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Transmission Investment in Competitive Power Systems Decentralizing decisions in Argentina

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Recent power outages in Argentina are largely the result of transmission problems that could be solved by more investment. Private concessionaires now operate the main and regional networks, but they are under no obligation to expand capacity. In a decentralized electricity market such as Argentina's the key to a successful transmission investment policy is coordination among the parties involved. Without coordination, an investment project in one site might affect or even disrupt power flow in another. But user coalitions are difficult to set up because of high transaction costs (mainly informational) and, in the Argentine system, because investment mechanisms do not provide a clear allocation of property rights to private investors. Investment decisionmaking for capacity expansion is centralized, but prolonged congestion indicates that the process is not working efficiently. Argentina is searching for a decentralized solution. This Note outlines the options for its high-voltage network and proposes a solution for the regional grids.

The unbundling and privatization of Argentina's power sector in 1992 has been a success. Six years after the reform wholesale prices had been more than halved (from about US\$50 per megawatt-hour) and output had increased by 52 percent. Retail prices have also fallen, and service quality has improved. Transmission has shown explosive growth: medium- and high-voltage lines increased 42 percent in length in 1991–97.

But there is growing concern about the efficiency and fairness of transmission investment rules: in some regions lack of transmission investments has led to outages and thus to reliability problems. More than 90 percent of power outages in the system have their origins in transmission problems that could be substantially avoided with increased investment.

The design of a regulatory framework for transmission is challenging. Transmission is an essential facility and whoever controls it can exercise a lot of market power. Reliability is key to the operating efficiency of a transmission network.¹ Regulation of transmission must induce optimal management of existing assets and optimal investments in generation and transmission. In countries that have established competition in bulk and retail markets, transmission regulation policies are aimed at:

- Guaranteeing open access to the network.
- Ensuring fair and efficient pricing.
- Protecting ownership rights to transmission assets (for both incumbents and newcomers).
- Establishing network use protocols and coordination and compensation mechanisms.



There are tensions between these objectives. No one should use a network facility without contributing to its financing. Thus property rights are crucial to internalize network users' effects on each other and to avoid free-riding problems. A first problem here is to reconcile existing ownership rights with the open access rule. Other challenges relate to the way transmission rights are administered: Should rights reflect differences in nodal prices (congestion pricing)? Should they be issued in the form of physical rights or as financial rights? And should they be dealt with through an exchange market? Setting up transmission rights may not even be cost-effective if competition is limited or if the rights are too hard to administer.

Who owns the grid and issues transmission rights also raises issues. Should investment be carried out by grid users or grid operators, and what are the implications of who pays what to whom? In the United Kingdom Gridco, the grid operator, has the monopoly on ownership and investment. In New Zealand network users or coalitions of users make investment decisions with minimal regulatory supervision. This is one of the alternatives under study for Argentina, where new entrants can construct, operate, and maintain new transmission facilities.

This Note looks at the issues in Argentina, where decisionmaking on transmission investments is centralized and projects must be approved by a federal agency. Underlying Argentina's search for better rules for investment is a belief that more decentralized mechanisms would lead to more efficient outcomes. The Note briefly describes current rules for transmission invest-



ment, discusses the experience so far, presents the alternative mechanisms under consideration, and proposes a solution to the remaining challenge: devising an efficient decisionmaking mechanism for the regional meshed grids.

How transmission is regulated in Argentina today

In Argentina a private, nonprofit company, Compañía Administradora del Mercado Mayorista Eléctrico SA (CAMMESA), is in charge of generation dispatch, power flows, and administration of wholesale transactions. The main high-voltage national network is operated under concession by a regulated private monopoly, Transener SA, in an unbundled electricity market where generation is very competitive. Six other private transmission companies hold concession rights to operate

and maintain high-voltage lines in regional areas. The regulation of transmission is rooted in five principles:

- Monopoly rights to operate the existing network.
- A prohibition on selling or buying energy.
- Open access by buyers and sellers.
- Periodic competition for the concession rights.²
- Incentive-based regulation of prices and quality.

Pricing

Argentina has put in place a system of locational electricity pricing. The price of power in each network node consists of four main elements: marginal generation costs, resistive line losses, congestion costs (these are administered costs; they are not calculated in real time or even

updated very often), and a reliability component.

Nodal prices vary with losses and, above all, when transmission constraints occur. When the capacity of a line is exceeded, the generation dispatch is altered, local prices change, and congestion charges thus appear as the differential in nodal price increases. These charges do not accrue to the grid companies, as they would create a perverse incentive to allow congestion. Instead, the charges are centrally administered and collected by CAMMESA for financing transmission investments. In aggregate, they bear no relationship to the costs of new investments and are frequently lower, so that other sources of revenue are required to meet investment costs.

Transmission companies face no obligation to expand capacity. Their pricing regime is a hybrid, with elements of price caps, revenue caps, and incentive clauses. Their main source of revenue is a fixed annual charge paid by network users and set on the basis of the energy losses forecast by CAMMESA and approved by the federal regulatory body, Ente Nacional Regulador de la Electricidad (ENRE). This charge acts as a revenue cap for a five-year period.³ Other revenue comes from connection charges (which are capped) and bonuses for high reliability (administratively determined) less penalties for lack of availability, the main source of risk in transmission.

Investment regulation

Capacity expansion in transmission requires prior authorization by ENRE, which evaluates proposed projects on economic efficiency crite-

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ria. Current law allows two ways of financing the construction of new lines:

- Private contracts among interested parties.
- Build, operate, and maintain (BOM) contracts.

The private contract mechanism is the most practical for lines that connect single users (or small coalitions of users) to a point on the grid. The mechanism is straightforward: interested parties finance the construction of the facility and operate it under the same price and incentive regulations imposed on Transener.

For large investments—such as one shared by several users—BOM contracts are more appropriate. They provide for a split-savings device, may be financed partly by accumulated congestion charges, and go through a four-step hearing and bidding process.

First, a group of parties (generators, distributors, or industrial users) interested in constructing a new line files an application with ENRE outlining the details of a BOM contract, including a description of the project, the annual levy needed to finance the venture, and the amortization period.

Second, ENRE evaluates the proposal and verifies that the net present value of the system's total investment, operation, and maintenance costs is less with the project than without it.

Third, using a standard methodology, CAMMESA identifies the beneficiaries of the project. The criterion is based on a physical concept: a network user is considered a beneficiary if it is located on a node where electricity flows will change as a

result of the new project. Beneficiaries will be liable for paying the levy that finances the project, though they can contest this liability through a public hearing. A veto of the project must have the support of beneficiaries representing at least 30 percent of the pool.

Fourth, if no veto stands, ENRE tenders the proposed BOM in a public bid, awarding the project to the bid with the lowest levy. If there are no competing bids, the project goes to the BOM contract proposed in the initial application.

The experience so far

While private contracts have been widely used for relatively small investments, BOM initiatives have been limited to two in five years.

The first initiative was proposed in February 1995 to upgrade conductor size on a line between the Comahue and Buenos Aires regions. It was expeditiously approved, but only because the project was entirely financed through the allocation of congestion charges.

The second initiative, also proposed in February 1995, was to construct a 1,000-megawatt line between Comahue and Buenos Aires (Comahue's fourth line) at a cost of about US\$200 million. The main beneficiaries were seven generators from the Comahue region suffering from reduced generation load and low local prices as a result of transmission constraints. Accumulated congestion charges could finance only a small part of the investment. The initiative was presented by five generators from Comahue but vetoed by



beneficiaries that disagreed with the allocation of costs. These represented more than 30 percent of the pool, thanks to the two Comahue generators that did not join the initiative, so the veto stood.

The rejection led to informal negotiations among the Comahue generators, which eventually reformulated the project and presented a new initiative in September 1996. In the second hearing complaints again arose about the way CAMMESA allocated investment costs, but this time the veto did not stand. The project was approved, and those that considered their share of the costs unfair were not compensated.

Lessons learned

Prolonged congestion in power transmission in Argentina indicates that the BOM and private contract procedures can lead to nonoptimal investment:

- The private contract procedure grants no property rights, and the resulting threat of free riding deters investment—as does the ineligibility for funding from congestion charges.
- The BOM procedure relies on an administrative rule for its most sensitive aspect, the allocation of costs among potential beneficiaries. That rule has conceptual flaws, and the veto safeguards are insufficient to prevent unfair and inefficient outcomes.
- The BOM procedure partially avoids free riding, since the allocation of costs may vary over time according to flows on the new line. But it fails to eliminate free riding for the same reason: physical flows are an imperfect measure of benefits because benefits have price and quality dimensions.

- Congestion charges are handled through administrative rules, not market decisions. The current rules are clear and simple, allowing little room for discretion. But congestion rents are collected by regions (or electric corridors), and it is unclear how the centrally administered funds would be allocated if more than one project becomes eligible for accumulated congestion rents. The allocation could be inconsistent with private investment incentives.

Alternatives under study

Policymakers in Argentina are considering three alternative investment mechanisms, all of which involve granting some form of financial (not physical) ownership rights: transmission capacity rights (TCRs) based on incremental capacity, transmission rights (TRs) based on bilateral power flows (Bastos 1998), and transmission congestion contracts (TCCs) based on postinvestment congestion charges (Anderson and others 1998).

Transmission capacity rights

Under the TCR mechanism the potential beneficiaries of a capacity expansion project would buy financial instruments (TCRs) in a public auction by submitting bids offering a price per kilowatt of the incremental capacity. These instruments would confer a form of ownership rights on their buyers that could be exercised directly or leased to another potential user of the incremental capacity.

The appeal of this mechanism is that the beneficiaries that finance the expansion would reveal their true preferences in the auction. In addition,

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the mechanism would eliminate free riding, since every user of the new facility would be required to hold TCRs equal to the power capacity it demanded. But this feature is effective only in a radial network, where flows typically go in one direction and the capacity utilization of any user is easy to measure. In a meshed network, where it is sometimes difficult to determine exactly the capacity used, users have little incentive to buy the socially optimal amount of TCRs in the auction.

Transmission rights

In the TR approach rights would be allocated on the basis of bilateral power flows in transmission lines; thus this approach is based on actual power flows, while the TCR approach relies on actual use of the incremental capacity of the transmission facility. Under both approaches the loop flows could prevent holders of rights from exercising them. That would affect the price of each right and thus the likelihood that the investment project would be carried out.

Transmission congestion contracts

A TCC from node A to node B would give a user the right to collect the congestion charges associated with the transmission of an energy flow from A to B. Those that congest the line without having paid for it would generate congestion rents that would accrue to TCC owners, thus sending the right economic signals to investors.

This mechanism shares a problem with the TCR approach—determining the nominal capacity of the newly built transmission line. This is a tricky

business because in a meshed network nominal capacity depends on loop flows, the hour of the day, and other factors. If the authority is unsure about the line's nominal capacity, how many TCCs should it issue?

The most important problem with TCCs is that for some types of transmission constraints, the allocation of congestion rents among flow paths can be cumbersome. Since the amount of congestion rents collected through TCCs would depend on the spot price of electricity, market shocks affecting this price would put at risk the ability of TCCs to recover capital costs. For example, a fall in the cost of generation would cause the spot price to fall and entitle TCC holders to smaller-than-expected congestion rents.

A local coalition approach for regional grids

Any of the three mechanisms could work well in the very high-voltage network of Argentina because the network is radial. But implementing transmission rights would be difficult in regional grids, which are voltage meshed. An alternative approach relies on a regional board to coordinate investment and allocate its costs on the basis of self-imposed rules. Coalitions of future users reveal their preferences through a cost-benefit ratio, which is used to rank and approve projects. The projects would be financed through an escrow fund created by regional network users. The legal status of such projects would be the same as that of current private contracts, except for the role of the board and its eligibility for the proceeds of congestion charges to help finance projects.

While this committee approach does not guarantee optimal investment decisions, it offers several advantages over existing Argentine regulation. It might lead to a better allocation of investment costs because it gives users incentives to reveal their preferences and no centralized agency would meddle in their decisions. Why could this approach better handle the cost allocation in meshed networks? One explanation

relates to the asymmetries of information between users and CAMMESA. No matter how hard this centralized agency tries, it will not have the same information as individual users do about their expected investment returns (with all foreseeable events internalized). A second explanation is that the approach would alleviate the free-riding problem, for two reasons: First, users internalize externalities when they voluntarily agree to undertake a project or when they bid the price they would pay for a project. Second, the board would have the power to provide for compensation among users whenever a new project reduces the expected returns of an existing one approved by the board.

There are also institutional advantages in the regional boards. By delegating some regulatory power to network users, the committee approach would lessen the risks of administrative expropriation and opportunistic behavior by government. Conflict resolution arrangements would probably be determined by the users themselves (with the regulator intervening only as a last resort). These elements would reduce the transaction costs of new transmission investments.

Conclusion

Alternative procedures for transmission investments are under study not only in Argentina but also in other countries that have deregulated their power sectors, including Bolivia, Chile, Colombia, Peru, New Zealand, the United States, and Victoria (Australia). One way of establishing property rights is to issue financial transmission rights over new lines. Transmission rights as described here can be made compatible with open access and efficient dispatch, but there are still shortcomings in their capacity to prevent free riding in meshed networks or where competition in the product market is limited. Their complexity is also a liability, though not an insurmountable one.

The regional board mechanism offers a different direction for policymaking, creating a forum for agents to discuss potential projects. There is no

hard evidence that this mechanism would lead to optimal investment decisions. But it offers a solution to the investment cost allocation problem under existing regulation in Argentina—it would generate incentives for agents to join together in a group that promotes coordinated decisions, and thus alleviate free riding. The mechanism has two clear advantages: it is highly decentralized, minimizing the scope for regulatory discretion, and it is simple, requiring no ex post calculations of power flows or nominal capacity.

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- ¹ Other needs in transmission include minimizing distances between generation and demand sites, controlling load patterns, supplying emergency and security responses, coordinating maintenance, and managing operating reserves. All these should be seen as services provided by the transmission company. The main difficulty, for both the firm and the regulator, lies in pricing these services, as costing them out is arduous.
- ² Concessions last ninety-five years, but after the first period, which lasts fifteen years, the government calls a public tender for the sale of the controlling share package at the end of each ten-year period. The incumbent has a slight advantage in this tender, since all competing bids are compared with the incumbent's statement of company value (submitted in a sealed envelope before the bidding). If no offer exceeds the incumbent's reference value, the concession rights do not change hands. But if offers do exceed that threshold, the group offering the highest bid acquires the rights by paying the incumbent the bid price. The periodic competition gives the incumbent the incentive to preserve the value of the assets under concession, dampening the traditional negative effect of franchising contracts with asset reversion clauses.
- ³ Structural changes in nodal prices are reflected in the revenue cap every five years, in the tariff review.

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