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Transmission expansion in Argentina 1: The origins of policy

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Abstract

As part of its electricity reform, Argentina developed a distinctive policy on transmission expansion. Market participants, rather than the transmission company or the regulator, would determine expansions. Initially, this policy proved controversial and some economists have been critical. This paper explains why it was decided to adopt the policy. The aim was to avoid the inefficiencies and over-expansions of the state-owned era. The solution was to introduce competition wherever possible and to minimise the role for regulation. The existing transmission system already contained several separate but coordinated transmission networks. Users would have the incentive to propose and approve expansions without the need for regulation, and competition was viable for the construction and operation of transmission expansions. The method has been criticised for allocating costs and votes according to usage instead of benefits. However, the method was pragmatic, to take advantage of the existing program for system control, and designed to limit the scope for subjective and unpredictable regulatory judgements. It has merit even where such problems do not apply, as a means of securing outcomes better tailored to the needs of users.

JEL classification: L33; L51; L94; L98

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1. Introduction

In 1992, Argentina restructured and privatised its electricity sector, along similar lines to the UK but in some respects going further. As part of the reform, restructured incumbent companies

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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 then to be put out to competitive tender.

There are many accounts of electricity reform in Argentina.[1] The prevailing view is that in general it has been a remarkable success. However, there have been concerns about the Public Contest method for transmission expansion. Within this, particular criticism has been directed at the Area of Influence method that determines the allocation of costs and votes amongst transmission users, particularly at the virtual exclusion of Buenos Aires consumers from the model. In consequence, the approach has been widely reported as deficient or unsuccessful, and an inappropriate model for other countries or infrastructure sectors.

This paper examines why and how Argentina came to adopt this controversial policy. Other papers in this Symposium explore how the policy was subsequently applied and modified, and what problems and successes were associated with it.[2]

2. The general need for electricity sector reform

The reform of transmission expansion arrangements has to be seen in the context of Argentine policy on reform of the public sector generally, and of the electricity sector in particular. This policy was motivated by serious concerns about previous performance during the state-owned era from the 1940s to the 1980s.

Commentators have documented the problems of a "tremendously distorted regulatory regime" that 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 delayed to control inflation, thereby encouraging further consumption growth. Distorted financial incentives favoured investment in new assets rather than operational expenses.[3] Operational performance was poor: "Almost half the thermal generating plants in Argentina were not available". So too was financial performance: sector enterprises as a whole made losses and the federal government did not have sufficient funds to invest.[4] The sector was used as a means to achieve a variety of other government and political objectives.[5]

Previous attempts at reform had failed.[6] By 1988–89 the energy sector was in crisis.[7]

[1] E.g. Bastos and Abdala (1996), Estache and Rodríguez-Pardina (1996), Bouille et al (2002), Gómez-Ibáñez (2003) and Pollitt (2008-this issue), plus Abdala and Chambouleyron (1999) specifically on transmission.

[2] This paper and companion papers Littlechild and Skerk (2008-this issue-a,b,c) are developments of earlier papers Littlechild and Skerk (2004a,b), which nonetheless contain some detailed material not included in this Symposium.

[3] Spiller and Viana (1996).

[4] Bastos and Abdala (1996), p. 21.

[5] "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 (1996), p. 23. All this is consistent with the economic theory of public ownership and with experience elsewhere. E.g. De Alessi (1974).

[6] Bouille et al (2002), p. 32.

[7] CAMMESA, Sector eléctrico, antecedentes, 1988–89, at www.cammesa.com.ar.

3. The extra-high voltage (EHV) transmission network

From the 1950s to 1992, some 6870 km of 500 kV extra-high voltage (EHV) transmission 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 of the load in the country. Over time, 500 kV lines were also used to link the separate electricity systems within the country and, later, to link the country internationally.

Fig. 1 shows the EHV transmission system that these lines formed, as it existed at the time of privatisation in 1992. It was essentially a radial system, largely interconnected but owned and operated by three different state-owned companies (AyE, Hidronor, and SEGBA). The separate system in Patagonia was linked to the rest of the national system by a 132 kV line.

4. Previous performance in the transmission sector

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.[8] Power transmission was not considered a separate activity, and therefore no explicit costs (or benefits) were allocated to it.[9]

The problems of the Argentine electricity industry in general were equally characteristic of the transmission sector in particular. In some cases, EHV lines were built to meet political pressures, without adequate justification. Provincial leaders argued for interconnection at 500 kV, in part since that would be paid by the Central government whereas lower voltage lines would be paid from the provincial budgets. One example was expansion in the northeast of the transmission system, where Misiones province took advantage of the opening of Yacyretá power station to argue for a 500 kV EHV line.[10]

To justify EHV transmission lines, provincial governments specified implausible rates of demand growth.[11] Their construction led to inefficiently low load factors.[12] As a result, there was

[8] "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 1996, 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.

[9] Bastos and Abdala (1996), p. 65.

[10] 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, even though 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. 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 1996, p. 30). In 1992 the Secretary of Energy approved the implementation of the 500 kV line 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.

[11] For example, two provincial governments in the northwest argued for a 500 kV line from Almafuerte to El Bracho 600 km to the north. They projected annual growth rates of 14%; in the event after the line was commissioned in 1987 the actual growth rates were negative (Sanz, 2004, p. 2).

[12] The above line into the northwest had a capacity of around 1000 MW but its average usage was only 34 MW. This average load factor of about 3 1/2% compares with about 25% in the Comahue corridor at that time, and about 50% in the same corridor in the decade from the mid-1990s.

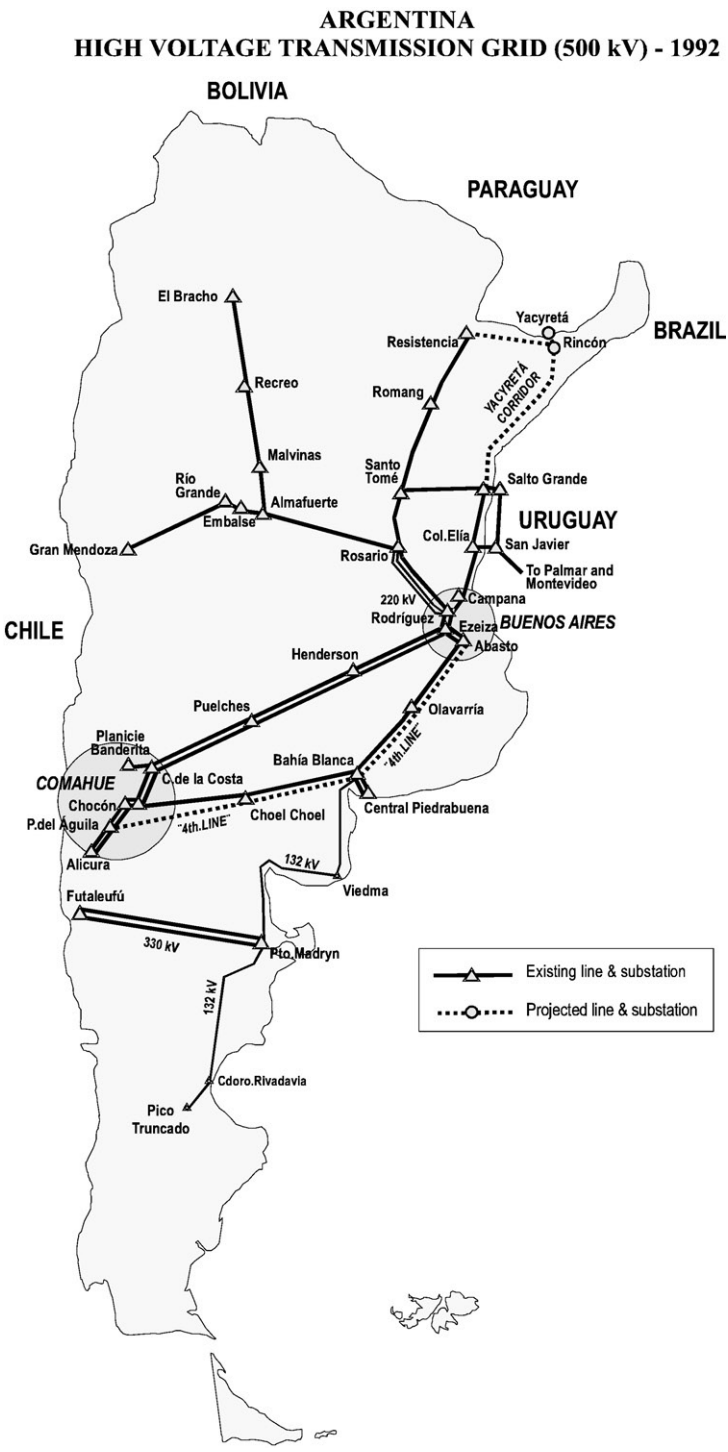

Fig. 1. Map of Argentine transmission system. Source: Mercados Energéticos.

an inordinate cost per unit, averaging nearly US $100/MWh transmitted in one case.[13,14] This cost of the transmission element alone is more than double the retail price of electricity during the 1980s (and four times the price during the late 1990s).

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 companies with transmission lines, were used as mechanisms for public works to support particular regions or to reward particular political allies. There was padding of suppliers' costs.[15] That 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 as each sought to expand its network.[16] The outcomes were not based on technical or economic considerations. A Working Group for Planning the National Transmission Network (1984–1991), reporting to the Secretary of Energy, was unable to make a unanimous recommendation on future investments in the extra-high voltage transmission system because of differences between the companies.[17]

Excessive expansion meant low utilisation of much capacity.[18] There were many other deficiencies of the pre-reform transmission system.[19] These included excessive cost,[20] over-staffing[21] and delays in repairing capacity.[22]

The pre-reform transmission sector in Argentina was thus as inefficient as the rest of the electricity sector. Moreover, the inefficiency lay not just in higher costs and poorer performance of

[13] The symbol $ is used to denote the Argentine peso as well as the US dollar. For most of the period following reform, the peso was equal to the dollar, and it is not necessary to distinguish the two. After the economic crisis at the end of 2001, the Argentine peso fell to about one third of the US dollar. Since then it has become conventional to express figures in US$ and convert to pesos on the day of exchange.

[14] Taking the same northwest case in round terms, 600 km line @ $200,000/km=$120m, plus $60m substations, total $180m. Amortised over 15 years at 10% rate of return, this is 16% p.a.×$180m=$29m/year. Assume 34 MW average flow×8760 h/year=300,000 MWh/year. Then average cost is $29m/300,000 MWh=$97/MWh.

[15] "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, 1996, p. 141).

[16] 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.

[17] For example, views of the companies differed on the need for a Fourth Line from Comahue to Buenos Aires: 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. Julio DiSalvo headed the Working Group; vice-directors were Luis Caruso and Gerardo López. Ramón Sanz was part of this group. Several of these participants played a major part in designing the transmission reform, as explained below.

[18] For example, under normal rainfall conditions, the main Comahue–Buenos Aires corridor had an average load factor under 25% during the 1980s. See Littlechild and Skerk (2004a), p. 51 and Fig. 5 p. 52.

[19] The following items are based on Sanz (2004), p. 2, supplemented by information from that author.

[20] 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).

[21] At the time of privatisation the consortium of international consultants (following an analysis by consultants 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.

[22] The average time to recover collapsed towers after major incidents (tornados) was 9 days in the 1970s (when these problems were little understood). 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.

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 as well as in *how* it was done.

5. Privatisation and reform

In August 1989 Administrative Reform Act (Law 23696) established the basis and principles for privatising all state-owned companies. Restructuring of the federally-owned electricity sector in Argentina took place mainly during 1990–91.[23] Resolution SEE 38 in July/August 1991 set the initial market regulations as guidelines to implement economic transactions among state-owned utilities. The Electricity Regulation Act (Law 24065) of December 1991 came into effect in early 1992.

Carlos Bastos, Secretary of Energy 1991–96, led the large-scale and radical privatisation of the electricity sector, within the general policy framework of the Minister of Economy Domingo Cavallo. Bastos, formerly an electrical engineer, researcher and consultant, brought the conceptual vision and insistence on a reformed, privately owned and competitive sector. He also took on the political battles, including with parties from the existing industry. He appointed officials within the Department to define and drive through the process, and to draw up the Electricity Regulation Act.

In many respects electricity reform followed the policy adopted a couple of years earlier in the UK (or more precisely in England and Wales), although sometimes more radical with respect to restructuring. The main restructuring decisions apart from transmission were

- The generating stations of the three previous companies owned by the national government were formed into over twenty separate generating companies.
- The distribution lines of the state-owned company Servicios Electricos de Gran Buenos Aires (SEGBA) were divided into three distribution companies accounting for some 40% of the energy distributed in the country.
- The transmission and distribution companies were required to provide access and use of system for generators, suppliers and large users.
- A Wholesale Electricity Market Managing Corporation called CAMMESA 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. CAMMESA was quite separate from the transmission and generation companies. The Secretary of Energy retained control over the Market Rules, which could be changed by ministerial resolution.
- A National Electricity Regulatory Agency ENRE was created, whose first president was appointed in April 1993.

Most of the electricity assets were privatised. 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.[24]

[23] A substantial part of the electricity sector was owned and operated by the provinces. Reform of this part of the sector took place later and varied considerably from one province to another.

[24] Some two dozen companies owned by the provincial governments, plus hundreds of cooperatives, distributed most of the remaining 40% of the energy. Many of them generated energy 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 (Bouille et al., 2002, pp. 33, 38).

6. Main considerations in transmission reform

To head his transmission privatisation team, Bastos appointed Luis Caruso, whom he had met during the 1970s. This team was largely responsible for the practical implementation of 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 matters.[25] 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.[26] Most of this demand was in the Buenos Aires area.[27] 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.[28]

The second consideration was that much high voltage transmission investment during the previous decade had been uneconomic and excessively costly. The team designing the transmission regulation were acutely aware of this from personal experience.[29] It was crucial to ensure

[25] Caruso joined the Operations Department of Hidronor in 1974, was head of its Operation Engineering division 1977–87, manager of the National Dispatch Center 1987–91, 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, and later the first Executive Vice President of CAMMESA 1992–93. His transmission team included Beatriz Arizu, Juan Carlos Berra, Roberto D'Addario and Ramón Sanz, all of whom had worked in the industry previously. Sanz later took over as Executive Vice President of CAMMESA (1995–1998). In 1993, Caruso and his team left to found the consulting group Mercados Energéticos.

[26] As indeed it did. In the event, consumption per head grew at an average of 3.3% annually from 1992 to 2002 (source: Mercados Energéticos 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, 2008-this issue, p. [13]). The rate of increase was even faster at first: "… a 67% increase in electricity demand during the same period [1992–97]. Electricity consumption grew at an average annual rate of 7.3% after the reforms, compared with 2.5% in the decade before." (Gómez-Ibáñez, 2003, p. 307).

[27] "Greater Buenos Aires area represents about 43% of the overall demand and the percentage increases to 70% if the Buenos Aires Province and neighbouring Litoral areas are included." (Sanz, 2004, p. 1).

[28] Argentina is the eighth largest country in the world. 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: about three times the average length in the US 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) (Sanz, 2004, p. 2).

[29] 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.

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.[30] The conventional concept of transmission regulation had no credibility in Argentina. Nor was there reason to believe that it would be immune to these difficulties in future. In fact, with private ownership of the sector the ability and incentive to influence public decision-makers to over-build transmission could be even greater than before.

7. A new approach to transmission

A new approach to transmission 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, which was generally held to be a monopoly, while retaining the technical unity of the transmission system as a whole.

There were several key steps in the thinking. These were the recognition

- that the existing transmission system was not homogeneous, but already included various elements in different ownership and operation;
- that the extent of effective capacity in the system as a whole depended not only on the availability of generation stations and transmission lines, but also and more importantly on the control and dispatch of the system;
- that such control and dispatch could be separated from the ownership and management of the transmission lines;
- that the existing transmission facilities could sensibly be split into several different systems at different voltages;
- that over time entry and growth of other transmission companies could be envisaged;
- and, crucially, that new facilities could be regulated separately and differently from existing ones.

The initial results of this thinking were the creation of

- an extra-high voltage (500 kV) national transmission system, known as Transener,
- five separate high voltage (132 kV) regional sub-transmission systems, and
- an Independent System Operator (ISO) called CAMMESA, separate from the transmission companies.

Thus, transmission was not to be the prerogative of a single entity. The policy was to start with many transmission entities, and to encourage the entry of more. This had the additional advantage of enabling generators to compete more effectively because if necessary they could build their own transmission lines: they were not dependent on another company for this.

[30] "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, 1996, p. 296).

What about competition and regulation of transmission? The operation and maintenance of the existing transmission systems could not easily be subject to competition. However, these activities could be subject to incentive price caps, which had recently (at that time) been introduced for the transmission and distribution businesses in the UK.[31]

The 1992 Electricity Regulation Act (Law 24065) provided the framework for the regulation of the existing transmission systems. The concessions themselves were distinctive, and reflect the pervasive importance attached to competition.[32] The obligations on concessionaires of transmission systems were to 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. Remuneration was essentially determined by price caps fixed for specified periods of time, to provide incentives to efficient operation. The EHV transmission company Transener was privatised on 16 July 1993, with an initial tariff fixed for 5 years.

8. Transmission expansion

In contrast to the operation of existing transmission systems, the construction and operation of new transmission facilities could indeed be put out to competitive tender. And there was reason to think that competition could be effective there, since there were several potential bidders.[33] The tendering process would determine the most efficient method of construction and operation, and the most efficient company to provide this. It would also solve the regulatory problem since it would effectively determine the appropriate price to charge for such expansions. All this would be achieved without the need for conventional regulation.

The remaining and substantial question was how to identify appropriate expansions. In particular, how to avoid the previous tendency to over-expansion?

The conventional model in economic theory envisaged the regulator and/or transmission company choosing 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.

Some contemporary discussions in the US and UK suggested that transmission charges based on nodal spot prices (as envisaged in Argentina) would send efficient short-term signals to market participants and would just recover efficiently incurred transmission costs. On this basis,

[31] These price caps had become part of the conventional regulatory approach in the UK. They had been used in regulating the newly-privatised telecommunications, gas, airports, water and electricity sectors over the period 1984 to 1989. There was also emerging evidence that they were conducive to improved efficiency.

[32] 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 must organise 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 was intended to provide an incentive to preserve the value of the assets under concession. See Abdala (1994).

[33] Interested competitors might include the construction companies that used to bid for tenders to construct lines put out by the previous state-owned companies, and transmission companies in other countries. This proved to be the case. SADE Ing y Construcciones (from Argentina) and National Grid Company (from the UK) were members of the consortium that purchased the EHV transmission company Transener at privatisation. Another construction company, Litsa, became an independent transmission company after winning the tender to construct the first line put out to tender (between Rincón and Salto Grande). At least nine independent contractors subsequently won tenders for transmission expansions. Littlechild and Skerk (2008-this issue-c).

transmission expansion decisions could perhaps be left to the market. 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%.[34] They could also give a perverse incentive to increase congestion.

The answer was to give the expansion decision to the users themselves. This was perhaps the boldest step in the whole electricity reform process. If the cost of a new investment were charged to those who used it (the beneficiaries), then these users would have the incentive to identify, propose and accept economic transmission investments and to reject uneconomic ones. There was no need for the incumbent transmission companies or the regulator to determine new investments. Indeed, given previous experience, such involvement would be positively undesirable.

The incumbent transmission companies could and would have a role in several important respects. They would provide various pieces of relevant information, ensure that expansions of their systems were properly done, and could (if they wished) bid to construct, operate and maintain the expansions decided upon by users.

The regulatory body ENRE would also have a role to check that total cost of generation plus transmission plus the cost of unserved energy would be lower with a proposed transmission expansion than without it.[35] This subsequently became known as the Golden Rule. The need for it was somewhat debateable.[36]

The Secretariat of Energy and the system operator CAMMESA, for their part, had a continuing role to oversee the system as a wholes.[37] But it was for the users of the system – not the transmission companies, regulator, government or system operator – to decide upon the expansions.

The principal users of the transmission systems were the generators and distribution companies and large consumers. Each of these would have a need to support appropriate transmission expansions.[38] Generators would have a direct profit incentive to do so. Distribution companies would have a need to do so because they were each given the obligation to supply all demand in their exclusive concession area. This had the additional advantage that there was no need for

[34] Pérez-Arriaga and Rubio (1995). The transmission privatisation team appreciated the importance of nodal pricing as a means of identifying economic investments, and was aware of Chilean policy in this respect following the Chilean Electricity Law 1982. The problem of total cost recovery with such prices was one that the National Energy Commission in Chile had been wrestling with since that time.

[35] Article 19 in Annex 16 to the Market Regulations, as ratified in Decree 743 (29 December 1992).

[36] Formally, if transmission costs were charged to beneficiaries, then an equivalent regulatory objective to the Golden Rule mentioned above was to choose network reinforcements so as to maximise the sum of net benefits to consumers and generators. Under certain conditions this is what a competitive market would deliver. Consequently, given the arrangements for market decision-making, there was arguably no need for the regulator to apply the Golden Rule test, 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 way of thinking, a check of this kind served to reassure the industry, politicians and customers. In the event, ENRE never deemed any proposed expansion to fail the Golden Rule.

[37] The 1992 Electricity Regulation Act (Law 24065) gives the Secretary of Energy the responsibility for formulating and modifying the Market Regulations. Amongst other things, a transmission company has to operate its grid under conditions laid down by CAMMESA in fulfilment of norms laid down by the Secretary of Energy under Article 36 of this Law. CAMMESA's functions include economic dispatch of generation and transparent administration of the market, and also coordination of the centralised operation of the system in order to guarantee security and quality of supply.

[38] "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 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 need the transmission network expansion to buy economical generation and avoid failures due to generation deficit." (Sanz, 2004, p. 4).

central planning of generation and transmission facilities. (At that time the concept of retail competition was not a familiar one.)

The new approach therefore 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 minimum quality of supply that had to be ensured, and design a system of penalties to enforce this. The ideas that all transmission expansions would be determined by all relevant users, with these users being well-defined and having appropriate incentives, and that approved expansions would be put out to competitive tender, are what distinguish the Argentina model from previous policy in Chile.[39] At the time these seemed relatively straightforward tasks. In practice they proved somewhat controversial.

9. The methods of transmission expansion

The initial regulations[40] provided three different methods for the construction and operation of new transmission lines for public use: Contract Between Parties (expansions for one or a few users, such as connections), Minor Expansions (under $2m for Transener's system), and Public Contest.[41] Attention has naturally focused on the distinctive Public Contest method. It was envisaged that this would be used for the most significant investments involving many parties, and this proved to be the case. In practice there were many more expansions by the other methods, even though their aggregate value was less, and they had a valuable role to play in enabling the arrangements to run smoothly without unnecessary cost.[42]

In order to request an expansion of transmission capacity by Public Contest, the proponents apply to the Transmission Company that holds the concession in the area of the expansion, which reports on the technical feasibility of the request. The Dispatch Organisation (part of CAMMESA) carries out a technical study, using the so-called Area of Influence method, to identify the

[39] Chile's Electricity Law DFL-1 of 1982 established that 'interested parties' (by implication generators) had a right of interconnection with and open access to transmission systems. They were to pay for O&M costs proportionate to the capacity involved and, if necessary, had the right to increase transmission capacity at their own expense. It was envisaged that, in such a case, they would agree a budget to finance an expansion designed and built by the transmission company (at that time the vertically-integrated and state-owned company Endesa). Renato Agurto and Sebastián Bernstein, as members of the National Energy Commission, began considering how to allocate costs of the existing (or expanded) transmission system between generators on a better basis than uniform 'postage stamp' pricing. To implement this, the Electricity Law was modified by Law 18922 of 30 January 1990 to incorporate a concept of Area of Influence. However, at that stage the concept simply meant 'all lines affected' and was not further defined. Nor was it applied to users generally, nor specific to transmission expansions. There were subsequent disputes over its interpretation, particularly after Endesa was privatised. A modification in December 1997 provided that the System Operator would identify the facilities that would be part of the Area of Influence of any interested party. The Area of Influence of a power plant was defined as 'the minimum set of assets that connect the plant with the nearest basic substation'. It was not until March 2004 that the Short Law made significant changes to the transmission pricing and expansion procedures. See also Araneda and Ríos (2005). In designing the Argentine approach in 1991–2, Luis Caruso and Ramón Sanz took from Chile the idea of locational (nodal) pricing in a linear (radial) system, and were aware of the Chilean concept of 'use' in general terms, but their decision to require identified 'users' to make expansion decisions instead of the transmission company and regulator was novel.

[40] Annex 16 of the Market Regulations (per SE 137/1992).

[41] 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, though this stance was later relaxed slightly.

[42] See Littlechild and Skerk 2008-this issue-b. Later governments introduced other methods.

"beneficiaries" of the expansion and the proportion in which each beneficiary would have to share the costs of amortisation.

The proponents must represent at least 30% of the beneficiaries that the expansion would bring in its "area of influence". ENRE has to check that the Golden Rule is met and arrange for a public hearing. In the event of opposition by 30% or more of the beneficiaries of the expansion, ENRE must reject the expansion request. If there is no opposition, or not sufficient to warrant further investigation, ENRE must approve the request, and issue a Certificate of Convenience and Public Necessity. The proponents then arrange for a public tender to Construct, Operate and Maintain the proposed expansion. Subject to some qualifications, the tender (known as the COM contract) goes to the lowest bidder.

Initially, the request for an expansion 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.[43] The duration of the amortisation period was limited.[44]

Transmission expansions via the Public Contest method are paid for by all those parties who are identified as beneficiaries in the area of influence of the expansion, in proportion to their shares as beneficiaries. This calculation is updated monthly during the amortisation period of the COM contract, so that actual users pay for the expansion in proportion to actual use. After the expiration of this amortisation period, the annual remuneration for operation of the additional facility follows the remuneration regime applicable to existing installations of the incumbent Transmission Company, which essentially covers Operation and Maintenance only.

10. The area of influence method

The system operator CAMMESA is required to use the so-called Area of Influence method in order to determine the beneficiaries of a new line. This is evidently an important step in the process, and has attracted considerable attention. CAMMESA uses a simulation model based on the same model that it uses to schedule generation and to set nodal prices. A generator is a beneficiary if an increase in its output (with a corresponding increase in consumption at the reference node or '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.

[43] Decree 2743/92, Annex III (the Annex 16 to the MR), Title III, Articles 15, 22, 27.

[44] 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. 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 at most 15 years. ENRE could approve a longer period 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.

In subsequent debate, a main concern has been that this Area of Influence method allocated votes in proportion to use of the line rather than in proportion to the economic benefit it conferred. A second important concern has been that the choice of Buenos Aires as the reference node effectively disenfranchised the distribution companies and large customers in Buenos Aires. These concerns were expressed by several commentators, analysed in some detail, and much repeated.[45] It is therefore worth examining what the designers of the transmission arrangements had in mind when they specified and applied the Area of Influence method.

The designers and implementers of the policy were transmission engineers rather than economists, but they were by no means averse to economic thinking and criteria. Indeed, their aim was to ensure a significantly more economic pattern of transmission investment and use than had obtained in the past. However, they considered that 'economic benefit' was a broad and not directly observable concept, and likely to be the subject of dispute if it were the criterion for determining expansion. In contrast, a criterion based on use rather than benefit reduced the extent of subjectivity required to apply the method. Use could be observed, recorded and verified, at least historically. The rules were thus specified to make the process workable and the calculations as far as possible immune to political pressures.

Adopting a criterion of use rather than benefit had another advantage: it meant that CAMMESA's model of the electricity system could be used to allocate costs and calculate votes. It was the most developed model available at the time. This decision obviated the need for CAMMESA or the parties themselves to negotiate what method of benefit measurement to use. That would have been time-consuming and perhaps inconclusive.

Some have suggested that beneficiaries could have been left to decide between themselves how to share the costs of an expansion. Others have recognised that voting might reduce transactions costs, provided that the voting rules accurately reflected benefits.[46] The designers used a more practical criterion: whether the rules were sufficiently accurate for their purpose, and less vulnerable to abuse than any other available method of estimating benefits.

Some have been concerned that limiting participation to beneficiaries in a specified area of influence could overlook important consequences of a transmission expansion decision that were external to those beneficiaries. However, the requirement that beneficiaries should be in a defined Area of Influence again reflected considerations of objectivity and practicality. It was a conscious attempt to limit the range, subjectivity and manipulability of the calculations.[47]

In addition, a defined area of influence meant that negotiation was confined to a relatively small and manageable subset of all the parties that might claim in principle to have an interest in a particular project. In the electricity system as a whole there were some forty generators, two dozen

[45] "A key problem of the Area of Influence method is that it does not in fact identify beneficiaries or accurately measure users' share of benefits." (NERA, 1998, p. 70; see also references in Littlechild and Skerk 2008-this issue-a). Most of the later commentators reference the research by Chisari et al. (2001). These authors use examples from a simulation model to identify flaws in that mechanism. In summary, the suggested flaws are the exclusion of consumers from the mechanism, the exclusion of market participants in the 'swing bus', the assignation of votes and fees based on usage rather than profit, and the possibility of strategic vetoes on expansion (p. 713). More recently see Chisari and Romero (2008-this issue).

[46] "Voting was less burdensome than a negotiated agreement. But voting also placed a premium on the accuracy of the rules for measuring how much different parties would benefit from the line, and thus how many votes they had." (Gómez-Ibáñez, 2003, p. 313); see also Chisari et al., 2001).

[47] "We were wary of the unqualified terms 'benefits' and 'beneficiaries' since we did not know how they would be interpreted. By specifying an area of influence we hoped to tie down the calculation to something more tangible." (R Sanz, personal communication, April 2004).

distribution companies, and over a thousand large users, not to mention the millions of residential customers. Application of the rules in the case of the Fourth Line, for example, identified 17 parties in the area of influence. The median number of voters was 5. This surely reduced transactions costs.[48]

How did the method deal with externalities? As regards externalities between participants within the electricity sector as a whole, the method of identifying 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). In addition, the Secretariat of Energy and the system operator CAMMESA would have a continuing role to oversee the efficiency of the system as a whole. 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, and was therefore to be avoided.

11. Buenos Aires as the reference node

The reference node for the Area of Influence method was chosen as Buenos Aires. Several commentators following Chisari et al. (2001) have been concerned that this effectively disenfranchised distribution companies and their customers in Buenos Aires. A distribution company was a beneficiary of a proposed new line to the extent that an increase in its consumption, matched by a corresponding reduction in consumption at the reference node, would increase the flow on that line. So if the distribution company was in the reference node itself, it could not be a beneficiary. Hence it had no vote in the Public Contest method and its views and those of its consumers did not count.

The transmission privatisation team was aware of this issue. Their thinking in 1993, when they came to flesh out the general rules laid down in the general framework of 1991, was as follows.[49]

1) In 1991 it had been decided to use Ezeiza substation (the main 500 kV node near Buenos Aires) as the reference node for calculating system marginal price.[50] There needed to be a good reason to choose a node other than Ezeiza for calculations using the Area of Influence method in applying the Public Contest method. No other node was an obviously better candidate.
2) The main investment decisions for the foreseeable future would not be *whether or when* to build new generation to meet increasing demand in Buenos Aires, but rather *where* to build it.

[48] The arrangements for expansion also reduced transactions costs in other ways. For example, the rules for Contract Between Parties, Minor Expansions and private use (Article 31) enabled nearly 200 such expansions worth about $300m to go ahead with minimal restrictions between 1994 and 2004 (see Littlechild and Skerk 2008-this issue-c). Similarly, the provision that 30% of the votes were needed to block a Public Contest project (rather than 70% required to approve it) meant that parties who were relatively indifferent to an expansion were not required to vote to support it. (See Gómez-Ibáñez, 2003, p. 314.) Parties with relatively minor interests at stake could not overrule a project that was in the substantial interest of the majority.

[49] R Sanz, personal communication, April 2004.

[50] The National Load Dispatch Centre (DNC), forerunner of CAMMESA until September 1992, had used Ezeiza as the load centre of the system in calculating marginal costs. Resolution SEE 61/1992, which derogated then extended and improved the initial market regulations in SEE 38/ 1991, provided more detailed rules and prepared the market for private participation. It explicitly set Ezeiza 500 kV substation as the Market Node. The Buenos Aires area (including the province) accounted for over 50% of national demand.

Specifically the main choice was whether to generate electricity in Comahue and transport it to Buenos Aires or whether to transport gas from Comahue to Buenos Aires and generate electricity there. This had two implications.

- First, if new generation would be built anyway, consumers in Buenos Aires would be broadly indifferent as to where the generation was located and whether a new transmission line was built. Location would be a matter for generators. So the ability of consumers and distribution companies to vote in this matter was not crucial.
- Second, there was no provision for electricity distribution companies to contribute explicitly to the cost of building gas pipelines to Buenos Aires to be used to generate electricity there. Would it then be sensible to make them contribute explicitly to the cost of building electricity transmission lines for electricity generated in Comahue? It was important not to distort the main investment decisions involving electricity and gas.[51]

3) A consideration was which parties could take investment decisions quickly. The private generators could do so, and indeed their management had done so historically as part of the former integrated generation and transmission companies AyE and Hidronor. In contrast, distribution companies did not previously have a role in the decision process on transmission. They were not all privatised, and were subject to regulatory limitations and delays. If, to overcome this, a distribution company were to be allowed to transfer the additional cost of this transmission investment to customers, then a regulatory approval process would have to be specified in the market rules. This might take time to implement.
4) Distribution companies were in any case imperfect representatives of electricity customers. They were effectively part of the regulated or "planned" sector of the electricity industry, whereas generation companies were part of the market sector. Deliberately to provide a larger role for distribution companies meant reducing or compromising the extension of the market sector to transmission expansion.

In light of these considerations, there did not seem a sufficiently strong reason in 1992 either to try to develop another decision-making model that did not involve a reference node, or to require the Area of Influence method to use a reference node other than Ezeiza near Buenos Aires. As with the specification of the Area of Influence method itself, this was partly a matter of convenience: the ability to use or apply an existing method. But it was more than that. There was an aversion to introducing unnecessary subjectivity into the decision-making process: to give a higher vote to Buenos Aires distribution companies and customers would mean arbitrarily giving a lower vote to companies and customers at some other node. It could lead to the votes being determined or negotiated during the process itself, which would be subject to political pressures. Moreover, the lack of a vote for Buenos Aires distribution companies was unlikely to be problematic in the specific circumstances under which the method would operate. The more important economic need was to ensure that generation companies made a sensible decision about where to locate new generation plant.

[51] It is arguable that, in a fully adjusted competitive market, consumers in Buenos Aires would pay the full cost of electricity generation wherever generated, since the gas and electricity prices would adequately reflect the costs involved. On this view, if the electricity distribution companies did not contribute explicitly to the cost of the transmission expansion, consumers would pay for it via the bid price of the generators. Various restrictions in the Argentine arrangements, and the lack of initial adjustment, meant that prices were not fully cost-reflective in this way.

The transmission privatisation team was conscious that the rules they developed might not be suitable for all future circumstances. However, they also knew that, if appropriate, it would be possible to revise the rules in the light of experience, and to meet changing circumstances.[52] They were designing rules to meet the main issues then obtaining, and for the then-foreseeable future, within the context of a flexible framework that allowed revision as and when proved necessary.

12. Conclusions

The Public Contest method for transmission expansion was arguably the most novel and radical aspect of electricity reform in Argentina. It was designed to solve a simple problem. Transmission performance under the previous state-owned system had been unacceptable, especially in terms of excessive expansion and excessive costs. Regulation had also been inadequate. It was feared that the conventional approach to transmission regulation would be equally vulnerable in future. The solution was not to specify or strengthen the roles of regulation or the transmission company, but instead to reduce these roles to the minimum. Instead, arrangements would rely on market mechanisms and incentives. Since market participants would have to pay for transmission expansions, they would have an incentive to propose those projects, and only those projects, that would be economically worthwhile to implement. Then the chosen projects would be put out to competitive tender.

The arrangements were designed by power engineers rather than by economists. Some have suggested that they paid insufficient heed to important economic considerations, such as the costs and benefits to all those affected by potential expansions. However, the arrangements were designed to be workable in practice. This was not just a matter of adopting and adapting existing and convenient models of system operation. The designers sought to achieve the same economic ends – more efficient resource allocation according to the judgements and preferences of market participants – by a more reliable route than conventional regulation. Their method relied less on subjective judgements and was less vulnerable to political pressures. Early reactions of some economists were that the transmission arrangements had failed to work in Argentina, or had delayed much-needed investments. Later research suggests that, on the contrary, the arrangements worked rather well, in terms of achieving their intended goals.[53]

The Argentine approach to transmission expansion was designed to deal with problems that are likely to be widespread internationally. Abdala (2008-this issue-a,b) suggests that these include problems of governance in weak institutional systems. The Public Contest method therefore deserves consideration elsewhere as an alternative to conventional utility regulation that may be vulnerable to such problems. It also has merit even where governance and institutional systems are not particularly problematic. It is a means of giving a greater role to market participants and thereby achieving a pattern of investment more suited to their needs than regulation could identify and deliver.

[52] For example, the team was aware that the Area of Influence method was likely to work better with the predominantly radial grid in Argentina than with a more meshed network obtaining in some other countries. They also recognised that, with recent and prospective lines increasing the meshed nature of the Argentine grid, in due course it would be important to consider whether the Area of Influence method needed to be changed. But that was a topic that could more sensibly be left to a later time. In the event, Buenos Aires province did not find it necessary to change the method when applying the approach to its more meshed sub-transmission system. (See Littlechild and Ponzano, 2008-this issue).

[53] See Littlechild and Skerk (2008-this issue-a), Galetovic and Inostroza (2008-this issue).

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