if and only if the subsequent competitive bidding yielded a fee less than the specified maximum. This removed an important risk to the beneficiaries.

The second modification enabled the Salex Fund to be used to defray the up-front expenses of construction, not merely to reduce the payments in subsequent years.[189] This considerably reduced the burden of financing the construction. At the same time the modification limited to 70 per cent the proportion of the expansion cost that could be defrayed by the Salex Fund. (It was considered desirable to leave some risk on the beneficiaries in order to give them with an incentive to act efficiently.) The Secretary of Energy noted that the modification was faithful to the spirit of the original purpose of the Fund.

In May 1996 the generators group (GEEAC) presented a new expansion request, for essentially the same Fourth Line project, with a maximum fee of $43.67 million over 15 years. This was to be supplemented by $80 m from the Salex account during construction. After adjusting for the Salex contribution, this maximum fee has been calculated as 6% lower than the fee in the first proposal.[190]

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nothing to gain by doing so, since if the line went ahead their contributions would be independent of whether they voted in favour or against. As their later actions proved, the majority of those who voted against were actually in favour of the line if the cost of it could be reduced to a level at which it was profitable for them.

[186] Galetovic and Inostroza 2004, p. 19

[187] In the event, the winning bid was considerably less than 85% of the amount proposed in the initial bid, but this was not known beforehand.

[188] Res SEyT 105/96, which revised Annex 16 to the Market Regulations.

[189] Resolution SEyT 105/ 29 April 1996. In a later ENRE resolution, this cost has been "calculated as the net present value of the annual canon offered by the winner in the public tender". ENRE Resolution 1472 (23 September 1998). Resolution 105/1996 also provided that if the Salex Funds accumulating in a particular corridor are not used within 7 years, they are transferred to a general account, and may be used to finance expansions in other parts of the transmission grid. The mechanism for doing this was to be set by the Secretary of Energy when the time came.

[190] Galetovic and Inostroza 2004.

When the new COM contract was put out to tender, a consortium forming part of GEEAC (Atalaya Energy) put in a bid of $39.47m.[191] This was a further 10 % below the specified maximum fee. But there were three other and better bids. One was slightly lower, at $38.00m. The winning bid by Transener was $24.52m, about 44% below the maximum fee and (together with the Salex contribution) nearly 60 % below the fee in the first proposal. Competition was evidently very strong.[192] In fact, the final price paid by the beneficiaries was even lower because more was eventually available in the Salex Fund than at the time of the second vote.[193]

9.2 What changed from 1995 to 1996?

Why did the Fourth Line proposal command acceptance in 1996 and not in 1995? Most critics have not really explained the change of mind. Some have suggested that the reduction in construction cost was critical. Others have suggested that the availability of the Salex Funds made the difference. Both these factors were in fact relevant, but it is also necessary to consider how the concerns mentioned earlier were addressed. These related to free riders, rules and possible rule changes, and uncertainty about Salex Funds. In addition, rivalry between owners and the impact of non-beneficiary interests has been mentioned.

The situation had evolved in all these respects. The users had secured changes in the rules that reduced risk, made bidding for construction more competitive and allowed the Salex Funds to be used up front. The users no doubt realised that there was no immediate prospect of further changes to the rules, either to provide protection against future entrants or to remove any perceived bias in favour of some users and against others. Generation capacity in Comahue had increased faster than expected, leading to greater congestion and an enhanced appreciation of the reality of the problem. This was

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[191] The consortium comprised four generators (Capex, Central Puerto, Piedra del Águila and El Chocón) and one construction company (Inepar), each with a 20% share. El Chocón was one of the proponents of the first proposal, while Piedra del Águila had voted against.

[192] The winning bid only just beat the bid submitted by one of the potential independent transmission firms Litsa-Cartelone ($24.99m). The keenness of the winning bid presumably reflected, amongst other things, Transener's concern not to lose its pre-eminent position in transmission. In the run-up to the bidding, competition also took other forms: technical, procedural, regulatory, jurisdictional, legal, etc. Galetovic and Inostroza 2004 describe these aspects of "the battle between transmission firms". Part Two makes some further calculations of the reduction in construction costs exemplified by this line.

[193] "In practice, between the date of the request and the start of construction work in 1997, funds continued to accumulate in the account because of transmission constraints. As a result, an amount far in excess of the US$80 million requested was ultimately available, and this was used to pay the fee for the first two years." (Galetovic and Inostroza 2004, fn 13, p. 14) All the funds in the relevant Salex account at the time an expansion becomes operative are eligible to use for reducing the payments (provided this does not exceed 70 per cent of the total cost). At the time the Fourth Line became operative in December 1999, the level of the Salex Fund on the Comahue corridor was $127.9m. After deducting the original $80m used to reduce the construction cost, this left $47.9m to reduce the monthly canon. This was expended as follows: $0.6m in December 1999, $17.7m in 2000, $18.5m in 2001, $8.2m in 2002 and $0.1m in January 2003, total $45.2m. (The lower total reflects the pesification policy after the economic crisis, which incidentally hit Transener as the construction company.) A new Salex sub-account for this corridor was created in December 1999, which could be used towards future expansions.

exacerbated by separate developments that refined transmission price signals with the effect of increasing peak-offpeak differentials.[194]

In consequence the Salex Fund was larger than expected, which reduced the cost of the Fourth Line to the users. The ability to specify a maximum fee instead of committing to a specific initial bid removed the concern about supporting a rival's transmission company. The lower level of that maximum fee compared to the initial bid, the clearer expectation of competitive bids below that level, the higher level of Salex contribution and the clearer indication of increasing congestion all served to reduce the concern about free-riding. (That is, they reduced the cost of the investment that might be vulnerable to free-riding.) The impact of these factors on Chilgener's Comahue plants evidently overcame any adverse effects of the expansion on its generation interests in Buenos Aires.

To try to quantify some of these factors, Table 6 summarises the various bids and Salex payments, and indicates the sources of the reduction in the amount eventually paid.

Both the Salex contribution and the bidding competition evidently made a significant impact. Some Salex contribution was of course expected in 1995 as well as in 1996.[195] There was less conviction initially that competition would bring down construction costs.[196] The relevant difference is the *change* in expectations from one year to the next. Some change in both factors seems likely. Other factors are likely to have been helpful, such as the continued or at least confirmed increases in demand and in Comahue generation, which implied a greater benefit to the expansion.

Table 6 Costs of Fourth Line

Item	annual fee	NPV[197]	NPVreduction
	$m	$m	$m
Initial proposal August 1994	54.6/61.4	370.1	
Initial Salex Fund $80m			71.8
Initial proposal net of Salex $80m		298.3	
Maximum fee May 1996	43.67	274.7	23.6
Highest bid (by generators)	39.47	248.1	26.6

[194] Resolutions SE 105 (20 March 1995) and SE 151 (17 April 1995). These were the first main modifications to the Market Regulations, though not involving transmission or motivated by it.

[195] At the 1995 hearing the proponents said they had estimates that if the Salex Fund had been applied during the whole of 1994 it would have reached $55m in a single year. In their calculations they assumed that the Fund would reach $45m by 1998, but they stressed that this was a very cautious estimate. At the second hearing in September 1996 the generators expected that the Fund would be $90m by 1998. This was not inconsistent with the expectation about it outlined at the first hearing. The proponents no doubt found it helpful to have such confirmation, but whether it was a "key difference" that explained the change in vote is less clear.

[196] "Although these firms [initially opposing the Fourth Line] realized the line needed to be expanded, they considered the fee proposed for a BOM contract to be too high, and evidently did not believe the auction would result in a substantially lower one." Galetovic and Inostroza 2004, p. 14.

[197] These NPV calculations follow Galetovic and Inostroza 2004 in assuming that the $80m Salex contribution is added to all except the initial proposal and is paid $68.98m and $11.04m at ends of years 1 and 2, respectively, and that the canon is paid at the ends of years 3 to 18, and using a 10% discount rate.

Lowest bid Oct/Nov 1997	24.52	154.0	94.1
Later Salex Fund $47.8m			38.7
Final cost to users net of Salex		115.3	

9.3 Estimations of private profitability

How would the previous calculations of private profitability appear at the time of the second vote? The availability of Salex had increased from $25m to $80m, and the maximum total cost net of Salex contribution was now reduced from about $54.5m ($58m less $3.5m) to $44m. The generators are likely to have known that their representatives would be bidding below this: in the event they bid just under $40m. Adjusting by the proportion that the generators might expect to pay yields a maximum annual payment of the order of 0.94 x $40m = $38m. This is somewhat below the previous $51m. The prospects for further reductions from higher Salex revenues and stronger competition to construct would also have seemed better than before.

The prospect for benefits would also be better. Congestion had continued on the Comahue corridor. $48m a year (the average 1994 to 1996) would now seem quite plausible congestion revenue. If this congestion could be entirely removed, an aggregate annual benefit of $57m including from additional output would not seem out of reach. Even if only three quarters of the congestion could be removed, and if 10 per cent of the benefits were lost to customers in the form of lower system prices, this would still leave the generators with benefits equal to the estimated private cost of $38m.

A study commissioned from consultants at the time sheds light on the situation as they perceived it. In the ‘base case’ the consultants estimated aggregate benefits as set out in Table 7.[198]

Table 7 Estimated benefits of Fourth Line (as at August 1995)[199]

Category of benefits ($m per year)	1999	2003
Benefits to Generators		
Energy benefits	26.4	27.5
(mainly higher prices in Comahue)		
Capacity benefits	19.4	37.4
(mainly increased adaptation factor and spinning reserve)		
Less Provincial royalties	- 5.5	- 7.4
Subtotal to Generators	40.3	57.5
Benefits to Distribution companies	2.0	- 1.4
Plus credit for variable losses	5.8	6.1

[198] The base case assumed construction of a new thermal generating plant at Genelba in Buenos Aires, which was in fact commissioned at 674 MW in 1997.
[199] We are grateful to Ruy Varela of Sigla Group for this information.

Total benefits	48.1	62.2

The study estimated lower benefits to generators in terms of energy prices in Comahue than we conjectured above, but assumed that distribution companies would secure a lower proportion of total benefits. (It calculated that in 2003 these benefits would be negative.) On the other hand, the study estimated significant capacity benefits, of the same order as energy benefits. Other market participants are understood to have taken a more conservative view of capacity benefits. In retrospect, the estimated capacity benefits seem on the high side, especially in 2003.[200] Provincial royalties and credit for variable losses roughly cancelled out. The total estimated benefits to generators were nonetheless sufficient to cover the estimated costs to them of building the line.

9.4 Transactions costs

Some have questioned the ability of market participants to agree on investments, with reference to Argentine experience.[201] Does the failure to reach agreement on the first vote indicate an insuperable level of transactions costs associated with a method such as the Public Contest? This would imply that there were 'gains from trade' that were offset by the cost or difficulty of the transactions involved. This in turn presumes that the Fourth Line was economic. However, it has been shown above that the Fourth Line was uneconomic: there were no such gains from trade to be had. There is no implication to be drawn that transactions costs precluded reaching an agreement.

Of course, the Salex arrangements and the Area of Influence method influenced the situation. If these are taken as given, it still seems to be the case that there was no gain to be had at the time of the first vote. However, by the time of the second vote the situation had changed in several respects, and there was a (private) gain to be had from building the line. And the generators achieved this. They did not fail to reach agreement because of (e.g.) bargaining costs, personality differences, opposition of interests or reluctance by the main beneficiaries to make side-payments to potential losers. The evidence shows that, whatever personality or policy differences there might have been, the generators were well able to work together, they did not disagree on the advantage of an increase in capacity at a suitable price, and when the problem was resolved this was not as a result of negotiated side-payments.

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[200] In the event, the adaptation factor did not increase as predicted, and if it had done so the resulting benefits would to some extent have been offset by higher transmission charges. Greater ability to provide spinning reserve may have been a private benefit to certain generators, though not a social benefit at the system level, but any such benefit seems small, volatile and hard to quantify.

[201] "It is sometimes argued that the problems created by lumpy investments can be resolved through negotiations between the various market participants who will benefit from the investment. That is, that the 'Coase theorem' applies. There are many reasons … to believe that negotiations among the affected market participants is unlikely to solve the problems." Joskow and Tirole 2003, pp. 52-4. "Mechanisms designed to aggregate stakeholder preferences to make choices about major transmission investments have not been particularly successful." Ibid, p.51, citing Chisari et al 2001.

Transactions costs were not the reason why the first proposal failed to attract wider support. Nor did the generators regard the transactions costs of bringing about the successful second proposal as being unduly high. [202] To achieve an agreed investment costing $115m, having reduced the cost from $370m, is a significant testimony to the ability of market participants to resolve the issue through negotiations.

These considerations suggest that the initial decision not to support the Fourth Line expansion in 1995 does not reflect a fundamental inadequacy of the Public Contest method. Certainly there was scope to refine the method, which was done at the time and later. There was also a significant change in circumstances. Given the borderline profitability of the line from the perspective of market participants, the combination of these factors is sufficient to explain why some beneficiaries voted against the expansion on the first occasion and in favour of it on the second. The experience of the Fourth Line does not indicate serious problems associated for example with the lack of votes for demand in Buenos Aires or a failure to accommodate transactions costs.

The significant reduction in cost and increase in the value of the Salex contribution made a significant difference for the market participants, primarily the generators, in terms of their own profit calculations. Their aim was largely to prevent a further transfer of income-in the form of Salex revenues. It seems very unlikely that the Fourth Line was economic (in terms of the Golden Rule) at the time of the second proposal. The calculations above suggest an annual benefit no more than about a third of the annual cost of $24.5m. The benefit might be higher as demand, generation and congestion increased over time, but seems unlikely to have exceeded the cost.

If this is so, then the 'problem' with Argentine transmission expansion policy was not that it led to too little expansion, but that it led to too much – at least, from the point of view of economic efficiency. And the cause of this lay not in the Public Contest method itself. Nor did it lie to an undue extent in the application of up to 70% of the accumulated Salex Funds towards relevant transmission expansions - in practice the contribution to the Fourth Line was only about 30%. The more serious distortion lay in the provision that local prices for generators should not be accompanies by local prices for customers. This led to the accumulation of congestion revenues that were put in a Fund that had no 'owners'. These revenues constituted a one-way transfer of income. No one had an interest in protecting them, and most had an interest in eliminating them. In consequence, there were artificial incentives to expand the transmission system in order to reduce them.

9.5 Effect of the Fourth Line on generation and transmission load factors

[202] As Juan Inostroza has pointed out (personal communication, 1 October 2004), time and costs spent modelling and negotiating with partners, suppliers and customers is the norm in commercial life. In that respect there was nothing exceptional about this negotiation. And it is not as if a regulated approach would obviate the need for this. The parties would still have to incur the time and costs of modelling and negotiating, but with the regulator, transmission company and government rather than with other market participants.

After the agreement to build the Fourth Line, there was indeed a further increase in Comahue generation, as the hydro generators feared, from two main sources.
a) Hidronor had designed a 250 MW hydro plant name Pichi Picún Leufú (PPL) as a compensator station of Piedra del Águila. It was under construction at privatisation but then halted. The government committed to finish it but there was no interest in buying it while the Comahue lines were congested.[203] The government then increased the federal compensation scheme and in 1998 was able to sell PPL to come on stream at the same time as the Fourth Line.[204] PPL, situated just downstream of Piedra, took over the latter's environmental constraint. This gave Piedra the flexibility to operate at peak hours, thereby accentuating the congestion problem.

b) At the same time as the fourth line came on stream, Capex converted its open cycle gas fired plants to combined cycle plants, increasing their 355 MW capacity by 270 MW.

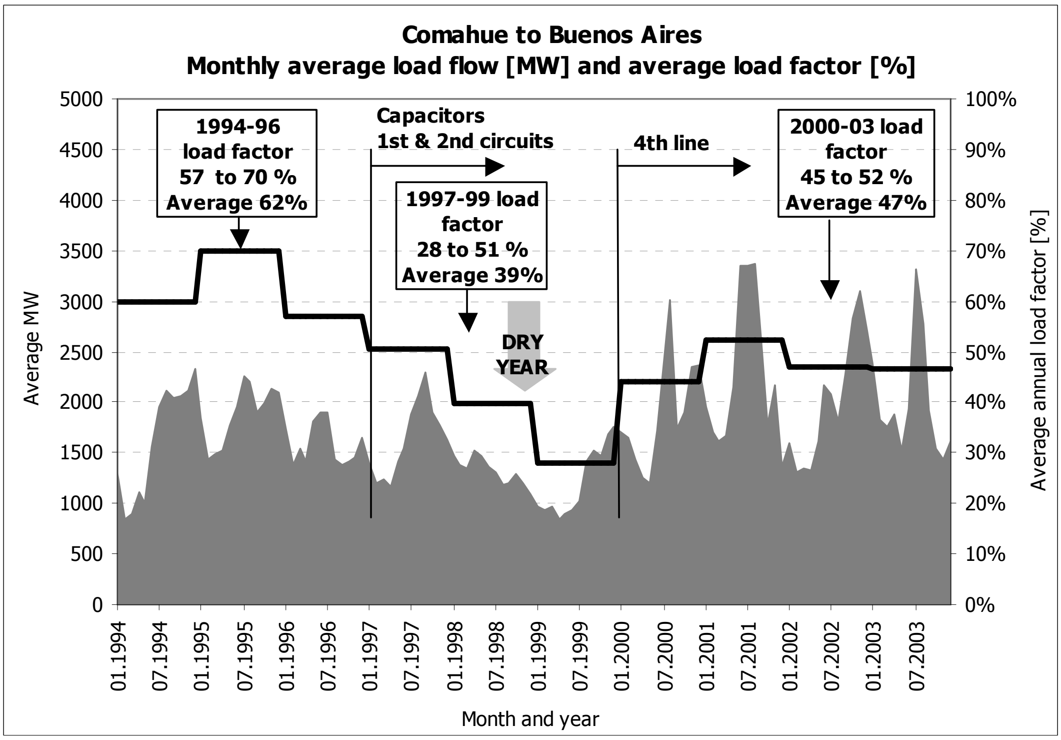
In total, then, the Fourth Line (and related control devices in that corridor) led to, or at least facilitated, an increase in Comahue generating capacity of over 500 MW of hydro and thermal plant, plus improved peaking conditions for other hydro generators including Piedra.

This had implications for load factors. Figure 6 shows that in the three years 1994 – 1996, the average load factor on the Comahue – Buenos Aires corridor was 60%. With the installation of the capacitors and with an exceptionally dry year[205], the average load factor fell to 40% during 1997 - 1999. But after the commissioning of the Fourth Line the average load factor actually increased to 48% during 2000 - 2003.

Taking the post-privatisation period 1994 – 2003 as a whole, the load factor averaged 50%. This stands in contrast to the load factors of just under 25% in conditions typical of the 1980s (Figure 5 above). After privatisation, both before and after the Fourth Line was constructed, the load factor of the Comahue corridor was roughly double what it was before privatisation. This meant that the Fourth Line did not significantly reduce the load factor on that corridor, and certainly not to the level seen in earlier (pre-reform) days. Instead, the transmission system was used more efficiently.

Figure 6 Average load factors Comahue to Buenos Aires 1994 – 2003

[203] Resolution MEyOSP 22 (14 July 1995) invited bids by 30 November 1995, but none was forthcoming. Resolution MEyOSP 49 (26 August 1996) invited bids by 17 October 1996, but again none was forthcoming.
[204] Resolution MEyOSP 646 (4 June 1997) invited bids by 13 August 1997. The winner was local group Pérez Companc (Presidential Decree 1254 of 25 November 1997).
[205] Dry year refers to the hydrological year, which in Comahue starts in June, with the first snow, and finishes in May/June of the next year.



9.6 Alternative ways of meeting increased demand

What does this say about the efficient use of resources? It made economic sense for the thermal generators in Comahue to build new plant to use surplus flared gas, to fill up the available off-peak capacity on the existing three lines, and to do the same again once the Fourth Line was to be built. It would presumably be worthwhile for them to do so yet again if a Fifth Line were built. But was it economic to build such transmission lines in the first place, and would it be economic to do so in future?

Hidronor's strategy before privatisation was essentially to build hydro stations in Comahue in order to serve peak demand in Buenos Aires, 1300 km away. To do this, it ran the transmission lines at less than a quarter of capacity. This was an expensive policy.[206] There were more economic alternatives, even at that time – notably to build open-cycle peaking plant near Buenos Aires. But this was presumably less attractive to Hidronor – and to the government generally - since it required less investment in hydro stations and electricity transmission. It also involved encouraging investment by, and dependence on, Hidronor's long-standing rival Gas del Estado.

Now that companies have to bear all the costs including transmission, strategy has changed. Since the Fourth Line, no further generation has been built in Comahue, except

[206] As pointed out by Roark 1997. A full assessment of this and of the Fourth Line needs to look at usage and prices at peak as well as average load factors, but it seems doubtful that this would change the overall assessment.

for some minor projects for self-supplying oil fields. And no further new electricity transmission lines have been built into Buenos Aires.[207] In contrast, some 4000 MW of new combined cycle generation capacity has been built near Buenos Aires.[208]. There has been significant investment in gas pipelines, especially from Comahue to Buenos Aires.[209]

It might be argued that, just as gas-fired generation plant was first built in Comahue to take advantage of spare electricity transmission capacity into Buenos Aires, so too gas-fired generation plant was first built near Buenos Aires to take advantage of spare gas pipeline capacity from Comahue to Buenos Aires.[210] Looking to the future, and assuming no such spare capacity in either gas or electricity networks, would it be economic to meet future demand in Buenos Aires by building further generation in Comahue and new lines to transmit the electricity? Or to build pipelines to transmit the gas to the Buenos Aires area and to build further generation there?

Figure 7 compares the costs of these alternatives assuming a ‘greenfield situation’. For 2GW generating capacity running at 60% load factor, the cost of transporting gas and converting to electricity in Buenos Aires would be about one sixth less than the cost of generating in Comahue and transmitting the electricity to Buenos Aires.[211] Since there are economies of scale for gas transmission but not for electricity, the cost of transporting gas equivalent to 8 GW of capacity is about half the cost of transmitting that electricity. In other words, although there may be scope for worthwhile local reinforcements of the transmission system given existing capacities (such as a Fifth Line via Comahue – Cuyo), in general it is unlikely to be economic to build more large-scale electricity transmission lines directly between Comahue and Buenos Aires.

[207] The possibility of capacitors to expand capacity on the Fourth Line is being explored, but there has been no proposal by market participants to replicate the Fourth Line. The possibility of a Fifth Line via Comahue to Cuyo, that would take advantage of existing spare capacity from Cuyo to Buenos Aires, may represent an economic investment. This is discussed in Part Two of the paper.

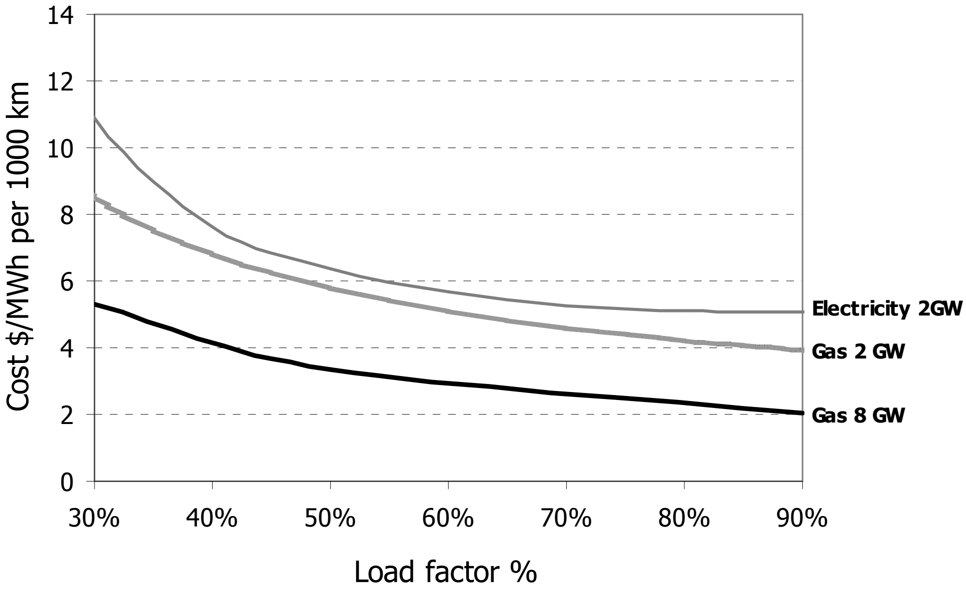
[208] Genelba 674 MW January 1997, Costanera 851 MW October 1998, Puerto 798 MW January 1999, Dock Sud 797 MW January 1999, and AES Paraná 845 MW January 2000, total 3965 MW. Source: CAMMESA, seasonal programming report May 2004.

[209] Total injection capacity to the gas pipelines grid grew 56% from 71.5m m3/day (million of cubic meters per day) in December 1993 to 111.2m m3/day in December 2002. In the same period Comahue exportation capacity grew 81%, from 40.7m m3/d to 73.8 m m3/d. About half of this increased Comahue exportation capacity corresponds to the increased generation in Buenos Aires. (An 800 MW combined cycle generator with 57% heat rate burns 3.5 m m3/d if it is fully dispatched, so 4000 MW corresponds to 17.5 m m3/d.) Source: ENARGAS Annual Report 2002, Annex 4/2.

[210] These pipelines had been engineered to meet winter peak gas demand in Buenos Aires. A natural gas producer that also owned a gas distribution company that had contracted for the firm capacity developed the generation plants to use up the spare off-peak capacity by.

[211] This assumes a high voltage AC line. The differential is slightly higher for 30% load factor, slightly less for 90% load factor.

Figure 7 Comparative costs of electricity and gas transmission



Building hydro plant in Comahue and transmission lines to Buenos Aires had appealed to the state-owned generation-cum-transmission companies and their patrons. These investments were an end in themselves, and the main constraint was simply that of financing them. But they were not necessarily the most economic way to meet electricity demand in Buenos Aires, particularly after changes in the technology and economics of gas-fired generation. The Public Contest method applied to the Fourth Line forced market participants to confront this issue for the first time. Understandably, they took their time about deciding. It was a borderline decision in terms of their profitability; they rejected the first proposal but with the prospect of significantly lower costs they eventually decided to build the line. Whether they would do so again is unclear.

What is clear, however, is that transmission expansion policy after privatisation has been very different from that before privatisation, and in most respects there is reason to believe that it is more consistent with economic efficiency. The Public Contest method deserves credit for this. The Fourth Line debate that it stimulated marked the beginning of a new awareness and more efficient decision-making in the electricity sector as a whole. If the Fourth Line itself was built even though it was not economic, this was not the fault of the Public Contest method, but of the method of dealing with congestion revenues in the generation market.

9.7 Other capacity expansions facilitated by Salex Funds

If local pricing and the availability of Salex Funds made it attractive for market participants to vote for a transmission investment that was uneconomic from a social perspective, was that also true for other expansions? Was the application of the Public

Contest method seriously flawed as a result of local pricing and the Salex Funds, or was the Fourth Line an exception?

The potential ‘problem’ is limited in scope because Salex Funds may be applied only where there is congestion and the expansion ameliorates it. Of the 28 transmission expansions that proceeded under the Public Contest method, only eight others (in addition to the Fourth Line) made use of Salex Funds (see Appendix). Five of these were actually (or in one case effectively) proposed by the transmission company, which did not stand to gain from the reduced congestion or the use of the Fund insofar as it did not pay for the expansion. This leaves only three expansions proposed by the users that reduced congestion and benefited from the Fund. All of them involved the installation of capacitors on existing lines. Two of these applications were to the Comahue corridor: at Henderson and Puelches (proposed in 1994 and installed in 1996) and at Choele Choel and Olavarría (proposed in 2001 and presently under construction). The other application was in the North West corridor at Recreo (proposed 1997 and installed in 2000).

In line with the previous calculations for the Fourth Line, for each of these expansions we have calculated a plausible range and average value for the short-run benefit of the expansion, given the circumstances of the corridor at the time, and a long-run estimate assuming the system is fully adjusted (and typically more congested). The same range of benefits has been assumed for all three expansions in the Comahue corridor, though the timings obviously differ by a few years. For the Northwest corridor we have taken the range of benefits as the average congestion value before ($0.62) and after ($0.35) the introduction of the capacitors. We have also calculated the average cost of expansion on a common basis, by converting the published cost or fee (before application of Salex reductions, see Appendix) to an equivalent annual fee over 15 years, then dividing by capacity-hours per year.[212] The long run calculations of benefit and cost refer to averages over 8760 hours per year. The short-run calculations spread the observed congestion revenue over actual usage, hence the short-run calculation of cost divides long-run cost by an indicative 50% load factor. (In fact, load factor varied around this level.) Table 8 sets out these values.

Table 8 Benefits and costs ($/MWh) for user-proposed expansions with Salex Funds

Expansion	SR benefit	SR cost	LR benefit	LR cost
Fourth Line	$1 - $3, ave. $2.30	$6.7-$10.8	$2.68	$3.35 - $5.40
H-P capacitors	$1 - $3, ave. $2.30	$2.66	$2.68	$1.33
CC-O capacitors	$1 - $3, ave. $2.30	$2.28	$2.68	$1.14
Recreo capacitors	$0.35-$0.62, ave$0.49	$1.60	$2.32	$0.80

As calculated earlier, the range of short-run benefits of the Fourth Line lies considerably below the lowest short-run cost of the Line, as does the long-run benefit in relation to

[212] Specifically, Fourth Line $36m/1225MWx8760 = $3.35/MWh, $58m/1225MWx8760 = $5.40/MWh; H-P $3.5m/300MWx8760 = $1.33/MWh; CC-O $2.0m/200MWx8760 = $1.14/MWh; Recreo $1.4m/200MWx8760 = $0.80/MWh.

long-run cost. In contrast, for the two Comahue capacitors, the average short-run benefit is of the same order as the short-run cost, and the latter lies within the range of short-run benefits. Moreover, the long-run benefit is about twice the long-run level of cost. For the Recreo capacitors, the short-run benefits are below the short-run cost, but the long-run benefit is about three times the level of long-run cost. In other words, both the Comahue capacitors seem economic, and the Recreo capacitors seem premature but potentially economic, at least under expectations obtaining at the time.[213] In contrast, the Fourth Line seems uneconomic under any plausible circumstances. The Fourth Line was thus an exception, and not characteristic of the operation of the Public Contest method generally.

Conclusions

In privatising its electricity sector in 1992, Argentina adopted innovative arrangements with respect to the regulation of transmission expansion. The incumbent transmission companies were forbidden to initiate expansions in capacity. With the exception of minor investments, it was for users to propose and finance such expansions, using a prescribed voting scheme called the Public Contest method.

The regulatory arrangements for transmission expansion in Argentina were not adopted simply for ideological reasons. They reflected a strong and plausible belief, based on much previous experience, that a traditional framework of regulation would fail to deliver the improved efficiency that would be crucial to maximising economic development in that country. The key to the success of the reform in the sector was to maximise the role of market disciplines relative to political influence.

It is widely held that this particular policy innovation has been unsuccessful. This conclusion is based almost entirely on the view that the Public Contest method delayed by many years a much-needed Fourth Line into Buenos Aires, and was characterised by problems in negotiating and securing consensus among the parties involved. Accordingly, Argentina has been held up as an example of "how not to do it" with respect to transmission regulation. More generally, its experience has been used to suggest that conventional methods of regulation should not be replaced by methods that give a greater role to market participants.

This paper has argued that these perceptions are incorrect. Evidence suggests that the Fourth Line was not much-needed. In terms of aggregate net benefit, it was uneconomic, both at the time it was first proposed under the new arrangements, and also at the second time too. Deferring the investment – actually by only a year and a half rather than by

[213] The Northwest corridor has been characterised by changing expectations. "The 500 MW line from Almafuerte up to El Bracho [through Recreo] was originally installed in 1987 to provide a load flow to meet demand in the northwest. But after the market developed, it began to appear attractive to install generation in the northwest, and to use the line in the opposite direction, south from El Bracho through Almafuerte to supply Buenos Aires." (Part Two of this paper, section 1.2) The Recreo capacitors were proposed in 1997 as an economic way of meeting this increasing generation and demand. But at about the same time as the capacitors came into service in 2000, a new Australian mining project increased local northwest demand by about 200 MW. The load factor of southbound transmission was significantly reduced, and in some hours load flow was in the opposite direction.

many years – was beneficial rather than costly. Moreover, the reason for the delay was not the level of transactions costs or the inability of the parties to work together as envisaged by the Public Contest method. Rather, the delay was caused by the uneconomic nature of the expansion, and the unprofitability to the main parties involved. That it was proposed at all reflects the interest of the main proponents in entering the transmission business itself. When conditions changed so as to make the expansion profitable to these participants, negotiations between them were not unduly costly or problematic and nor did they preclude consensus. In fact the generators that voted against the initial proposal worked actively with the proponents to develop a proposal that all could support, and this succeeded.

Why was there such a strong view that the Fourth Line was desirable, and that delay constituted serious failure? This is explicable in terms of public choice theory. Politicians, governments and regulators all have an interest in promoting new transmission lines. Transmission companies and contractors have an interest in building them. Distribution companies get improved quality of service and therefore lower penalty costs for non-performance. Some generators benefit from higher prices. For all these parties, the potential benefits of transmission expansion are significant. Under the conventional regulatory process, the costs of this are relatively low, since they are spread among a large number of consumers in the system as a whole. Such consumers do not find it worthwhile to express a view, if indeed they are aware of what is happening. In consequence, transmission expansions find ready support and little opposition.

In contrast, the Public Contest method focuses the costs of expansion on the beneficiaries, who have to think seriously about approving the investment. It is not surprising that the Fourth Line was widely held to be desirable, that the beneficiaries resisted when they realised the cost, that this initial adverse vote was disappointing to many, and that as a result the Public Contest method itself was readily held to have failed.

In fact, however, the Public Contest method forced a needed reappraisal of pre-reform transmission investment policy, and a subsequent change to a more economic policy. Far from demonstrating the failure of the Public Contest method, the Fourth Line experience is an indication of its success, in terms of greater economic efficiency. If the Fourth Line was uneconomic from this perspective, the explanation lies in the system of pricing that created congestion revenues, and thereby distorted the decision, not in the nature of the Public Contest method itself.

Part Two of this paper documents the subsequent experience of the Public Contest method in Argentina after the Fourth Line.

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