

The Regional Electricity Market in Central America

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Background

Purpose

International interconnections in Central America started in 1976, when Honduras and Nicaragua connected through a 230 kV line. In 1982, Costa Rica and Nicaragua did the same, and so did Costa Rica and Panama in 1986, along with El Salvador and Guatemala. Before 2002, there were two subsystems: one of El Salvador and Guatemala in the North, and one from Honduras to Panama in the South. These physical interconnections proved to be very useful for mutual support during emergencies and to exchange the excess of hydroelectric energy.

However, no more than 50 MW could be exchanged in a sustained way, because the national systems could not endure the sudden loss of a larger power in the event of an accidental disconnection of the single interconnection, which would leave an energy deficit hard to fill and possibly lead to national blackouts. It was desirable to have a second, high capacity transmission line, which by means of adding redundancy would allow for some level of uninterruptible transactions. The possibility of having these uninterruptible transactions would justify the installation of new, larger generating plants, too large for a single national system, but adequate to serve the regional demand.

To create this new regional transmission line and a regional market, the six Central American countries, with aid from Spain and international banks, started the SIEPAC project (the letters stand for Electrical Interconnection System for the Central American Countries). The final purpose of SIEPAC is to improve the economic efficiency of electricity supply, through the creation of a competitive market sizeable enough to take advantage from the

economies of scale. This is especially relevant in Central America, where the small national power systems do not allow the countries to enjoy economies of scale and atomized markets.

Origin

The legal framework for the Central American Regional Electrical Market (MER for its name in Spanish) was laid out in the SIEPAC electrical interconnection treaty signed in 1996 by the presidents of the six Central American countries: Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama. In 2000, these countries together encompassed a population of 36 million people in a total area of 500,000 km², an installed capacity of 7.1 GW, and an annual generation of 27 TWh. Their maximum demand, which was 4.5 GW in 1999, is expected to reach 6.4 GW by 2005, at which time their annual generation should be in the vicinity of 35 TWh.

The market came to life only six years after the treaty was signed, when the transmission line between El Salvador and Honduras was closed in mid 2002, connecting the North and South subsystems. As of today, two of these countries have government-owned utilities: Costa Rica and Honduras, while the remaining four have competitive markets.

The detailed design of the market and its regulations had an estimated cost of \$16.4M. This cost was financed with a \$9.9M loan from the Inter American Development Bank (IDB), a \$5.0M donation of the same institution, and a \$1.5M contribution from the regional power systems.

Present stage

Although it has been operating for almost two years now, the market has not reached its permanent state yet. Since its start in mid 2002, it has been operating in what is called a “*temporary stage*”. This stage was scheduled to end in 2004. However, delays in the installation of a regional SCADA system (a remote measurement and control system) and in

the discussions of the final rules (especially the transmission rules) have moved the end of the temporary stage to at least late 2005.

Experience so far

According to the Panamanian Market Operator, the regional market has been operating rather smoothly during the last two years. Maybe the most relevant criticism so far is that the regional regulator has not been resolving some issues fast enough. For example, a pending modification to the temporary rules has been waiting for a solution from CRIE for 8 months, with no final decision so far.

Some Panamanian local distribution companies (LDCs), which purchase part of their energy in the spot market, have complaint that spot prices have risen as a result of the roll of Panama as an exporter in the regional market. However, this complain is tempered by the fact that the exposure of the LDCs to the spot prices is voluntary, since they are allowed by law to hedge all their energy purchases through long term contracts.

Future

Although the treaty allows other American countries to join the market, no other country is expected to join this market in the next eight years as a minimum. In the future, interconnections with Mexico in the north and Colombia in the south, could couple the Central American grid with North America and South America.

Governance

Regional Regulator

The regional system regulator is called CRIE. It is composed by one representative from each country. It is located in Costa Rica. This location was selected in a public bid, open to all six member countries. Its purpose is to develop the regional rules, modify them when required, and solve any dispute related to the regional system that cannot be solved at a

lower level. Since the CRIE is responsible for authorizing the transmission rules, it is also the institution that determines the expansion of the transmission system for the regional market.

Regional Market Operator

The regional market operator is called EOR. It is composed by two representatives from each country. During the temporary stage, a branch of this institution, called OMCA, is in charge of the operation of the regional market. OMCA is scheduled to disappear at the end of the temporary stage, at which time EOR will be in charge of all market operation.

OMCA is located in El Salvador. This location was selected in a public bid, open to the six member countries. Although OMCA is operated by the system and market operator (S&MO) of El Salvador, the location of OMCA creates no bias over its decisions.

Regional System Operator

Currently, there is no regional system operator (SO). Each national SO is in charge of the operation of its own system. The regional rules require that the national SOs operate their systems following both the national and the regional rules, and in close coordination with EOR. In the temporary stage, the EOR is a regional coordinator, but not a regional operator.

It is expected that in the permanent state, the EOR will have some operative control over the regional system, but still fall short of being a regional system operator. In the permanent state, the EOR will have real time supervision of the regional network and will be able to intervene at any time to request special operations from the national SOs.

Regional Rules

There are three groups of regional rules: 1) The Operative Rules, which regulate the technical and market operation of the regional system. 2) The Transmission Rules, which regulate the quality, expansion and rates of the regional transmission. 3) The Internal Rules for the CRIE and EOR.

The discussion of the Transmission Rules has proven to be difficult. There is still no consensus on how the transmission rates will be defined in the final state.

For the technical and market operation of the system during the temporary stage, a set of temporary regional Operative Rules is being used. The temporary Operative Rules will be replaced by the final Operative Rules when the market enters the permanent state (possibly by late 2005). The final Operative Rules are currently under discussion. They are expected to be similar to the temporary Operative Rules to a large extent, being one of the main differences that in the permanent state the EOR will have real time supervision of the regional system and will be able to request special operations from the national SOs.

When the temporary regional Operative Rules were approved, significant changes had to be made in the national regulations of the member countries. The purpose of these changes was to harmonize the national rules with the regional rules. Additional changes in the national rules are expected when the final Operative Rules and Transmission Rules are approved in the future.

Regional system operation

Coordination

The national SOs operate their own systems in close coordination with EOR. The SOs are expected to obey both the regional rules of MER and their own national rules. Regional rules mandate that each national SO must share information not only with EOR but also with other SOs when it will perform operations that could affect the regional network.

Stability and Safety Studies

The EOR performs the studies that guarantee the stability of the regional network and the safety of the operations of power exchanges planned for the spot and contracts markets.

It also performs the contingency analyses for the regional system, in anticipation of future perturbations in the regional network.

In order to perform these studies, the EOR will keep an updated database with all the information of the regional system. It is the responsibility of the national SOs to collect this information in their own systems, and to keep it updated, for the EOR.

Analysis of perturbations

For every perturbation (failure of a line, outage of a generating unit, etc.) that affects the regional system, an *ex post* analysis should be performed and a report should be prepared describing, among other things, the causes of the perturbation, the lectures of the measuring instruments, the operation of the protection schemes, the sequence of actions taken, and how to avoid that a similar perturbation occurs again. If the perturbation that affected the regional system occurs inside the network of a single national system, both the report and analysis of this perturbation are performed by the national SO who is in charge of the national system where the perturbation occurred. When there is more than one country involved in a perturbation, each SO prepares its own independent analysis and report. These reports are given to the EOR and all the other SOs. It is the responsibility of each national SO to collect the information related to a perturbation within its own system, and share it with the EOR and the other SOs.

Solidarity

In case of perturbation in a country member of the regional system, the neighboring countries are expected to provide their collaboration in order to stabilize the national system that suffered the perturbation. This cooperation usually comes in the form of energy, frequency control and voltage control, and requires that the neighboring systems remain connected to the system with the problem. The expected solidarity among member countries during emergencies does not prevent a neighboring country from disconnecting its national

network from the network that suffered the emergency if this disconnection is required to protect the equipment and personnel of its own national system.

Regional Ancillary Services

The national S&MOs provide EOR with the information about their system's topology and their capability to provide ancillary services. With this information, every six months EOR calculates the levels of ancillary services that are required in every national system for the safe and stable operation of the regional system.

It is the responsibility of the national S&MOs to keep the ancillary services of their own systems within the levels that EOR calculated. The internal payments and charges to national agents for the ancillary services within a national system with a competitive market are responsibility of the S&MO, and are transparent to EOR. Every month, the S&MO must inform the EOR of the performance of the ancillary services in their systems. A national system can buy ancillary services from another national system, as we discuss later.

Maintenance

A regional maintenance plan is prepared annually, with the collaboration of both EOR and the six national system operators. The national SOs must coordinate with the EOR the scheduling of maintenance operations for any equipment that affect the regional network.

The list of equipment that affects the regional network is not limited to the transmission lines of the international interconnection: it also includes transmission, generation and demand equipment that may be used for ancillary services, and that may be the property of private companies operating inside the national markets. Each national SO serves as an interface to coordinate with both the EOR and the private companies (also called *national agents*) inside its national market the maintenance of private equipment that affects the regional network.

The regional rules authorize the national SOs to perform emergency maintenance operations without previous notification to the EOR if these operations are required for the safety of the national or the regional system. In this case, the SO is expected to communicate to the EOR, as soon as possible after the emergency has been cleared, the details of the emergency and the actions taken.

Regional market operation

Coexistence

The regional market is sometimes referred as a “seventh market” superimposed on top of the markets that exist inside the six countries that compose the regional system. The national markets still exist: they coexist with the regional market, and benefit from it.

Participation

Only the agents that are authorized to trade in the regional market can do so. The list of authorized agents includes: 1) the system operator of the countries that have government-owned utilities, and 2) the national agents (companies) of the competitive markets of the other countries that have passed a simple authorization process.

Authorization process

Every national agent that is enabled to operate in his national market can request from the S&MO of its country the authorization to participate in the regional market. The authorization process is simple. First, the agent should declare under oath that it will abide by all the regional rules. This implies the collaboration of the agent with the national S&MO, by sharing all the information about the agent that the S&MO must provide to the EOR. Secondly, the agent should deposit an amount of money in a bank as guarantee.

Guarantee

The guarantee serves as a fund to cover the transactions the agent will perform in the regional market. It is also a limit for the transactions that the agent can perform in the regional market: in other words, the national market operator (MO) will not allow an agent to engage in regional transactions when its debt associated to past regional transactions in the current month has reached the amount of the guarantee.

Not only the national agents have to deposit the guarantee: also the system operators of the two government-owned utilities that participate in the market must deposit this fund in a bank to cover the amount of their transactions, and can engage in regional transactions up to the amount of the guaranty. In their case, it is the EOR who supervises the fulfillment of this requirement.

Overcoming national differences

The task of coordinating six very different national power systems in a single regional market is not simple. The national differences are overcome by using the national S&MO as interfaces, that is, as points of contact between the regional market and its institutions (EOR and CRIE), and the national systems, including – where applicable – the national agents.

This means that every flow of information between the regional authorities (CRIE, EOR) and the national players has to go through the national S&MO. The S&MOs have the responsibility of collecting the information about their national systems in order to report it to the EOR. The national agents do not report to the EOR: they report to their national S&MOs.

As we discuss in detail later, the national S&MO also serves as intermediary for the trading and billing of different products in the market: ancillary services, spot and contract energy, and transmission services. For example, each S&MO presents the spot offers of demand and generation of its country to the regional market. The S&MO is also the

responsible for any regional contracts that a national agent from its country places with any other agent in another country.

Nodal Prices

A system of national nodal pricing is used. Each point of access to the regional transmission network is considered a node. The price of each node is calculated based on formulas described in the regional rules. They reflect the short-term costs that a spot injection or demand of energy represent to the system. They highlight the restrictions in transmission capacity (congestions). The nodal prices apply to every regional transaction.

Interruptibility

The current topology of the transmission network is not redundant. Failures happen. Currently, both spot and contract energy transactions are interruptible, e.g. they can be interrupted if there is a failure in the transmission line. The new line will double the transmission capacity and add redundancy to the transmission network. With the new line, some transactions will be uninterruptible, because of the redundant transmission capacity. Exactly which transactions will be uninterruptible is not yet defined, for the final Operative Rules have not been approved yet.

Paying for the regional regulation and operation

For every MWh sold in the spot and contracts markets, a fee is paid to cover the expenses of the regional regulation and operation institutions, e.g. CRIE and EOR.

Products of the Regional Market

The main products that are commercialized in the regional market are energy (both through spot offers and contracts), ancillary services and transmission services (capacity). In this section we discuss the first two, while the last one is discussed in the next section.

Spot Energy Market

To avoid that the differences between the national systems (e.g. some are government-owned and some are competitive) affect the regional spot market, the following system is used: Each national MO prepares for the next day an offer for demand and an offer for generation, specifying volumes and prices for each hour. Based on the offers from the six countries, the EOR will allocate the energy offers to the demand offers in order to maximize the revenues of the transactions, within the limits of safe and stable operation, and will notify the national MOs of the results. The real time operation of the national systems is performed by the national SOs; they make sure that the volumes of energy determined by the allocation specified by EOR will flow between the countries.

For those countries with government-owned utilities, the utility itself will determine its offers of demand and generation for the next day.

For those countries with competitive markets, the national MO will accept from the private agents their individual offers for demand and generation for the next day. Based on these individual offers, the national operator prepares the national offer of demand and generation that it will present to the EOR.

At the end of the month, the EOR will pay and charge each S&MO the money for the regional transactions they made in the month. The MO of each competitive market then pays and charges the national agents of its national system.

Spot transactions can be interrupted by the national S&MO. The volume of the transactions is limited by the transmission capacity of each node in the regional network.

Contracts

During the temporary stage, two agents of the market (either a government-owned utility or a national agent) can undersign contracts for regional energy transactions. No

capacity contracts are allowed. All energy contracts are interruptible in case of a severe perturbation in the system.

These contracts must comply with both the regional rules and the national rules of the countries of all parties that undersign the contract. The regional contracts market is the group of contracts for energy import and export signed by national agents authorized to trade regionally. In the regional contracts market, the national agents are represented by their national S&MO. These contracts are also considered part of the national contract markets of these countries.

Involuntary energy flows

The regional rules define the way the involuntary energy flows between countries will be remunerated. The energy flows that result as a consequence of involuntary drift will be paid at the price of the spot energy in those nodes, as if they were spot transactions.

Transactions altered by failures

The differences between the planned and the actual exchanges of energy that result as a consequence of a perturbation in one of the systems will be paid as indicated in the following five points. This way the rules eliminate any perverse incentive to create intentional perturbations for the benefit of a party:

- When the failure is in the exporting system and the actual energy flow was less than the programmed flow, the exporting system must pay an indemnization to the importing system, equal to the substitution price that the importing country incurred to supply by other means the energy that was not supplied by the exporter.
- When the failure is in the exporting system and the actual energy flow was more than the programmed flow, the excess energy will not be compensated.

- When the failure is in the importing system and the actual energy flow was less than the programmed flow, the importing system must pay the amount of the programmed flow.
- When the failure is in the importing system and the actual energy flow was more than the programmed flow, the importing system must pay the excess energy at the cost of substitution that the exporting system incurred to supply it.
- If the failure originates in a transit country between the importer and the exporter countries, then the same concepts illustrated above apply twice to the country, first as an importer and then as an exporter. We must remember that the Central American network is a long sequence of countries, where energy has only one path: there are no multiple paths for the energy to flow from one country to the other.

Ancillary Services

Ancillary services are one of the products of the regional market. If a national system lacks the capacity to supply the ancillary services for its own system, the S&MO of that country can buy these ancillary services from another country in the regional system. In this case, the ancillary services will be paid at a price equivalent to the cost that this service would represent for the lacking country had this country installed the equipment to satisfy its own requirement for ancillary services.

Financing and Recovering Transmission Expenses

Financing the current international interconnections

Before there was a regional market, most Central American countries had interconnected with their next-door neighbors. Different sources were used by different countries to finance the transmission lines, substations and other equipment required for these interconnections.

Some countries financed these investments with the capital of their own national utility. This is the case of Panama, who financed the interconnection with Costa Rica in 1986 using capital of the government-owned utility (the Panamanian system became a competitive market when it was privatized later in 1998).

Other countries used international loans to finance the interconnections. This is the case of El Salvador and Honduras. The 2002 interconnection between El Salvador and Honduras, the missing link that would connect the North and South subsystems, was financed through a loan of an international bank. This loan will later be paid with the transmission charges on the energy transactions that flow through this line, as we explain later in this section.

Financing the new regional transmission line

The new regional transmission line, with a capacity of 300 MW, double circuit, 230 KV, built parallel to the current line, should be finished by late 2006. This new line almost doubles the current transmission capacity, providing additional stability to the regional network and allowing uninterruptedness to some regional transactions.

The line will have a total length of 1,830 km. The line has different lengths in different countries: it will have 282 km in Guatemala, 282 km in El Salvador, 369 km in Honduras, 294 km in Nicaragua, 462 km in Costa Rica, and 140 km in Panama.

In 1999 a new company, called EPL, was created to build, operate and maintain the new transmission line. EPL is owned by seven partners: the six national transmission companies of the member countries and a Spanish company called ENDESA. Notwithstanding the different lengths of the line in the different countries, each of the seven partners will have equal participation in EPL. No partner is allowed to own more than 15% of EPL.

The new line has a total cost of \$320M, which will be financed as follows: \$170M (53%) from a loan of IDB, \$70M (22%) from a loan of IDB Spain, \$40M (12.5%) from a loan of BEI (an European bank), and \$40M (12.5%) from capital contributions of the six Central

American countries. Consistently with the equal-ownership principle, the capital contributed to the line by each country is equal. The loans required guarantees from the six governments, which are of equal amounts. These loans will be paid with the transmission charges on the energy transactions that flow through this line, as we explain later in this section.

EPL will be remunerated for its services through annual payments. Since transmission is a regulated activity in the regional market, EPL's profits are limited contractually. The transmission rates will be fixed by the regional regulator, CRIE. The payments for EPL will be collected by EOR from the six national S&MO. Those S&MOs from countries with competitive markets will collect the transmission payments for EPL from the national agents of their respective countries.

Recovering transmission expenses in the temporary stage

As we mentioned before, the regional market uses a system of nodal prices. These nodal prices play an important role in the payment of transmission charges.

Every energy transaction, either spot or contract, pays a transmission charge, which is equal to the price difference between the destination and origin nodes of the transaction, times the amount of energy traded.

Spot energy transactions pay the transmission charge "implicitly," because the consumer pays the energy at the price of the receiving node, while the generator is paid at the price of the origin node. The difference is the transmission charge, which is distributed by EOR, through the S&MOs, among the transmission systems involved in the transaction, as origin, transit or destination systems.

Contract energy transactions pay the transmission charge "explicitly," because contract prices are agreed upon beforehand, when nodal prices are still unknown. When a contract is signed, the parties involved specify which party will pay for the transmission charges. The

transmission charges are then paid by this party to the EOR, which later distributes them among the transmission systems involved in the transaction, as origin, transit or destination systems. The amount paid as transmission charge is exactly the price difference between the spot prices of the destination and origin nodes times the energy traded.

In countries with competitive markets, the EOR will pay the transmission charges collected to the S&MO, which will in turn pay the transmission company (generally only one per country) for the transmission service. In countries with government-owned utilities, the EOR will pay the transmission charges collected to the utility for the transmission service.

These payments cover both the variable and fixed costs of transmission. The variable costs are the transmission losses of energy. The fixed costs are the transmission investments made by the transmission companies or the utilities. From these payments, the companies can pay the loans they received for transmission.

The EOR divides the money received from transmission charges on regional transactions as follows:

- The transmission charges paid to EOR in base of the price difference between the two nodes, both of which are inside the same country, are transferred by EOR to the S&MO of that country.
- The transmission charges paid to EOR in base of the price difference between the two nodes, each one in a different country, are divided by EOR between the two S&MO of these two countries. The division is proportional to the distance that separates each node to the frontier between the countries.

Final Transmission Rules

There is still no consensus on how the transmission rates will be defined in the permanent state. The final Transmission Rules are currently undergoing discussion, and have proven to be a thorny topic. The future expansion of the transmission network for the regional market is determined in the transmission rules.

Since the profit of EPL (the owner of the regional line) is limited by regulation, but its revenues are determined by congestion, one of the difficult issues that the transmission rules must address is how to manage the excess of revenue that cannot be passed as profit to the EPL, in a way that promotes the development of additional transmission lines in the future.

We have no information on the final form of these rules.