Exploring Market-Based Options for a Reformed Brazilian Electricity Sector

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Chapter 1: INTRODUCTION

1.1 In April 1995, the National Council for Privatization of State Enterprises (Conselho Nacional de Desestatização or CND) appointed a Special Inter-Ministerial Reform Committee to define a reform strategy for the electricity sector.1 In September 1995, the Committee issued a report reflecting its members' substantial agreement on the basic principles that need to be met by the reform. The main aim of the reform proposal is to improve the efficiency of the sector through competition and increased private sector participation in the sector. By early October 1995, the report had already been endorsed by the Government. The Ministry of Mines and Energy (MME) is now working on the definition and implementation of the new sector structure and regulatory framework while the Banco Nacional de Desenvolvimento Econômico-Social (BNDES) is formulating privatization options based on the premises established by the restructuring study. Within a year, Brazil is expected to have spelled out the features of its vision for the electricity sector.

1.2 The incentive to reform. Both the sense of urgency and the consensus for the reform stems from the increasing pressure of the two most serious problems affecting Brazil's electricity sector:

- high operational costs, particularly those related to labor productivity and efficiency;
- large investment needs with few public resources to meet these requirements.

1.3 Operational costs are high because the financial management of the sector has not kept up with the changing needs and capabilities of the country. Some emphasize that this is due to macroeconomic controls on tariffs, but many recognize that operational costs have often been much higher than the standards for efficient uses of resources within the sector and higher than what would be required under a commercially oriented sector. Moreover, the negative consequences of these financial problems have been aggravated by fiscal problems. The public sector can no longer finance the investment requirements of the electricity sector (averaging more than US$6 billion annually over the next five years) and the opportunity cost of public revenue has been increasing in terms of investments in other important sectors such as education and health. Coupled with the fast-growing electricity demand, supply bottlenecks will likely occur unless alternative financing sources are found to meet the considerable investment requirements of the sector.

1.4 The general direction of reform. The need to solve the problems of high operational costs and unmet financing needs simultaneously is shaping the direction of reform. Thus, there is close attention being paid to competition and increased private sector involvement.

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1 The CND comprises officials from the Ministers of Mines and Energy, Planning and Budget, Finance, the Executive Office of the Presidency and BNDES.
Cost minimization is one of the main payoffs derived from the introduction of competition in the sector, and with the sector’s operating costs conservatively estimated to be 20-to-30 percent too high on average, giving operators explicit incentives to cut costs would assist the Government by reducing the need for politically costly increases in tariffs.

1.5 The second problem mirrors the limited capacity of the public sector to “fund everything everywhere”. As revealed by the experience of Argentina, Chile, Mexico and many East Asian countries, there is a lot of potential for private investors to displace at least some of the sector financing provided by the Government if the regulatory cards are played right. Opening the sector to private participation and introducing competition under transparent and equitable operating and pricing rules should provide all actors with the appropriate incentives to cut operating costs and generate additional financing resources to finance investment needs in the sector.

1.6 The main reform proposals. The Reform Committee has identified four broad options individually put forward by the Office of the Energy Secretary, the National Department of Water and Electricity (DNAEE), Centrais Elétricas Brasileiras S.A. (Eletrobrás, the main national utility) and BNDES. Essentially, all four entities propose that the reform should transform the sector—dominated by large, federally-owned, vertically-integrated public monopolies but with a significant share of the distribution function under concession to state-owned companies (some of in the sector to resolve both problems, which also own generating assets)—into a vertically disintegrated (unbundled) sector featuring competitive generation and a competitive supply market2; a single public transmission company; and privatized distribution enterprises. The intended outcome anticipates that:

- potentially competitive segments of the sector (i.e., generation and supply) will be separated from the natural monopoly segments (transmission and distribution) and awarded as concessions or sold to private investors, hence reducing the public share of the financing requirements in the sector;
- pricing will be more transparent, reflect opportunity costs, and remove or reduce cross-subsidies;
- regulation will minimize the risk of abuses from the natural monopoly segments of the sector and efficiency gains from competition in supply and generation will be passed through to consumers; and
- in transmission activities, economies of scale will be possible but regulation will have to minimize the risk of abuse possible.

1.7 The proposed changes reflect anticipated reassignments of functions, responsibilities and property rights. They will entail changes in institutions (generally via creation, but in some cases via

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2 Following the British terminology, electricity "supply" involves the purchase of bulk power either for resale at the retail level or for direct use in the case of large, deregulated consumers.
consolidation, adaptation or elimination). These changes will need to recognize, but not be determined by, the constraints imposed by the physical and technical characteristics of the system. The reform plans do not target changes in the physical system inasmuch as they seek to provide incentives to various actors in the sector that will achieve greater efficiency in all areas and attract new sources of financing to the sector. The main challenges to implementing the selected reform plan will be institutional in nature, derived from the inertia born of the reasonable (operational) success of the Brazilian electricity sector over the course of many years. There is strong evidence that after some initial difficulties, the government is managing to meet that challenge. Since the Constitutional changes that lead the approval a the concession law, Brasil has already privatized two companies, Escelsa and Light and is working towards the privatization of Eletrobras. Moreover, the states are following the federal lead and 15 states have announced their intention to privatize their state electricity companies. For instance, as of June 1996, Sao Paulo announced its own privatization programs. Rio de Janeiro is trying to privatize CERJ, Bahia has already approved the privatization of COELBA.

1.8 Purpose of the paper. The acceleration in the privatization decisions is making the need for a integrated regulatory framework even more pressing and this is the main topic of this paper. The specific purpose is twofold. First, it reviews the main issues embedded in the options being considered by the Reform Committee and identifies some omissions and inconsistencies in these proposals. Second, it discusses some viable options and configurations for the reformed system. These are premised on the introduction of competition at the generating and supply levels and on appropriate regulation aimed at maximizing potential gains to consumers and limiting the Government’s financial and operational involvement to activities or regions not attractive to the private sector. It is hoped that these ideas will ultimately be helpful in the preparatory work undertaken by consultants to shape the final design and implementation plan of the reform policy.

1.9 Organization of the paper. The paper is organized as follows: Chapter 2 highlights the major issues that the reform program will have to address and summarizes the four proposals discussed in the Reform Committee’s initial report. The issues that have already been discussed by the Reform Committee and resulted in some degree of consensus are synthesized in this chapter as the “Brazilian” model. Chapter 3 explores how market mechanisms could be applied for the Brazil model in each of the sector’s functional areas. Chapter 4, recognizing certain issues that were not yet fully addressed, develops the various potential market scenarios and institutional needs derived from these; Chapter 5 discusses some challenges the government will probably face during the transition to a new sector organization and operating framework. The Annex provides a snapshot of Brazil’s electricity sector as it exists today.
Chapter 2: AN OVERVIEW OF CURRENT REFORM PROPOSALS

2.1 Discussions of alternative reform paths for the Brazilian electricity supply industry (ESI) have been underway for some time. Numerous conferences, books, treatises and papers have been produced relevant to this topic during the past several years. This has resulted in a multiplicity of high quality proposals reflecting the talents of professionals working in the Brazilian electricity sector.

2.2 The initial report of the Reform Committee partially summarizes the key themes of this debate. Table 2.1 presents a comparative view of the main models analyzed in the August 8, 1995 “Management Report” of the Inter-Ministerial Committee on the Privatization of the Eletrobrás System.³

2.3 This chapter focuses on the following three key aspects of the proposals:
   - Areas of agreement or consensus;
   - Areas of debate or contention; and
   - Other issues and omissions.

2.4 The third item is the main focus of this chapter and also of the discussions in Chapters 3 and 4 on important points that have not yet received due attention.

2.5 Areas of consensus. The points that are commonly accepted under all proposals can be categorized into one of two groups. One group provides the basic guidelines for the system, entailing:
   - Competition in generation;
   - Open access to transmission and distribution networks;
   - Competition in supply for large (deregulated) consumers; and
   - A spot market to supplement bulk power supply contracts market.

2.6 These points are central to most electricity sector reform programs around the world and are clearly interrelated. Moreover, there is a consensus among experts on the superiority of using these market mechanisms to achieve efficiency gains in electricity sectors traditionally dominated by vertically integrated state monopolies.

2.7 The issues around which a consensus has formed have already been partially formalized through legal provisions. In brief, efforts to introduce changes to increase competition in generation, open access to transmission, deregulate large consumers, explicitly recognize independent power producers (IPPs) and facilitate transmission transactions over the interconnected systems (via simpler agreements and a “single transmission agent”) had already been included in legislation prior to being adopted by the Inter-Ministerial Committee as the general foundation for

³ There are many other models circulating in Brazil but not explicitly considered here. One put forth by Dias and Rodrigues of the Universidade Federal de Rio de Janeiro (UFRJ) Danilo Souza Dias and Pieres Rodrigues: “Proposta de reforma do Setor Elétrico Brasileiro”, mimeo, Rio, UFRJ is typical and is, generally consistent with most of the proposals considered by the Inter-Ministerial Committee.
<table>
<thead>
<tr>
<th>Proposal</th>
<th>SNE</th>
<th>Electrobras</th>
<th>BNDES Consultant</th>
<th>DNAEE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open competition in Generation</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Open access to Transmission and Distribution</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Structure and Organization of Transmission</td>
<td>Single associative company to be created with the participation of agents under pulverized control.</td>
<td>Transmission company(ies) under federal control for the interconnected electric transmission grid operating agreement with Electrobras. Optional privatization for the rest of the grid.</td>
<td>Transmission entity to be created under operating agreement.</td>
<td>Single, monopolistic company federally controlled with two options: a) transports and markets energy bought from generating companies and sold to consumers, b) transports energy only.</td>
</tr>
<tr>
<td>Administration of Open Access, and of transmission, distribution valuation and Procedural System</td>
<td>Managed in an integral manner by the single transmission company to be created</td>
<td>Administered by SINTERI under an operating agreement to be extended to the entire system, under Electrobras coordination.</td>
<td>Administered by the transmission entity to be created, under an operating agreement.</td>
<td>Managed in an integrated manner by the single transmission company.</td>
</tr>
<tr>
<td>Provides for Central Dispatch, Operation and Planning</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Organization and structuring of Operation &amp; Dispatch</td>
<td>Under the control of the single transmission company to be created</td>
<td>Under federal control, coordinated by Electrobras in conjunction with the transmission company. Preserves GCOI</td>
<td>In a federal company to be created, subordinated to the regulating agency CAME.</td>
<td>Operating committee coordinated by transmission company. Expands GCOI through participation of consumers committee.</td>
</tr>
<tr>
<td>Provides for indicative expansion planning</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Organization and structure of indicative expansion planning</td>
<td>Conducted by &quot;Electrobras Development and Research&quot;</td>
<td>Under federal control, coordinated by Electrobras, and integrated into operation and transmission planning coordination. Preserves GCPS.</td>
<td>Under the control of a federal company to be created, subordinated to the regulating authority - CAME.</td>
<td>Planning committee coordinated by the transmission company for a ten-year period. Expands GCPS through a consumers participation committee.</td>
</tr>
<tr>
<td>Decouples Large Users to let them freely select their suppliers and negotiate the terms of supply</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Provides for spot market sales in bulk power markets to supplement contract sales</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>---</td>
</tr>
<tr>
<td>Settlements</td>
<td>Managed in integrated manner by transmission company to be created.</td>
<td>Managed in integrated manner with centralized operation and dispatch planning, under the coordination of Electrobras via GCOI.</td>
<td>Performed under the control of the federal company to be created - CAME.</td>
<td>---</td>
</tr>
<tr>
<td>Collegiate bodies for expansion &amp; operation</td>
<td>Replaced respectively by &quot;Electrobras Research &amp; Development&quot; and transmission company.</td>
<td>Participation of all companies, under Electrobras coordination. Preserves GCOI and GCPS.</td>
<td>Coordinated by the federal company to be created - CAME.</td>
<td>Coordinated by the single transmission company and enlarged by consumer representation.</td>
</tr>
<tr>
<td>Sector inventory, feasibility &amp; basic design studies</td>
<td>Performed by &quot;Electrobras Research &amp; Development&quot;, and integrated into indicative generation planning</td>
<td>Performed under Electrobras coordination and integrated into the coordination of indicative expansion and generation planning.</td>
<td>Performed by a federal company to be created under coordination of the regulating agency - DESE.</td>
<td>---</td>
</tr>
<tr>
<td>Financing of the Sector and management of RGR</td>
<td>To be determined by government decision.</td>
<td>Integrated into expansion planning and MME governmental policies, under Electrobras coordination.</td>
<td>---</td>
<td>Integrated into ten-year expansion planning for 5 years. To be reviewed after this period.</td>
</tr>
<tr>
<td>Electric power R &amp; D</td>
<td>Coordinated by CEPEL, other research centers and universities. Creation of a specific fund.</td>
<td>Coordinated by Electrobras via CPPP, together with other research centers and universities.</td>
<td>---</td>
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</tr>
</tbody>
</table>

Source: Electricity Reform Committee, Brasilia
reform. Their legislative provisions, however, did not effect the intended changes to date, and thus these topics are now being resuscitated in the context of the current discussions on reform.

2.8 The other group of commonly accepted points revolve around specific centralized activities that are seen as vital for the efficiency of the reformed sector. These include: (i) the central economic dispatch and operation of the system, and (ii) indicative expansion planning. The perceived need for retaining these activities as pivotal functions with the integrated system reflects peculiarities of the Brazilian electric power system, including the vast size of the country; the dominance of hydro not only as a generating source but as the primary energy source for the country; and the rapid pace of electricity demand growth recently experienced and forecasted to continue during the next decade. The incorporation of these important factors in system operations and planning requires a high level of coordination that central dispatch and indicative planning at the system level can very effectively provide.

2.9 Areas of debate/contention. In contrast to the common ground easily found in the basic principles of all of the reform models, the more pragmatic discussion on the application of these principles is much less consensual. The main differences in this area are related to institutional issues. As seen in Table 2.1, entries discussing sector organization, structure or institutions relevant to the different activities encompass a wide range of approaches. The lack of consensus in these areas is expressly noted in the Reform Committee’s initial report.

2.10 Uniformity is not necessarily expected as there are many ways of implementing a single scheme. The multiplicity of options stems in part from the existence of jurisdictional and functional trade-offs for the different organizations involved in formulating the reform policy. These trade-offs have not yet been explicitly spelled out in Brazil despite their pivotal influence over the ultimate direction of reform. Particular preferences of the institutions drafting the proposals have manifested themselves in different "optimal" institutional arrangements. As seen by the variations on institutional arrangements presented in Table 2.1, the two outstanding issues that are vital to the restructuring effort as a whole and that must be settled if the reform is to proceed on schedule are:

- the structure and organization of the interconnected transmission system, and
- the future role of Eletrobrás.

2.11 Regarding the former, the two key options being considered for the organization of the interconnected transmission system are: (i) a single transmission company or (ii) an operational agreement (such as SINTREL). Those who are primarily concerned with factors affecting the interconnected system—including those such as economies of scale and strong externalities over long distances—support a single integrated company arrangement. Those who are concerned primarily with the issue of federal-state arrangements for the split ownership of transmission assets generally favor the "operating agreement" option. There are other options to be considered: for example, that of an
Independent System Operator (ISO), which is presented later in Chapter 4.

2.12 The role of Eletrobrás in the post-reform sector is the other major source of disagreement. In addition to being a majority stockholder in several companies in the sector, the federal entity performs or directs a number of essential sector functions, including the coordination of “real-time” operation and operation planning; the coordination of the system’s expansion planning; sectoral banking activities and R&D. The responsibility for these activities in the post-reform period is a central bone of contention. The two primary options boil down to keeping Eletrobrás, albeit without any involvement in “commercial” activities, as the integrating agency for the sector or creating a new institution for this role. The direction taken on these two issues is so critical to the reform that they are subjected to a much more detailed assessment in Chapter 3.

2.13 Towards a consensus. In an effort to bridge the differences between the various proposals, in September 1995 the Reform Committee organized discussions of the issues under debate. The discussions led to a consensus on what would be used as the main goals guiding all future sector reform efforts, as follows:

- Increasing competition and ensuring transparency in the role of and relations between agents;
- Establishing an independent, stable and unbiased regulatory authority;
- Requiring compliance with financial obligations;
- Unbundling the vertically integrated federal companies and immediately segregating costs by functional area for all utilities;
- Retaining the integrative functions currently performed by Eletrobrás under centralized system entities;
- Ensuring a smooth transition;
- Expanding SINTREL to cover other utilities, if a "transmission entity" cannot be implemented in the near-term to accommodate open access to the national interconnected transmission systems; and
- Preparing an "Electric Power Code" applicable to sector participants on a non-discriminatory basis.

2.14 Other issues and omissions. While the scope of the various reform proposals is impressive and the areas of “consensual recommendations” mark a significant step in the right direction, there are a few issues which merit identification and discussion at this stage of the reform process. These issues, omitted in the summary discussions of the models presented by the Reform Committee documents, include: (i) discussion of restrictions on the ownership of assets spun off from formerly integrated utilities; (ii) potential gains from the creation of a power pool; (iii) allocation of rulemaking and transmission responsibilities (operation/expansion/pricing); (iv) the specific role and nature of sector regulation; (v) regional considerations; and (vi) the consequences of restructuring the sector which are probably more of the sphere of the Finance and Planning Ministries but need to be addressed anyway as part of the reform preparation.
(e.g., impacts on employment, economic effects from writing off bad public sector debts, how revenues from privatization are distributed).  

2.15 In addition, there are some viable alternatives that appear to have not been considered by the Reform Committee. These would rely more systematically on market mechanisms and at the very least would increase the sector's overall efficiency and to these points, referring to items presented in Table 2.1):

- The Brazilian "consensual model" endorses unrestrained competition in some extent the equity of the reform's outcome. But the proposals are not problem-free. For instance, the approach considered for generations actually allows for multiple prices by means of a system of price differentiation that would equalize rates of return rather than prices. Alternatively, the use of more effective market mechanisms could result in a single price that would imply a differentiation in the level of profits and thus reward the most efficient generators (whether existing or new). The implication of this option on optimal bidding strategies will be discussed in the next chapter.

- While there is evident concern in the current reform proposals about the design of the system's interconnection/transmission company, relatively modest consideration is given to alternatives (including one presented in Chapter 3) to the two given options. This could be a significant failure, in light of evidence showing generally weak support from the states for the SINTREL-type option.

- Although under the Brazilian consensual model the activities carried out between agents within the sector would be managed by the transmission company, international experience suggests that a pool arrangement could effectively serve this purpose and should be considered.

- Planning, if it remains in the hands of the federal government or with the interconnected system's transmission company, could end up excluding many participants. To avoid this, consideration should be given to placing the planning function in a separate agency jointly owned by all system actors under a formal pool arrangement.

- The reform proposals should reconsider the size threshold defining large "deregulated" users and how they can be effectively liberated from local distribution monopolies.

These and many other related issues are the main focus of the next chapters.

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4 There is a partial omission of regional issues. Obviously some of the proposals (especially regarding transmission issues) are trying to generate a regional consensus, but most are ignoring the redistributive role of the sector's current financing strategy and the need for alternative mechanisms if the current system is dismantled.

5 The assessment in this paper is based on the documents made available to the Bank, which contained few details for some of the proposals and therefore the information is extracted from the Reform Committee's background summaries.
Chapter 3: Restructuring Brazil's Electricity Supply Industry Around Competition

3.1 All four reform proposals properly treat sector restructuring as an institutional rearrangement that does not necessarily involve changes in the physical configuration or functioning of the operating system in Brazil. However, Table 2.1 empirically illustrates that the reorganization proposals have not yet achieved internal consistency in selecting congruent—or even complementary—means to achieve the common goals (economic efficiency and new sources of financing), despite the threat that a piecemeal approach could undermine the whole reform process. Therefore, this chapter aims to foster a solid understanding of coherent options that are consistent with the stated goals by focusing on the organizational aspects of a reformed Electricity Supply Industry (ESI) in Brazil. The institutional issues relevant to the reorganization of the sector will be discussed in the context of the distinct stages of the electricity production and supply chain:

- primary energy sources;
- generation and dispatch;
- transmission;
- distribution; and
- deregulated supply.

3.2 The next chapter will then present more detailed descriptions and analyses of the various options for market structures and market institutions utilizing competition in relevant segments.

Primary Energy Sources

3.3 The relative lack of indigenous fossil fuels juxtaposed with the high hydro potential in Brazil point towards a continuing strong reliance on new hydro plants to meet electricity demand increases in the near future. Gas, although of relatively minor importance at the present, has the potential to increase its share in total electricity production over the next several years as large gas pipeline projects from Bolivia and Argentina, together with an intensified effort to use Brazil’s own gas reserves, will increase gas availability.

3.4 Countering some of the expected increase in gas utilization in power production, however, is the probability that the more efficient Combined Cycle Gas Turbines (CCGT), with its relatively low capital costs, will be the generating technology of choice in Brazil, as it was in the United Kingdom (U.K.), Argentina and several other countries after sector reform. Thus, the legal frameworks for the Brazilian gas and electricity sectors need to be closely coordinated in light of the high level of (fuel) inter-substitutability.

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6 The ideas discussed in this chapter are not intended to provide definitive solutions to Brazil’s complex system, but to show how most of the existing problems of reform design can be addressed through market mechanisms. The market mechanisms maximize the available system information in order to increase efficiency.

7 This is what Eletrobrás projections indicate but it still has to stand the test of the market if and when the system is liberalized.

8 Some private agents point towards a relative underestimation by Petrobrás of gas potential. If this is the case, the recent breaking up of Petrobrás’ monopoly could result in more dynamism in gas exploration and exploitation.
3.5 In the short run, however, the most pressing issue to ensure the viability of competition in the electricity sector is to figure out how to allocate and enforce water rights. The effective resolution of this issue is vital to the development of a competitive generation market.

3.6 As a monopolistic owner of a resource has the power to appropriate rents from all downstream activities through pricing, competition in the awarding of licenses or concessions for water can mitigate some of the concerns about anti-competitive effects of downstream uses (e.g., for generating purposes). However, water resources are not only a primary energy resource but have several alternative uses which are often subject to different regulatory authorities, e.g., the environmental regulator. Effective coordination between the different regulatory entities with jurisdiction over this resource is therefore essential to preserve fair and equitable use of the water at reasonable costs and with optimal benefits for society.

3.7 Allocating water rights to the highest bidder. As the Government of Brazil (GoB) owns all water rights, naturally the competition that will take place is for the right to use the resource rather than to own or control it. Public bidding seems to be the best approach to franchising hydro use rights and Brazil has already advanced in this direction through the public service concessions law which requires public bidding to be implemented for all hydropower potential in excess of 10 MW. The defined requirements for the bids, however, affects the type of organization the system will adopt at the wholesale (bulk power) level. The concessions law accepts either of two mechanisms as the basis for awarding bids to achieve efficiency in the allocation of water resources—i.e., the lowest asking price for energy or the highest payment for the water use; with the latter leading to a single price set by the market and the former allowing different prices for different plants. To optimize the competitiveness of the market, the latter mechanism seems to be more appropriate as it results in a single price for all plants from that particular source.

3.8 One of the main outcomes of such a market oriented reform is an improvement of allocative efficiency. This means that the market decides how much investment goes towards those sectors and where it is more profitable to increase capacity. If the bidding is conducted in terms of the lowest price for the energy produced and discriminating among bidders allocative efficiency would not be assured as the assessment of each bid would be done taking into account only the production costs of the plant under consideration. On the other hand if the concession is awarded to the bidder offering the highest payment allowing her to sell all her production freely, all the information available in the market enters into the decision process through the observed and forecasted market prices.

3.9 Avoiding discrimination among bidders. A second important design issue in allocating water rights is the need to avoid discrimination among the types of potential bidders—including generating companies, industrial self-generators and distribution companies—allowed under the current reform proposals. Not only is there no efficiency gain.
to be achieved by differentiating the allocation rule according to the type of bidder but, on the contrary, such discrimination may in fact penalize efficient producers by excluding them from the market.

3.10 The above point on the need for non-discrimination is a major departure from the position taken in some of the proposals under study by the GoB. It should be clear that if energy prices are supposed to be the result of market mechanisms, the opportunity cost for all categories of potential bidders is the same (i.e., the market price) and there is subsequently no need for discrimination.

Generation and Dispatch

3.11 The various proposals under consideration by the Reform Committee all recognize the competitive potential of generation and the strong natural monopoly in transmission functions. Thus, they all call for the separation of these activities to achieve the efficiency gains that can be obtained via competition in generation. The gains from competition will, however, only fully benefit consumers if the linkage and need for effective coordination between generation and transmission activities are not ignored. Moreover, unbundling is only desirable if the efficiency gains resulting from competition in generation are larger than the economies achieved under vertical integration.

3.12 The likely payoffs from competition. Competition, in a pure form, ensures productive and allocative efficiency. Productive efficiency ensures that, for each instant, production is achieved at the lowest possible cost. For the electricity supply system, productive efficiency depends on how effective the dispatching system is organized, as is discussed later. Allocative efficiency relates to resource allocation within and across sectors, ensuring that resources are assigned to the most productive activity. Dynamic efficiency gains, selection of better technology and control of costs through competitive pressure over time are other payoffs expected from competition.

3.13 The extent to which intra-sectoral misallocation of resources is a serious problem in Brazil is difficult to assess because currently there is no separate accounting for each of the
multiple activities in the vertically integrated monopolies. Furthermore, conversations with key actors in the sector suggest that extensive and substantial levels of cross-subsidies are prevalent, which implies inefficient allocation of resources. To a large extent this is due to the fact that the current basis for cost recovery in Brazil's electricity sector does not rely on prices to allocate resources. This inefficiency would be quickly rectified if competition were introduced in generation. Indeed, price signals are precisely the mechanisms by which competition ensures efficiency. In competitive systems, prices equal marginal costs and also give consumers and producers an adequate measure of the social costs associated with each unit of consumption. This concept is, however difficult to put in practice.

3.14 Achieving competition in generation. Three main conditions must be met for competition to be effective. The first condition is the existence of a number of producers active in the market. Thus the privatization strategy becomes of paramount importance. If Brazil can derive only one lesson from the Chilean and U.K.'s respective experiences in introducing competition in generation, it should be that major restructuring does not of itself necessarily create enough actors in the generation market. The only sure way to achieve this is to horizontally separate the major units supplying the bulk power market. The existence of firms with strong market power, even if they are government controlled, imposes an insurmountable barrier to real competition.\(^{10}\)

3.15 The second condition, closely related to the first, is assuring unrestricted entry to the generating market. Regardless of the number of producers already in the market, it is the openness to (or in some cases, even the threat of) new participants that serves as the main force to keep prices at competitive levels. However, careful attention must paid to the bias towards vertical-reintegration which is built-in the current system. If Distribution companies are encouraged to bid for the construction of new generation, strong pressures are created towards vertical integration between generation and distribution. Given that this kind of integration can undermine competition, it seems deisrable to avoid giving Distributors a preference in bidding for water rights. Furthermore, limiting the amount of generation that any Distributor can own or control (15% of its own demand is the value adopted in England and Wales), or upright prohibition of owning generation to all distribution companies might be needed to ensure a transparent and competitive generation market.

3.16 The third condition for effective competition in generation is the complete separation of transmission and generation activities (which will be further discussed below) and horizontal division of generation assets into several business units to be privatized separately. This implies that there is a need to consider whether it would be beneficial to introduce limitations on the share of total generating capacity that an individual entity can acquire or control (as was done when a limit of 10 percent was imposed in the privatization of Hidronor and AyE assets in Argentina).

3.17 Traditional potential sources of productive efficiency gains. Productive efficiency comes from the minimization of costs. How effectively costs are minimized depends on both technical and institutional considerations. In most ESI, effective technical cost minimization in generation is

\(^{10}\) In Norway, for example, Statkraft, the dominant and publicly-owned generator, led a 1992 attempt to collude on price (London Economics, March 1995).
achieved through the central economic load dispatch function. This is the case in Brazil, where the GCOI coordinates all generators to ensure that demand is met at minimum (system operating) cost. In this respect, it is unlikely that major increases in productive efficiency will be obtained as the technical capabilities relevant to the operation of Brazil's large hydropower-based supply systems are among the best in the world.

3.18 Designing institutions to minimize costs. Another potential source of productive efficiency gains is the minimization of costs associated with the institutional and organizational dimension of the sector. Potential gains, in turn, depend on how effectively institutions are able to assimilate information on each generators' unit price and availability. Various countries obtain that information by requiring generators to bid for the right to be selected as sources of generation, e.g., in England, Wales and Colombia. In England and Wales, the generator's daily bid price and availability for the next day must be submitted by 10 a.m. An economic merit order for dispatching is then formed based on organizing these bids from the lowest cost to the highest. The dispatch is carried out according to the established merit order until demand is covered. Each generator is then paid the marginal cost represented by the last generator's bid. If enough generators participate in the market, the resulting behavior results in each generator bidding their individual marginal cost for the Pool.\footnote{The fact that the British market is dominated by two large generators imposes a serious limitation to the efficiency of this mechanism. See Green and Newbery for an estimate of efficiency losses associated with this duopoly arrangement.}

3.20 Although theoretically a pure market could resolve this information problem and some virtually pure hydroelectricity markets actually exist (such as in Norway), in practice there seems to be no notable efficiency gains to be achieved by allowing generators to bid prices in a hydro-dominant system.

3.21 Brazil will likely benefit from maintaining a central dispatch function for each interconnected system. However, discussion of this issue needs to consider who should compose or be in charge of the entity, which in turn will make a difference in how objectively and equitably (and therefore well) it will function. The problem caused by the interdependence of production costs across generators due to the hydro nature of the system requires the kind of coordination that a centrally dispatched system provides. Furthermore, the optimization methodologies and system control and data management software currently in use in Brazil's ESI are state-of-the-art. Considering these positive attributes, the actual central dispatch activities undertaken via the GCOI seem to be--in both the short- and medium-term--the best option for the sector even after reform, although there will still be some problems due to lack of
full information. However, there is a perceived need for some institutional changes, particularly regarding rulemaking and (oversight) organizational entities, which will be discussed later.

3.22 Standard pricing approaches are not effective. The second problem due to Brazil’s predominantly hydro system is that marginal prices can be very low over long periods and thus impede the timely recovery of capital costs. Pricing rules like those adopted in the U.K., Chile or Argentina, where energy price is set at the cost (or bid) of the marginal plant would, in a system like the Brazilian one, result in highly volatile prices ranging from zero to the cost of unserved energy as the system swings between periods of excess water and drought conditions. The cost recovery problem also requires a different approach for setting dispatch rules.

3.23 How can Brazil’s central dispatch function be consistent with competition? The reconciliation of a central dispatch function within the context of a system premised on market competition and market-based pricing can be accomplished by placing the focus of competition not on the physical dispatch of energy but on relevant financial (contractual) arrangements. Regardless of the market structure adopted for the sector--which will be further explored in the next chapter--the basic operating environment for competitive generation can be optimized by having both a central dispatch entity (to achieve productive efficiency) and a bulk power market that allows both capital and variable costs to be recovered and provides incentives to minimize costs (to achieve allocative efficiency).

Box 3.2 Significant Features Distinguishing a Hydro System

The main feature of a hydro system is that the optimal dispatch no longer depends only on the demand level and existing units available at each moment, but also has to take into account the inter-temporal problem posed by water storage: i.e., using water now or saving it for use in the future. Water in a reservoir has an opportunity cost set by future prices (or costs) and the probability of overflow (once the reservoir is full). When storage capacity is full and (always) for run-of-river power producers, the opportunity costs are nil and water has to be run through the turbines or spilled.

Opportunity costs are also low when future expected prices are low. An optimum dispatch rule for a hydro system involves balancing the present profits of using water now and the future profits of storing it. Future profits are associated with expected savings on water consumption on one hand and the avoidance of rationing costs on the other. The decision on the optimum use of water today requires a simulation of the evolution of the system in the future. The length of the simulation period depends on the storage capacity of the system. For a system with multi-annual storage capacity--e.g., Brazil's—the horizon for simulation is five years. The problems of estimating demand patterns, rainfalls, equipment failures, etc. for such an extended period makes the problem of hydro dispatch a very complex one that only Norway has addressed through market mechanisms, but its case offers few insights as the institutional model they have selected is so dramatically different from any of the options that are realistically conceivable for Brazil.

Another peculiarity of Brazilian generation of direct relevance here is the existence of several generating units in the same river. The externalities of such arrangement (as the generation capacity of any such plant is influenced by the storage capacity of upstream generators) adds to the difficulties in establishing optimal dispatch and pricing rules for generation. As a result of these peculiarities, the Brazilian system is much more dependent on centralized system dispatch than more thermal-based systems are. Some estimates suggest that the losses associated with decentralized dispatch in Brazil could be as high as 18 to 20 percent of the annual energy generated, representing an additional cost in the system of US$1.2 billion per year. Thus, it appears appropriate to incorporate into the Brazilian model a system with centralized dispatch and in which contracts are purely financial instruments that do not affect the physical dispatch of energy.

12 Central dispatch is not 100% efficient because of a lack of complete information about system components. For example, in the case of interest rates in a hydro system, the value of water is set based on future expected prices which have to be discounted at the relevant interest rate. As this rate differs among different actors (because of different time preferences, debt and so forth), the adoption of a single discount rate uniformly applied by the central dispatch unit results in a less than optimal solution.
Transmission

3.24 The transmission network is the backbone of electric operating systems and a *sine qua non* condition for the existence of a functioning market for electricity. A reliable and efficient transmission system is also a precondition for achieving an efficient electricity sector. By interconnecting separate regions or utilities, a transmission system makes it possible to pool generation and demand with the following benefits:

- reduction of unit's required reserve margin;
- reduction in spinning reserves;
- bulk power transfers; and
- economic operation on a system basis.

3.25 The technological peculiarities of the interconnection or transmission activity include economies of scale, indivisibilities and high capital intensity with large sunk costs, which make it a strong natural monopoly. Furthermore, it is especially difficult to efficiently price transmission, although the considerable externalities associated with this activity emphasize the need to do so as the wrong incentives not only induce inefficiency in transmission but might also bias investment and operation in generation. Finally, the continental size of the Brazilian system and its predominantly federal character add to the complexity of devising an effective system of rules that provides adequate incentives for efficient operation and expansion of the transmission network.

3.26 Based on its size and its uniformity as a virtually 100 percent hydropower system—implying that for all practical purposes the location of generation is pre-determined—Brazil's national interconnected systems are among the biggest in the world. This also makes transmission account for a significant share in total supply costs. Although the existing vertically-integrated sector enterprises do not yet have to perform separate accounting for each of their areas of activity, transmission costs are estimated to be in the range of 15 percent of the final consumer price.

3.27 **The federal nature of the ESI as a constraint.** As described in the Annex, Brazil's federal organization is reflected in its electric system. Although the central government retains authority over all electric concessions, several states have integrated companies under federal concessions and changes in this respect are politically difficult. This has a particularly strong impact on transmission activities which are, by nature, interregional. The only way out of the dilemma posed by this dichotomy is to provide universal open access to the transmission system as a means of facilitating competition in generation. The open access issue is at the heart of current discussions on restructuring. The importance of this issue had already been recognized by the Brazilian authorities when they created SINTREL (*Sistema Nacional de Transmissão Elétrica*) in late 1994 to organize the transmission systems under federally-owned utilities and coordinate open access to large users. It appears, however, that a transmission entity that fully integrated (regional) transmission systems under state as well as federal control would provide a far more efficient solution. Unfortunately, with the ownership of transmission assets being split between states and the central government, it is politically difficult to achieve the creation of a single unified transmission company for an interconnected system. This leaves two solutions that are under discussion
by the Reform Committee and a third option that is presented here for consideration:

1. a coordinating mechanism for interconnected transmission systems, such as SINTREL;

2. the joint ownership by the States and the federal government of the interconnected system, via a holding company, or

3. an Independent System Operator (ISO) that leases the “wires” from the owner entity, and operates and maintains the assets according to standard terms to optimize the operating and economic efficiency of the system. (See Box 3.3).

3.28 The difference in the economic outcomes of contractual arrangements concluded under a grid coordination mechanism as compared to those concluded under an ownership mechanism depends on differences in the transaction costs and in the consequences of unknown elements in the decision-making arena (e.g., incomplete information). Strong technical externalities are also important in the particular case of interconnected transmission networks.

3.29 Why coordination mechanisms won't work. The main problems in an interconnected grid stem from the allocation of costs and responsibilities. The numerous decisions needed to make cost allocations involving a multiplicity of operating conditions make designing a comprehensive contract (i.e., a contract that anticipates all possible outcomes) a nearly impossible task. This leads to the conclusion that the integration of various transmission entities into a single company would be the most efficient and cost effective solution, as was clearly stated as follows by the Inter-Ministerial Committee, among its other consensual recommendations:

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To expand SINTREL to cover the transmission and distribution systems of the other utilities, if it proves impossible to immediately implement a "transmission entity", so as to render effectively feasible the free access to transmission systems nationwide.
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Box 3.3: What Exactly Would an ISO Achieve?

An intermediate solution between the creation of a single transmission company (or holding) and an operational agreement between completely independent companies is the creation of an Independent System Operator (ISO) in charge of the coordination and operation of the interconnected transmission system. Under this scheme, existing companies retain the property of their assets which are leased to the ISO in charge of operating them. Operation and maintenance is done by the ISO, meaning that only the capital costs associated with these assets need to be paid as rent to the owners. In exchange for their payment the owners of the assets leave all operational responsibilities in hands of the ISO. To ensure the efficient operation of the system the ISO must have clearly defined authority (i.e., enforcement rights) over all technical standards of operation (including reliability standards), rules and procedures.

This arrangement helps to avoid the legal problems associated with the transfer of assets actually in the hands of State companies while enabling the benefits of centralized operation of the system. This scheme also has the advantage of becoming a transitional step towards the creation of a single transmission company. If expansion obligations are placed with the ISO, the system will naturally evolve towards a single company owning all the assets as new investment gradually replaces the existing one. On the other hand, if expansion responsibility is kept with the owners of the assets, this natural evolution does not take place, but a transfer of the assets to the transmission company can be done at a later moment when it becomes feasible and desirable. A significant issue raised under the given scenario is the strong need for coordination. This needs to be achieved through effective planning. Investment planning seems to be better done at the centralized level (ISO) while construction decisions can be decentralized to the different companies.
3.30 The creation of a single Holding Company to which all transmission assets are transferred in exchange for an ownership share in the company seems to be a viable solution. The single function of this Holding Company, which could (some would argue should) remain publicly owned, would be the ownership of a consolidated National (Interconnection) Transmission Company in charge of managing the network. It could also be in charge of the central dispatch function but it is not a requirement. The actual operation of the network and dispatch could be contracted out to the private sector by this entity through management contracts. Incentives (discussed below) would have to be included to induce efficient operation of the network.

3.31 Under this arrangement, however, several problems would still have to be solved. These can be summarized in what Perez-Arriaga\textsuperscript{13} presents as basic guidelines for the regulation of transmission services:

1. Regulation must ensure financial viability;
2. Transmission pricing must promote short- and long-term economic efficiency;
3. Regulation for existing and new transmission investments must be consistent;
4. Economic efficiency must be upheld in the realization of transmission investment and O&M activities;
5. Satisfactory levels of performance in the provision of transmission services must be a requisite; and
6. Risks associated with uncertainty in transmission prices must be reduced.

These requirements can in turn be grouped into three basic problems:

- payment to the transmission firm (1);
- transmission charges (2, 5 and 6); and
- expansion rules (3 and 4).

3.32 **Payment to the transmission company.** The main payment problem stems from two technological characteristics of the transmission system. The first is the existence of economies of scale reflecting: (i) limited expansion technologies—when listed in an increasing order of carrying capacity they are monotonically decreasing per unit costs—and (ii) the fact that the impacts of underinvestment on system operating costs are significantly higher than those due to overinvestment. The second relevant technological attribute is that transmission investment is intrinsically indivisible, implying that "optimal" investment criteria are limited by minimum investment modules.

3.33 **Marginal cost pricing won’t work.** Marginal cost pricing under the technological constraints associated with transmission systems would result in the transmission company becoming financially unviable. Subsequently, this requires that reasonable costs (of the transmitter) are first determined and subsequently allocated among users. The difficulty is mainly in determining what the revenue requirements of the transmission company are, in order to cover its investment (including a reasonable rate of return) and O&M (including losses and constraints) costs. Ancillary services such as reactive power support, load frequency control, operating reserves management are also part of the services to be coordinated by the transmission company.

3.34 For this purpose, a possible mechanism is to determine the transmitter's revenue based on the periodical calculation of these costs for an efficiently operated company under normal conditions. Given that the transmission function is achieved through a complex mix of network investment, generation to compensate losses and redispaching costs to cope with network constraints, an important consideration is to clearly identify all transmission costs as such in order to send the correct signals to the system. In brief, the mechanism for doing this can be the following:

1. calculate generation costs of the system through unconstrained dispatch (i.e., single node model); and
2. calculate total costs using a complete representation of the system including transmission.

Losses, out-of-merit dispatch, unserved energy, and operation and maintenance of the grid (i.e., the differences between 1 and 2 above) are the transmission costs that have to be covered by the system.

3.35 The transmitter will be responsible for "buying" all losses and constraints in the system. In this way, an incentive to improve the system's short- and long-run operational efficiency is created. If costs are lower than expected, the transmission company will increase its profits; conversely, under-performance is financially penalized.

3.36 Income from transmission activities could be divided into two parts: one that will be directed to the Holding Company as remuneration for the use of the assets (i.e., basically a fixed sum to remunerate the use of fixed assets) including a reasonable rate of return. The second part will go to the operator to cover variable costs (losses, non-economic dispatch, constraints, etc.) and to provide an incentive for adequate performance.

3.37 Although expansion investments can also be treated with this mechanism (the decision to expand is the choice of the transmission enterprise that chooses whether to build new capacity or to pay for the constraint), the peculiarities of the Brazilian case requires further consideration of ad hoc mechanisms to make such a proposal compatible with indicative planning functions and major expansion projects, as discussed below.

3.38 Transmission charges. Once the revenue requirements for the transmission company are established, the next step is to allocate the total cost among all system users. Several conditions have to be met by the pricing rule:

- Promote short-term (productive) efficiency;
- Promote allocative efficiency;
- Recover all costs; and
- Be viable in a practicable sense.

3.39 Short-term efficiency implies marginal cost pricing but, as explained earlier, economies of scale in transmission render the revenue resulting from marginal cost prices insufficient to cover total costs. A mechanism for revenue reconciliation has to be added if marginal cost pricing is to be adopted. Although efficient revenue reconciliation mechanisms exist in theory, most of them are too complex—in terms of information requirements—to implement. The trade-offs between efficient price signals, timely information and calculated requirements are central to most pricing systems actually in use. Data collection and cost calculation cannot be neglected.
3.40 Some studies suggest that the benefits of optimal transmission pricing can be expected to be below the transaction costs associated with its implementation. Efficient transmission pricing systems separate costs that can be identified with one (or a small group of) user(s) from costs that are associated with all users. While the former can be recovered through connection charges levied on the direct beneficiaries, the latter costs have to be recouped through more broadly applied mechanisms.

3.41 The advantage of adopting some form of marginal cost pricing is that user payments correlate to the system costs at particular nodes relevant to the interchange of power on behalf of the user(s), rather than based on a calculation of actual or notional electric paths. To be efficient, transmission charges have to be completely independent of contracts: i.e., the user’s charge is determined by the amount of energy actually taken from or injected into the system at the specified node, regardless of contracts with other market participants. With this kind of mechanism, users receive correct spatial and temporal signals through the costs that they impose on the network.

3.42 In the Brazilian case, these signals are not relevant for most generators as plants are sited where the energy source, water, is located. On the other hand, particularly when making investment decisions on where to locate major facilities, consumers might find these signals quite significant. With this in mind, the abundance of hydro resources in some under-developed areas could become a factor of regional development. However, the high calculation costs associated with marginal cost pricing in transmission requires some

interim mechanism that would allow spatially differentiated prices to be adopted and held constant for relatively long periods of time (e.g., one year) instead of recalculating them hourly (as in Chile and Argentina).

3.43 As discussed above, marginal cost pricing does not generate enough revenue to cover all transmission costs and a revenue reconciliation charge has to be levied. This charge relates to economies of scale and discreteness, so the allocation rule needs to minimize interference with actors’ decisions. Ideally, some form of Ramsey Pricing could be used, but the price elasticity data required is not available. The application rule is to cover generators and consumers alike, as both benefit from the network and therefore must contribute to recovering sunk costs.

3.44 Currently, there is no single proposed solution to equitably recovering sunk costs in the area of transmission that completely meets Brazil’s needs. In systems that have already implemented advanced schemes of transmission pricing—such as Chile, the U.K. and New Zealand—unique solutions have been adopted. For example, in Chile the revenue reconciliation charge is fully charged to generators; whereas in England, Wales and New Zealand it is fully charged to consumers with the estimated usage of the facility providing the basis for apportioning the charges (Perez-Arriaga op. cit.). Basing the allocation rule on the economic benefits rather

\[\text{15}\] If the problem is negative profit with marginal-cost prices, then prices should be raised above marginal costs for all outputs until the target profit is reached. Prices are not necessarily raised equally, however: they are raised in inverse proportion to the absolute value of the demand elasticities of each user. This minimizes the welfare losses associated with higher prices (Berg & Tschirhart, “Natural Monopoly Regulation.” Cambridge Surveys of Economic Literature, Cambridge University Press, 1988.)
than on the usage seems to be the best workable option, although more work is still needed to define precise rules for the Brazilian case.

3.45 How to finance transmission expansion? Investments in the transmission sub-sector account for a sizable proportion of the investment needs of the whole electricity sector in Brazil. Given the system’s dependency on hydro resources, grid expansion is largely determined by the availability and location of hydro potential. The continuing hydro nature of the system, together with fast growth rates and long construction lead times, infer a need for some degree of indicative planning in order to sensibly coordinate generation and transmission investments. A decentralized planning function such as the one adopted by Argentina in which individual agents independently decide where and when to invest in grid expansions, is not an efficient solution nor one that is workable in Brazil.\textsuperscript{16} It would appear more appropriate to have expansion studies undertaken by an indicative planning agency that has access to information collected by the central dispatch entity, interconnection enterprise or power pool coordinator, depending on which option is selected.

3.46 Some degree of competition can be introduced in the area of transmission expansion by soliciting bids for the construction of new facilities, as has already been established in the pending Brazilian legislation. When the winning bidder for the project has been awarded, the project can be included in the system’s planning horizon and its costs incorporated into the revenue requirements of the transmission company.

Financing the investment (envisaged under some kind of Build-Operate-Transfer or BOT arrangement) is in the domain of the developer, who will be able to recover the investment and a reasonable rate of return through a charge to be paid over a predetermined number of years. Alternatively, a transmission surcharge on system users can be earmarked for a specific fund for future investment projects.

3.47 Decisions on the timing of new transmission projects will normally be related to the construction schedule for new generating facilities. When the need for a particular power plant is signaled (and how this can be done through a price bid mechanism is discussed later), the time frame for the associated transmission infrastructure is defined. The cost of the system expansion can then be allocated to the beneficiaries of the investment following rules similar to those used to apportion the transmission revenue reconciliation charge (i.e., in proportion to financial benefits resulting from the expansion).

3.48 What should happen to Eletrobras’s banking function? It is difficult to talk about financing without mentioning the banking activities currently performed by the sector. One of the centralized tasks presently performed by Eletrobras is to serve as a bank for the sector. Through income derived from Itaipu and RGR (each source accounting for about US$1 billion/year), Eletrobras contributes about 30% of total sectoral financing. However, the banking needs under the new structure have to be carefully evaluated before deciding who should be responsible for this function.

3.49 At this point, it appears that what is really needed is an infrastructure bank to formulate and implement procedures to

\textsuperscript{16} Even in Argentina’s system, which is far less complex than the Brazilian one, these arrangements are proving to be troublesome.
manage sector funding accounts. This bank would ideally be under the federal government, rather than established as a sectoral institution, considering that the sectoralization of funds unnecessarily restricts development policies and that development policies are not for a sector but for the economy as a whole. BNDES actually appears as the most suitable agency under which a subsidiary Electricity or Energy Division can be established to play the role of infrastructure bank. But this is beyond the coverage of this paper.

3.50 **Distribution** Distribution is the most “separable” activity in the electricity sector as there are no major externalities with respect to the rest of the system. Although many distribution companies in Brazil have their own generation due to their historic founding as isolated generating and distribution companies, there is presently no economic rationale justifying vertical integration. Unbundling the integrated companies in the Brazilian electricity sector is desirable for purposes of efficiency and correct pricing even if it is politically difficult. The separation of accounting for the distinct activities in the sector is already underway in many states in Brazil, and another stride in this direction was made when the Inter-Ministerial Committee included it as a formal recommendation in its initial report.

3.51 **Distribution vs. supply.** It is important here to distinguish between “distribution” and “supply” components, which have traditionally been treated as a single activity. Distribution refers to the transmission of energy through a medium- and low-voltage network. Because of technical characteristics, the “wires” activity is a natural monopoly with substantial sunk costs. Supply, on the other hand, is the commercial activity of buying wholesale (bulk) power for direct consumption (as in the case of large consumers) or for resale at the retail level. Although supply was traditionally performed under the distribution company’s regional monopoly, it is nonetheless a separate activity. Advances in metering and data acquisition and processing technologies have made it possible to separate supply activities, which are fundamentally competitive in nature. Other activities traditionally associated with distribution—e.g., metering, billing, meter installation—can also be spun off from the distribution (wires) enterprise and managed by a separate company. These options have not fully emerged in the current debate.

<table>
<thead>
<tr>
<th>Box 3.4 Distribution and Supply in the U.K.</th>
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<tr>
<td>The different economic characteristics of distribution and supply can be illustrated by the British experience.</td>
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<tr>
<td>England and Wales were among the first to formally separate distribution and supply functions. Initially, only customers with at least 1 MW of demand were free to choose their own supply sources. The threshold was reduced to 100 kW in 1994 and is scheduled to be eliminated altogether in 1998 when all customers will be free to choose a supplier.</td>
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<tr>
<td>The 12 Regional Electricity Companies (RECs) in England and Wales have a turnover in their distribution business of around £300 million and make around £200 million profits on average. The turnover in supply is in the order of £2000 million with a net result of ± £10 million. This reflects the high capital costs of distribution (wires) service which require a reasonable rate of return. On the contrary, supply is a competitive activity with almost no capital involved.</td>
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3.52 **Competition in supply matters.** Competition in supply is important as a complement of competition in generation because it increases the number of participants in the wholesale market. Two conditions are needed for competition in supply to be workable:

- open access to transmission and distribution networks and
• formal separation of the distribution and supply activities.

3.53 The right of users to have unrestricted access to the transmission and distribution network under a fair tariff scheme is a fundamental requirement for the development of competition in supply. The debate continues on what the threshold should be to optimize the participation of consumers in the supply market, though there seems to be little benefit from setting a value as low as the one adopted by England and Wales and Argentina (i.e., 0.1 MW) because the metering costs exceed by many times the possible efficiency gains under a hourly pricing scheme. A limit set as high as currently in Brazil (i.e., 10 MW) would, alternatively, probably exclude too many important participants from the market. A threshold somewhere between 1 and 5 MW seems the best compromise in the interim.

3.54 **Separate accounting.** Separate accounting for distribution and supply activities in an integrated company is an important ingredient of reform for two reasons. First, it is a means to check—and thus ensure—that distribution companies are not discriminating against third parties (i.e., they are charging themselves the same that they charge others). Secondly, it facilitates regulation of the natural monopoly (distribution) activity by separating it from competitive activities—which have different requirements vis-à-vis regulation—performed by the same company.

3.55 For this structure to work, distribution and supply have to be transformed into financially independent activities. In other words, the income of the distribution business cannot depend on the identity of the supplier, because the service—i.e., transmitting energy through the distribution network—is the same regardless of who is selling the power.

Therefore, the distribution company revenues should not be impacted by a user's decision to switch suppliers. This has already been recognized by the government and a separation of accounting has become a requirement for the extension for contracts as of 1996.

3.56 **How to achieve financial independence.** Financial independence between distribution and supply functions can be achieved by having a complete and clear pass-through of wholesale prices in the distribution tariff. The objective is to make the distribution company indifferent to whether it is supplier of a specific customer or just the carrier of energy bought to a third party. The following formula illustrates this logic, with \((T_c)\) as the per unit tariff for a consumer who is supplied by the distribution company:

\[
T_c = P_w (1+d) + DC \quad [4.1]
\]

wherein:
- \(P_w\) wholesale price of energy,
- \(d\) distribution technical losses (%),
- \(DC\) distribution costs

Assuming that a customer, \(i\), previously supplied by the distribution company decided to change its supplier would imply a change in the distributor's expenditure equal to \(P_w\), as it no longer purchases wholesale energy to sell to \(i\). The tariff for the distribution service \((T_t)\) that would leave the distributor indifferent can be obtained by subtracting the reduction in the distributor's costs from \([3.1]\):

\[
T_t = P_w (1+d) + DC - P_w
= P_w d + DC \quad [4.2]
\]
3.57 The net result for the distributor company is nil, thus making it indifferent to supplying customer $i$. The remaining issue is how to define and eventually regulate each of these variables. In this way, sunk cost problems are avoided as distribution investments made for particular clients remain remunerated at the same rate regardless of who is selling the power to the client.

3.58 **What happens to captive users?** As long as the distribution company has some captive customers (those which are below the threshold set for participants in the deregulated market), it will be necessary to control the way in which the company purchases wholesale power on behalf of these customers. One means to provide such control is via an economic purchase obligation that restricts distribution companies to passing through only the prices paid for wholesale power purchased according to pre-determined rules. Under market arrangements as those discussed later, the distribution company will have to buy sufficient power under contracts with generators to meet the demand of its own captive supply customers. Moreover, the purchase agreements should be based on a competitive bidding process that enables the distribution company to obtain the best available market prices.

3.59 In addition, some kind of yardstick (benchmark) competition can be introduced by allowing the distributor to pass-through only the *average price* paid by all distribution companies, thereby pressuring all of them to seek the best contracts.\(^{17}\) Existing contracts will also have to be considered in pass-through arrangements. When undergoing privatization, a distribution company should be allowed to completely pass-through all costs imposed under existing contracts which are transferred. In Brazil, the mandatory purchases of power from Itaipú exemplify such a situation.

3.60 Transmission costs are also part of the wholesale costs which are not under the control of the distribution company and as such should be passed on to customers. As a general rule, all costs beyond the direct control of the distributor should be covered by pass-through mechanisms.

3.61 **Dealing with losses.** Losses, both technical and commercial, are the second item considered in the above tariff formula. As seen in the Annex, this is an important issue, with total losses in some companies reaching levels well over 20 percent. A certain level of technical losses cannot be avoided and therefore it is reasonable to include some recovery for these in distribution tariffs. The level of acceptable technical losses depends on the system’s topology and physical condition and therefore need to be set on a case-by-case basis for each company. The treatment of commercial losses (e.g., theft), however, is more difficult as it involves some sensitive social and political problems. Commercial losses are often associated with theft by very low-income sectors but are also due in part to theft by middle income and commercial and industrial users. While theft by low-income residential users represents a more complex social problem, theft by the other sectors requires direct and immediate control measures to be enacted.

3.62 To deal with the issue of losses within the context of tariffs, two approaches can be followed. First, a portion of the commercial losses can be covered in the tariff formula’s component for losses by introducing a cross-subsidy from paying to non-paying customers.

\(^{17}\) An ex-post analysis by the regulator which decides if the purchases have been reasonable or not (as done in the U.K.) is another solution but it leaves too much discretion in hands of the regulator.
This solution, although easy to implement, has a very high cost in terms of efficiency as it does not provide the company with incentives to reduce losses. Furthermore, it encourages excess consumption by non-paying customers. The second approach is to exclude commercial losses from the tariff formula, thus putting pressure on the distribution company to reduce theft. This alternative can yield very good results relevant to theft by middle-income, commercial and industrial users as shown by the Argentine experience (see Box 3.5). Nonetheless, this partial solution needs to be complemented with targeted direct subsidies for low-income customers, which requires decisions to be made as to who should pay for the subsidy, the states or the federal government, what will be the source of funds; how to make this program transparent; and how to phase out or reduce the program over time.

### Box 3.5 Argentina’s Experience Dealing with Losses

The problems of Edenor, Edesur and Edelap, the three distribution companies representing 47 percent of Argentina’s market, are typical of those of many distribution companies in Brazil: poor physical condition of the system, low productivity and high levels of theft. Over the last two years, for instance, non-technical losses in Edenor and Edesur amounted, respectively, to 30 percent and 25 percent. Yet, the companies are only allowed to pass through about 11 percent to consumers. To reduce its financial losses, Edesur reduced technical and other losses (i.e., theft), employment and overtime. Personnel were cut from 7,417 in January 1992 to 4,677 in October 1994. The personnel in Edenor was reduced from 6,368 to 3,759 over roughly the same period. Allowed overtime was reduced from about 40 hours per employee per month to 3 to 5 hours.

The reduction of theft was more complex because it involved shanty towns and low-income areas where cutting power supply was not viewed as acceptable by the local authorities. The solution was a deal negotiated between the utilities and the Regional Metropolitan Area, under which Edenor and Edesur installed a medium-voltage distribution network in the targeted areas and connected only about ten consumers to the low-voltage lines and related transformer. The voltage in the medium voltage lines is too high to permit illegal connections, while illegal use of the low-voltage line will be easy to identify as the transformers are not able to handle more than ten users. This solution places the burden on the community to solve the problem of illegal usage.

Moreover, the municipality agreed to take on the responsibility of directly paying the concessionaires the amount billed and collecting payment from the customers in these neighborhoods to cover it. The outcome has been positive, with payments in low-income areas reaching 90 percent for Edesur, while about 50 percent of Edenor’s low-income customers are paying their bills.

As part of this deal, the Federal Government also paid the companies US$20 million in exchange for past theft and did not impose the Value-Added Tax in order to keep tariffs low.

### 3.63 Distribution costs matter.

Distribution costs comprise the third part of the tariff formula under discussion. These costs include all direct and indirect costs associated with distribution service (i.e., wires, transformers, metering, billing, etc.) and require direct regulation due to the monopolistic nature of the service. Two different problems can be identified. The first is how to set the tariff level at the initiation of a concession or upon its privatization. The second is how to adjust the initial value over the course of the concession term. As distribution is a natural monopoly, market forces can not be imposed to set efficient prices for the service. The general rule, then, is to align prices with costs. Distribution costs, in turn, are related to service obligations and quality standards.
3.64 Paying for service obligations and controlling quality. Regarding service obligations, the general approach is to institute a formal obligation to serve all reasonable demand for electricity in the concession area. When this obligation exists, the tariff has to cover expansion costs in the area (i.e., long-run marginal costs). This rule is quite simple to implement in an homogeneous urban area, but can become unfeasible in mixed rural/urban and rural areas. In such areas, specific rules for expansion into areas previously not connected have to be implemented, which should include a clear definition of which elements of the expansion are covered by existing tariffs and which will be paid for by other mechanisms. More to the point, the discussion is about what has to be included explicitly in the tariff, not whether the user pays or not: the user will always pay. In addition, quality of service levels influence costs via the capital investments needed to reach the required standards, and therefore are an important determinant of distribution costs. In general, quality of service standards are exogenously set by technical parameters and unserved energy costs.

3.65 How to regulate changes in tariffs. Once service obligations and quality standards are established, a tariff can be calculated that gives the company a fair and reasonable rate of return on its investments. The focus then shifts to how changes in tariffs can be regulated. Two approaches can be followed, drawing upon those used in the U.S. and in the U.K. The traditional U.S.-style approach is to directly regulate the rate of return that the company is allowed to earn in any one year. When the rate of return differs from the allowed level an adjustment in tariffs is made. The problem with this approach is that there are no incentives for the company to be efficient (i.e., to reduce costs). Alternatively, the U.K. has adopted a particular form of price cap regulation called the “RPI - X” regulation. The basic idea is to set a price cap which gives an incentive to the company to increase its profits by reducing its costs. At the same time, an efficiency factor (X) is introduced, allowing part of the benefits of the productivity increase to be transferred to customers through price reductions.

3.66 RPI - X may be the best option for Brazil. These two alternative forms of tariff regulation have some points in common and some differences. The objective of both is the same, to allow the regulated firm to recover its costs and a fair rate of return on investment. Other points in common include the need to determine the rate base and a fair rate of return for the specific activity. Differences arise regarding risk allocation and the timing of returns. In rate-of-return regulation, all risks of cost increases are born by the customer, while under the RPI - X approach, the risks are assumed by the service provider. Moreover, tariffs are reviewed periodically at pre-set intervals (usually five years) under RPI - X regulation, until which time the utility can increase its profits by reducing costs, without constraint. By contrast, in rate-of-return regulation the tariffs are changed every time the rate of return moves away from the defined target.

3.67 An RPI - X mechanism appears better suited for regulating distribution companies in the Brazilian context because it will promote cost-saving measures by the enterprises while giving them more freedom to manage their business in an efficient way.

3.68 Implementing RPI. It is important to select the appropriate means for implementing RPI - X in Brazil. In the U.K., the targeted variable is generally the unitary income of a basket of services provided by the firm. This means that relative prices between the
different services are left for the company to determine. In Argentina, the price cap is set based on a structure of tariffs that enables relative prices (e.g., low-voltage and high-voltage tariffs) to be determined in the concession contract. A problem that Argentina has experienced with this solution, however, is that an existing distortion in relative prices send a biased signal to customers: e.g., medium-voltage service is much cheaper than low-voltage service, thereby encouraging customers to do their own transformation. Generally, the enterprise should have the ability to determine relative prices, based on intimate knowledge of its own costs, within the parameters of established rules (which would insist upon non-discrimination, no cross-subsidies, etc.). The rules need to be defined in the Electricity Law rather than in the concession contract.

3.69 Monitoring results. Once an RPI - X mechanism has been adopted, it becomes increasingly important to enforce minimum quality of service standards and the obligation to serve. Otherwise, providing lower quality of service levels or denying service to certain customers would be an easy way for the regulated enterprise to reduce costs (and thereby increase its profits). This control, that under competitive conditions is provided by the market (with poor service leading customers to change suppliers), has to be provided by the Regulatory Entity for monopolistic market areas, such as in distribution.

3.70 By monitoring results (i.e., quality and obligation of service) and prices, the Regulatory Entity can focus on the outcome rather than on the day-to-day management and operations of the enterprise. This is the most efficient way of protecting users rights (the main task of the Regulatory Entity) while leaving the enterprise to manage its business in the best way it can. The indicators used by the Regulatory Entity to assure a good quality of service level is also an important issue. Traditional quality indicators used in the sector such as the number of service interruption, total time of interruptions, and voltage variations require complementary quality of commercial service indicators (i.e., time to connect new service, meter reading, handling of customer complaints, etc.).

3.71 Summing up. This chapter has shown that there is already a great deal of consensus among the major participants of the sector on the broad directions of change. The main areas where is there is disagreement or some degree of fuzziness are mostly institutional and most importantly the organization of the competition for water rights and for some parts of the distribution activities as well as for the organization of transmission activities.
Chapter 4: EXPLORING MARKET OPTIONS AND COMPETITION

4.1 The core of the reform process is the creation of a market in which generators can compete to supply distributors and large users. The expected gains of competition are an increase in productive efficiency (through lower costs) and particularly in allocative efficiency (through decentralized markets based investment decisions).

4.2 An effective way of capturing efficiency gains derived from competition might be to introduce two markets: a contract market and a spot market. The dual market organization should allow generators to recover capital (and fuel) costs in the contracts market and variable costs (except for fuels) in the spot market. In sum, this concept of the electricity market would basically separate long-term supply contracts concluded in a purely financial market environment from short-run electricity trading conducted in a spot market setting at short-run marginal costs (SRMC). If demand for firm energy is larger than the available firm energy, prices in the contract market will subsequently rise, as will profits, thereby encouraging new capacity to be added to the system. On the other hand, if available firm energy is greater than its demand, prices in the contract market will fall and make the construction of new capacity unprofitable. In a state of “equilibrium”, the value of a unit of firm energy will be equal to the cost of providing an additional unit of firm energy (i.e., by expanding capacity at existing plants or by bringing new units on-line). As long as the expansion plan of the system is optimal (i.e., cheaper hydro sites will be developed first), the fact that the value of firm energy covers the capital costs of the next added unit will ensure that the capital costs for existing plants will be covered as well. To clarify various aspects of the proposed structure, the following presents a more detailed look at each market type and their respective features.

4.3 The Spot market. The spot market is a mechanism for trading energy within a defined time period (typically one hour). In a spot market, generators are dispatched in merit order following SRMC, with each generator paid its own marginal costs for the energy delivered in each time period. Each buyer, in turn, is charged the average marginal cost for the energy delivered in each time period. The market, therefore, “clears”—i.e., total revenue exactly matches total disbursements—within each time period. For thermal generators, only non-fuel marginal costs are covered in the spot market; fuel costs are covered in the contracts market.

4.4 The Central Dispatch Entity is in charge of the physical logistics for coordinating and implementing the trade in power that is effectuated in the market, while a “Settlements Agency” is usually established to be responsible for payments and collections made on behalf of the market participants. The Settlements Agency will need to be informed of the measured values of generation and consumption by the Central Dispatch Entity on a daily basis (or other defined period) in order for the reconciliation of accounts to be carried out smoothly and in a timely manner. Settlements can be performed daily (as in England and Wales) or monthly (as in Argentina). In any case, an interval for informing all participants of the resulting physical and price values for each time period and to settle complaints and errors needs to be adopted.
Figure 4.1: Interactions Between Agents in the Proposed Pool

Regulated payment made by captive users to Distribution Co which includes purchase of power and distribution services

Contracts for firm energy freely traded. The contract market as such can exist or be organized on an over the counter basis or left to bilateral arrangements

Transmission charges paid by generators and users to the transmission company

Transactions in the Spot Market
4.5 The contracts market. Paying generators for energy at their own marginal costs leaves them with all fixed capital costs yet to be recovered. Capital costs are particularly high for hydro generators. Moreover, hydro plants present strong externalities over other hydro plants in the same basin. Particularly in Brazil, the payment methodology needs to take into account these characteristics of a hydro system. A contracts market in which firm energy certificates (FECs) are traded seems to be one of the best workable solutions for these problems.

4.6 Hydro systems are normally not constrained by the available capacity as much as by limits on energy production. Therefore, the driving force for new investment in such systems is the need for more energy, not more capacity, to become available. The available energy in a hydro system depends on the installed capacity, the system’s topology (more than one plant on the same river), storage capacity and on random variables such as rainfall.

4.7 In the contracts market proposed for Brazil, each generator will be issued FECs, which gives it the right to obtain from the system the amount of energy stated in the certificate. Generators will be free to trade these certificates in a contracts market. Distributors and large deregulated users, on the other hand, will be required to hold FECs as a condition of access to the spot market. This means that only those buyers who have secured energy supply contracts with generators and have thereby become holders of FECs will be able to buy energy in the spot market. Moreover, they can only make spot market purchases up to the amount of energy indicated by the FECs they hold.

4.8 The basic mechanisms by which the contracts market would work will set the price of the FECs to collectively cover the capital costs of all generating plants. This will occur under the natural market interactions, as explained through the following conceptual scenario. Assume, for the sake of understanding the relevant market forces at work, that there is no generation available and that demand is X MWh a year. Also assume that there is a list of generation plants projects that can be built overnight, each one with a different capital cost and no variable costs, and that these projects are owned by different agents who can decide if the project is built or not. If an auction is then held in which energy users bid the price they are willing to pay for the energy produced by generating plants, it will result in the projects being arranged in ascending order by cost and being built according to this order until all demand is covered. The capital cost of the last project built is the cost of energy in the market under the prevailing demand.

4.9 The difference between the described market and the current arrangement in Brazil is that the many existing generators will be selling their FECs in an open market. When demand for FECs is larger than the available stock of certificates, the price will go up until it covers the cost of the next plant. At this point, a new plant will be added to the system, bringing the price back to equilibrium. This is the way in which the market fulfills its main task which is to improve, through price signals, on allocative efficiency. The decision as to when and how much new capacity is needed comes from individual actors dealing in an open, competitive market. Under this scheme, the established Planning Agency will have an inventory of available projects and associated basic studies for review. For this mechanism to be effective, an obligation to serve all captive users’ demand in its concession areas has to be
imposed on the distribution company. Setting the fine for not attending demand as a function of the value of lost load ("costo de deficit") will send the proper signal as to how much to invest in new generation plants. As long as the costs of FECs is lower than the value of lost load, it is efficient to build a new plant. As distribution companies act as representatives of their captive users, the value of lost load, which represents the maximum price users are willing to pay for the service (also called reserve price), has to be determined by the regulator with periodical reviews. This way new investment takes place up to the point in which the cost of new plants is higher than the reserve price.

4.10 The requirement for purchasers in the spot market to hold FECs in direct ratio to the amount they want to buy deals with the potential problem of having, when marginal costs are very low, incentives for users to buy all energy requirements on the spot market, thus paying only variable costs and not contributing to recovery of the generators' fixed costs. Meanwhile, the issue of spot market energy purchases by buyers without FECs can be treated in different ways. One possibility is to simply prohibit these purchases unless the purchasing agent has FECs. However, this solution would entail the need, for enforcement purposes, for the Central Dispatch Entity to keep track of existing FECs to see if a certain demand will be covered or not. An alternative—but one that still requires monitoring of FECs and spot purchases specifically for this purpose—is to impose a financial sanction on purchasers who withdraw more energy from the system than their holding of FECs. If the sanctions are set at an appropriate level—for example, the long-run marginal cost (LRMC) of the system—and properly enforced, there will be no incentive for purchasers who lack the necessary amount of FECs to buy unauthorized energy on the spot market. The proceeds from the sanctions can be divided among all generators in proportion to their firm energy.

4.11 In order to ensure that FECs are used properly and effectively in the market, these certificates need to be fully tradable until they are "cashed in" for immediate delivery. Agents in the market need to freely acquire and resell the certificates to accommodate their particular needs at any given moment. As in any financial market, paper transactions in the energy market are expected to exceed by several times the actual transactions in the physical sense.

4.12 How is firm energy calculated and updated? Basically, the problem in calculating firm energy is to find a methodology which internalizes the externalities affecting the different generating plants. The definition of the firm energy of a generating system should be the maximum amount of energy that can be produced by the system without exceeding the predetermined loss-of-load probability (which in the Brazilian case is 5 percent). For each generating plant, the firm energy is the contribution made by that plant to the system's firm energy. To calculate the contribution of each plant, it is necessary to run a simulation model for the whole system with and without the generator under consideration. The difference between both results, in terms of the system's firm energy, is the firm energy of the specific plant under study. Using this approach, all externalities associated with the plant are captured as part of its own firm energy.

4.13 As an example, assume that a plant has a large reservoir which benefits downstream generators by increasing their productive capacity. In the simulated run for the generator under consideration, the available energy will be augmented not only by the production of
this plant but also by the increased generation in the downstream plants. All externalities can thus be captured by defining the firm energy of the plant as the difference between the two scenarios, rather than by the energy generated by the plant under the isolated scenario.

4.14 Firm energy for the system and for each generator changes as new facilities are added to the system. This implies the need to recalculate periodically the firm energy of every agent. Given that the addition of new generators adds to the firm energy of the existing ones, the need for updating the information should not impede the conclusion of long-term contracts.

4.15 **How can the contract market be implemented?** The contract market has to be completely independent of physical dispatch, and it may be particularly difficult to persuade the current dispatch managers in Brazil of the need for delinking the two areas. The potential trade-off to entice generators to transfer the control over production decisions to the central dispatch entity could be to provide them with entitlements to receive an amount of energy from the system that is proportional to their contribution to the system. As the Central Dispatch Entity, seeking to optimize system operation, is likely to increase the total amount of energy obtained from individual plants (unless it is a poor performer), each generator would receive entitlements that are at least equivalent to its own (optimized) physical contribution. The entitlements (FECs) can then be freely sold to purchasers in the competitive contracts market. There should be no constraints on trading these energy contacts among generators, distributors, large deregulated consumers and brokers (if any). Actual trading can be organized in a physical market location (similar to a stock exchange), on an over-the-counter basis, or it can be left up to bilateral transactions in which case some kind of centralized market will probably emerge spontaneously. The convenience of each type of arrangement should undergo further analysis.

4.16 Briefly, the basic idea of the FECs is that the generator is selling its capacity to the system during a given period, rather than the energy produced during that period. The requirement, in parallel with issuing FECs to generators, that distributors and large deregulated users buy firm energy as a pre-condition to purchase energy from the spot market (i.e., Pool), creates a market for the FECs. This kind of arrangement partially mimics the type of capacity contract-based Pool that is operating in New England.  

4.17 The described system also accommodates thermal plants and secondary trading. For the few thermal plants in the system, firm energy equals its generating capacity (corrected by scheduled and unexpected unavailability). When a thermal plant is called into service by the Central Dispatch Entity, it will not receive payment that will cover its fuel costs. Given that its capital costs are much lower than for hydro plants, while its variable costs are higher, the thermal generator’s firm energy contracts will have to recover both capital and fuel costs. Under this guideline, the dispatch of energy from a thermal plant will only be justified if the capital plus fuel costs are lower than the capital costs of the nearest hydro plant.

4.18 Meanwhile, the trading of excess energy (including secondary) can also be accommodated by the spot market (Pool), although more specific rules will be needed to avoid situations of “free riding.” Excess energy in this case corresponds to the water

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that would otherwise be spilled by a hydro generator, while secondary energy is that
which has a high probability of being spilled.

4.19 Free entry to ensure allocative efficiency. A necessary—although not
sufficient—condition for the existence and sustainability of competition in any market is
free entry of producers and consumers. If prices are too high, resulting in excess profit,
new entry will be attracted into the industry, pushing prices down until profits in the sector
are in line with other sectors with similar risk levels. This is the basic mechanism by which
competition secures efficient levels of investment in the industry.

4.20 In this discussion, FECs constitute the market signal for investment. Allocative
efficiency is achieved when the value of new additions of capacity (in terms of firm energy
for the system) is signaled to market participants. Moreover, deciding whether a
thermal plant is more desirable than a hydro plant is left in hands of the developer who
assumes fuel-related risks. Clearly, the bidding system most compatible with this structure will
be based on the highest payment for the concession rather than on the lowest price for
the energy produced.

4.21 One of the main objectives of the Brazilian reform is to improve on allocative
efficiency. This basically means leaving sector participants, both public and (increasingly)
private, to decide on the level, opportunity and type of investment as indicated by the
cumulative market signals. One of the likely results of the reform will thus be a change in
the historical investment pattern: e.g., market mechanisms for resource allocation, coupled
with free entry to the market, will surely increase the share of gas in total generation.¹⁹

4.22 The increase in the share of gas-based generation, with its significantly lower capital
costs vis-à-vis hydro generation, is expected to play an important role in the post-reform
expansion of the system. Reducing the share of hydropower will also make the system less
dependent on hydro conditions and thus reduce uncertainties associated with variations
in climatological conditions. In synthesis, there should be no discrimination towards any
primary energy source (water, gas, renewables) for power generation purposes if
the spot market rules are properly defined.

4.23 Summing up how the spot market (Pool) works. Variable costs (excluding fuel)
will be recovered through spot market transactions. The spot market is based purely
on a short-run marginal cost dispatch (such as the current system uses). Generators are
concerned about both their variable and capital costs. Since capital costs are huge in Brazil’s
predominantly hydro system, it is important to design the contract market in a manner that
effectively ensures the recovery of these costs.

4.24 Cost recovery can be obtained by requiring distributors to purchase sufficient
amounts of firm energy to cover all their expected demand as a pre-condition to buying
energy on the spot market. This obligation will eliminate any free riding tendencies by
purchasers who would otherwise gamble on buying secondary energy in the spot market.
The value of firm energy (i.e., contracted energy) will be freely negotiated in this market,
and will also signal the need for new generation in the system. Meanwhile,
transactions between generation and transmission companies cover only payments
for transmission services and rebates from the

¹⁹ In a recent conference, a Director of
Eletrobrás predicted an increase from 3% to 20% in
the share of gas as a source of electricity during the
next ten years. (Maria Clara R.M. do Prado, “Setor
elétrico desponta,” Gazeta Mercantil, November 28,
transmission companies to the generator (G) for system constraints and availability.

4.25 Distribution companies are responsible for buying firm power (in the form of FECs) to cover the forecast demand of their captive consumers. Once this obligation is met via the contractual market, the distributors can buy energy on the spot market. The cost of both contract and spot market purchases are then bundled with the cost for distribution services for tariffs applicable to retail sales to captive users.

4.26 Large users (those above a defined size threshold) can commercially bypass the distributors to purchase their requirements directly in the contract and spot markets. They have to pay regulated tariffs for the related wheeling service provided by the distribution company to which they are connected. These users can also buy FECs in the contract market and resell them to other large users or the distribution company, although they cannot provide the actual relevant distribution service as this service is an exclusive right of distribution companies.

4.27 What kind of institutions are needed to implement these two new markets? Two alternative arrangements are immediately obvious:

- Leave all coordination activities with a restructured Eletrobrás, or
- Create new institutions.

4.28 The suggestions made here differ from the models discussed in Chapter 2, in which the durability of Eletrobrás in practical terms is the major concern. The key difference of the two options is that the former implies some degree of inertia as habits and the approach to incentives are hard to change; whereas the second option entails some start-up costs and major concerns about employment, but allows a clean start with a minimum of inertia. It is clear that the solution proposed here is just one way of addressing the problem and there may be many others. The main purpose of spelling out a proposal here is to show that there are realistic ways of minimizing inertia.

The Market's Institutional Framework

4.29 The market functions proposed to be performed in a centralized manner are: dispatch, settlements, indicative planning, research and pool rulemaking. Sectoral banking is an issue that needs separate treatment and will be discussed later in this paper. Presently, all these activities are formally or de facto the responsibility of Eletrobrás. The essential nature of these functions testify to Eletrobrás' leverage in the ongoing reform process and its support for restructuring rather than creating substitute organizations.

4.30 What would restructuring Eletrobrás entail? A restructuring of Eletrobrás would in principle involve the transfer of its commercial assets to other companies. Eletrobrás' new core responsibilities would be directly related to coordination functions. It is clear, as rightly pointed out in the Management Report of the Inter-Ministerial Committee, that allowing Eletrobrás to be involved in both production and coordination functions would lead to conflicts of interest, and would jeopardize the independence that is requisite for effective coordination. Even assuming that restructuring the federal utility is accepted by all involved parties, the option would still expose the reform process to two serious risks. First, there is an employment issue that arises, because if Eletrobrás is unbundled, its productive activities will likely be streamlined in order to maximize their transfer value. There
is conversely the risk that the existing overstaffing conditions (discussed in the Annex) will not be dealt with and instead will be shifted to perform the centralized tasks remaining under the company’s domain. This would put a strong burden of inefficiency onto the sector as a whole.

4.31 The second risk relates to Eletrobrás’ own history. During the last 40 years, Eletrobrás has played a central role not only in developing Brazil’s electricity sector but has also been an important instrument in the country’s industrial and economic development. This success story, however, was achieved with rules that are completely different from (if not opposite to) those that will govern the new model and may even become a handicap to successfully reorienting the sector’s institutions, based on its inertia in past efforts, to change the path of the future.

4.32 What would a new institutional approach entail? The main question is to decide if all centralized activities should be performed by a single or multiple agencies. International experience show a wide range of options in this regard. In England and Wales, for example, dispatch, settlements, ancillary services and some indicative planning (“Seven Years Statement”) are the responsibility of the transmission company. Fully-owned subsidiaries of the National Grid Company (e.g., the National Grid Settlements and National Grid Ancillary Services) performed these tasks. In Argentina, CAMMESA was created to be the company in charge of the administration of the wholesale market. Owned in equal shares by the Secretary of Energy (which retains veto powers over all decisions) and the Associations of Transporters, Distributors, Generators, and Large Users, this company is responsible for dispatch, settlements and administration of the contracts market.

4.33 In England and Wales, rulemaking is left to the Pool members (with the Regulatory Entity retaining veto powers). In Argentina, rules are issued by the Secretary of Energy, generally with little or no consultation with other participants in the market (see Box 4.1 for a discussion of the role of pools). More critically, however, this role can potentially lead to serious conflicts-of-interest and a breach of trust with the sector participants if the political agenda shifts and results in changes in the appointed Energy Secretaries and political interference with the operations of the market via this office’s rulemaking authority.

4.34 Who should be making what decisions? In a market scenario, equity and efficiency in the establishment of the system’s dispatch, coordination and settlement rules are likely to be optimized if the rulemaking authority is placed with representatives of market participants, rather than imposed by a central, government authority. Following the example of the British Pool, an organization that is open to the participation of all actors in the market—i.e., generators, distributors, transporters and large users—should be in charge of designing and approving all rules. The Government’s role would be essentially that of defining the basic framework, generally in a law, that establishes the general principles and objectives that must be followed when designing the rules. Secondly, the Government would provide supervision of the market through two basic mechanisms. One mechanism would be formal veto power placed in the hands of the Regulatory Entity, to be exercised on any initiative which goes against the public interest. The second would be a “must do” authority, also placed with the Regulatory Entity, that enables it to impose rules on participants that are deemed to be necessary to safeguard public interest. These
powers would help to avoid some of the problems actually faced by the British Pool.\(^{20}\)

4.35 The Government could also retain control over a few rules which are central to the functioning of the system: for example, the acceptable level of risk to be considered to calculate firm energy (actually 5 percent). These rules can be identified as being under the Government’s domain in the basic framework, or alternatively, be defined with any proposed changes required to be explicitly approved by the Regulatory Entity or, less formally, to be passed by a qualified majority vote of the market’s representative body.

4.36 **How should the members of the Pool make decisions?** Within the established guidelines and under the supervision of the Regulatory Entity, as described above, members of the Pool should be fully enabled to create and modify rules of the market. Conflict of interest among the different participants (like in any market) is the underlying mechanism that ensures fair outcomes. In principle, different kinds of rules will entail the creation or modification of the definition of qualified majorities, for voting purposes. In turn, voting rules require careful consideration of their design by the organization to guard against situations where the qualified majority requirement results in minority rule or other sub-optimal outcomes (see Box 4.2). The decision-making process will work more smoothly if weighted voting, maximum discussion time before issues are referred to the Regulatory Entity, and appeal mechanisms are integrated at the outset.

4.37 In Brazil, it is also important that regional and social concerns are considered when establishing the voting mechanisms, thereby acknowledging the strong disparities within the system. Alternatively, voting rights can be apportioned according to weights assigned to agents for the purpose of nullifying any bias—e.g., regional—of individual interests in favor of the system. Finally, not all decisions are necessarily made through general voting. As in most “club” type of arrangement, a Management Committee in charge of daily management functions can be established. This requires the Committee’s functions, capabilities, resources and appointment procedures to be clearly spelled out to ensure its sustainability. In fact, the structure and details of the institutional arrangement as a whole deserve more careful consideration and definition in regard to the Brazilian model at this stage of analysis.

\(^{20}\) In the British Pool, where majority votes of 65% are required and the regulator (OFFER) has veto powers, there is ongoing discussion about the decision-making process as some rules fail to get the required consensus. Outside impositions were made by OFFER (re: availability redeclaration and pool price cap) and the Department of Trade and Industry (re: onsite generation). See *Power UK*, March 1995, Issue No. 13.
Box 4.1: A Set of Rules for the Pool

Arrangements by which two or more utilities pool their resources as a mechanism to achieve savings go back to the 1950s. These Pools, which were initially used to provide back-up power and reliability to utility systems, and later to minimize generation costs by inter-utility trading, became the basis of the market in most sector reform programs. Transitioning from a Pool set up with mechanisms for cost savings and marginal trading (usually including a rule to allocate related savings) to a market in which all energy is freely traded among all or most sector participants is a major evolution of sectoral organization. The restructured systems in the U.K., Argentina and Norway exemplify Pools which have acquired quite different forms and functions.

In the U.K., the Pool is an organization open to all participants in the market (similar to a Club) which is in charge of making the rules (known as the Pool and Settlement Agreement) by which the system is governed. The Regulatory Entity has the power to veto any rule which it deems against the public interest.

In Argentina, CAMMESA—the Compañía Administradora del Mercado Eléctrico Mayorista—is a mostly private, legally-constituted corporation in charge of the administration of the Wholesale Power Market. Representation on CAMMESA’s board is limited to delegates from the government-created sectoral associations of Generators (AGEERA), Distributors (ADEERA), Large Users (AGUEERA) and Transporters (ATEERA), each one holding 20 percent of the shares. The remaining 20 percent is in hands of the Federal Government—represented by the Secretary of State for Energy—which has veto powers over all decisions. CAMMESA is in charge of the Physical Dispatch and Settlements of the nationally interconnected system. The rule-making authority, however, is with the Secretary of Energy under article 35 of the Electricity Act.

In Norway, the Pool—originally limited to large generators—was opened to all participants by the Electricity Law of 1991. Three markets (one weekly, one daily and one spot) are operated by the Pool which is also in charge of system coordination. These markets have the function of short-term optimization as there is no central dispatch entity (long-term contracts are based on physical energy and therefore determine dispatch) by allowing generators to achieve cost minimization through trade.

These particular arrangements are the outcome of specific situations in each country which do not necessarily apply to the Brazilian case. The design of the functions and responsibilities of the Pool are a cornerstone of the restructuring process which deserves careful analysis in each case.

The main task of the Pool as an organization comprising all sector actors should be rulemaking. In fact, an efficient Pool can be seen as the set of rules of engagement freely agreed by all members. Conflict of interest among participants (generators pushing for higher and users for lower prices, for example) is the mechanism by which fair rules are obtained. Regulatory supervision has also to be included as a mechanism by which to safeguard the public interest (which goes beyond the electricity sector).

4.38 Who should be in charge of settlements? One of the new features associated with the creation of an electricity market is the need to administer the payment function between all participants on a continuous basis. The workload of the settlement procedure currently carried out by Eletrobrás will increase dramatically when the system is restructured and the scope and frequency of the tasks are greatly expanded. The new market will require hourly credits and debits to be computed for each participant in the spot market, and transmission charges to be collected and paid to the transmission company. Billing, collection and payment tasks can be performed by more than one agent as these are completely separable activities and current technology can fully support the transfer of massive amounts of data from the system’s data collection instruments (i.e., meters) to the settlement agency. The Pool members must set the rules for data transfer, validation and dispute resolution; after which the actual settlement procedures can be undertaken by a specialized agency.
Box 4.2 Voting Rules

Voting arrangements are crucial to the outcome of the decision-making process. Qualified majority shareholder/voting requirements, veto powers, weighting factors, and other features have to be carefully designed to avoid undesired results. To illustrate the kind of problems that may arise when designing the voting scheme, consider the following example. Imagine that there are three different agents with voting rights in the transmission company, each with 33.3% of votes. Assume also that a proposal can be rejected by any group having at least 30 percent of the votes (as is the case with transmission expansion in Argentina). There are two alternative projects (A1 and A2) and a third alternative (B) for which no project is planned. The preferences are:

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<td>1   2  3</td>
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<tr>
<td>Agents</td>
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<tr>
<td>I  A1 A2 B</td>
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<tr>
<td>II A1 A2 B</td>
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<tr>
<td>III A2 A1 B</td>
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Having to choose between A1 and A2, Agent III rejects A1 in favor of A2. Given the choice between A2 and B, no one objects and A2 (an option with less support) is chosen. By requiring a qualified majority to approve a project, a de facto practice of minority rule is imposed on the group. To explore this issue further, the following preferences can also be assumed:

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<th>Project Ranking</th>
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<td>1   2  3</td>
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<td>Agents</td>
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<td>I  A1 B A2</td>
</tr>
<tr>
<td>II A1 A2 B</td>
</tr>
<tr>
<td>III A2 B A1</td>
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In this case, no project can move ahead. Between A1 and B, Agent III would veto A1. If a vote between A2 and B is called, A2 is vetoed by Agent I. While everybody prefers at least one of the alternatives to doing nothing, the votes results in no project being developed.

4.39 One plausible option for maximizing efficiency in this task is to contract out the settlements service to an agency specializing in the field. For example, financial institutions certainly have the know-how—and possibly economies of scope, as well—to perform the settlement tasks efficiently. Competitive bidding for this service would enable the Pool to secure a qualified contractor at the lowest possible price, and for fixed periods (around five years appears to be a good term) to keep the performance of the service at its competitive best.  

4.40 Enforcing payment. One of the most important problems faced by the electricity sector in Brazil and in many other developing countries is enforcing payments. An immediate

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21 As there are very minor sunk costs in this activity (computers can be moved to a different task) and very fast technological changes, there should be no problem in changing the service provider.
and comprehensive solution for the problem needs to be found by the GoB whether it restructures the sector or not. If restructuring proceeds as planned and a market-based system is adopted, solving the non-payment problem will be a high priority as timely payment for services provided is the primary requisite for any market.

4.41 In Brazil, although matters have recently improved, non-payment has been common at all levels: i.e., between distributors and generators, between state and federal governments; between utilities and governments; and between final users and distribution companies. The spread and social and political complexity of the problem call for a deep and comprehensive solution. At the wholesale level (i.e., for transactions between generators and distribution companies in the Pool), the most effective way of dealing with the issue is to have an inviolable rule that any company that fails to pay its bill on time will be excluded from participation in the system. Failure to enforce the rule will certainly result in higher costs for the whole system, as the risk of investing in the sector subsequently increases.

4.42 Who should be planning what and why? The need for planning in the electricity sector is related to technological factors such as indivisibility, inability to store, strong externalities, etc. In Brazil, it is widely recognized by public and private sector specialists alike that these factors are augmented by geographical and resource endowment peculiarities. The undertaking of system-wide technical and economic studies and planning are activities with strong economies of scope and positive externalities. An agency with centralized faculties to perform these studies, make relevant forecasts for the sector, and make its findings publicly available provides additional transparency to system participants. This, in turn, promotes greater competitiveness and thus efficiency in the sector. For the planning process to be credible, however, the independence of the designated agency from vested political interests and particular interests of the sector (e.g., generators or users) needs to be provided.

4.43 Given that complete independence is difficult to achieve or maintain, however, it may be just as effective to establish the agency under joint control, thereby relying on conflicting interests to secure the impartiality of the entity. Formal or structured dependence within the context of the Pool thus seems a practical way of achieving the "independence" of the planning agency. Social ownership will also serve to ensure non-discriminatory access to all studies and forecasts done by the agency.

4.44 Another possible means of distancing the planning agency from political and sectoral influence is to have the agency depend, through an arm's length relationship, on the Regulatory Entity. The studies and other tasks--covering transmission and generation expansion plans, feasibility studies, demand forecasts and sectoral statistics--can be competitively contracted out to various firms and institutions for fixed periods of time. Decentralizing the contracts to involve various experts in private firms, universities, research

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22 Pluri-annual reservoirs in the Brazilian system, to name but one, require a five-year horizon in order to devise an optimal operation plan (i.e., decisions taken today will have direct effects during the next five years).

23 The indicative planning agency would, for example, make available a list with the best hydro "sites" likely to be developed.

24 Political interference can result in an upward bias (low growth forecasts may be politically costly) and also in a regional bias.
centers, non-governmental organizations (NGOs) and so forth throughout the country offers an attractive means of broadly establishing impartiality and acquiring high quality results.

4.45 Professionals working in this area under Eletrobrás, which has historically undertaken these studies under recognized standards of excellence, can be recruited to staff the planning agency. These professionals may be able to facilitate, through their established contacts with existing sector participants and their understanding of the physical elements of system planning, the full access to the information on sector activities and participants which is necessary to enable the agency to perform its task. Provisions to authorize the agency to collect the information from all sector participants should also be included in the sector’s basic legal framework established for the Pool.

4.46 **The Regulator and the Pool.** The relationship between the Regulatory Entity and the power pool is an issue which has to be carefully analyzed and depends basically on the form that the power pool takes. Using the example of a Pool as presented in this paper--i.e., a club of all actors in the system in charge of designing their own rules of commercial operation within a previously defined framework--would require formal supervisory powers for the Regulatory Entity to be adopted. These powers should take two basic forms. One would be formal veto authority by which the Regulatory Entity should oppose any initiative which goes against the public interest. Second, the Regulatory Entity should have the capability to impose rules on participants which uphold the public interest.

4.47 Given that a main focus of the Regulatory Entity’s functions in regard to the Pool is the protection of the common interest, it must take on the responsibility of assessing the likely impact of Pool rules on the economy as a whole. For example, environmental problems associated with the sector represent the kind of externalities which can have a strong impact on the economy at large. Representing the interests of captive consumers vis-à-vis the Pool would similarly fall under the domain of regulatory responsibility.

4.48 **Summing up.** Based on the international experience and Brazilian realities, the most important institutional elements needed for the market structure under consideration seem to involve the following:

- decision-making authority in the hands of Pool members, subject to regulatory supervision (including veto and “must do” powers);
- indicative planning carried out by a “new agency”, possibly under the Pool;
- settlements among system actors to be performed by a specialized agency.

4.49 The proposed institutional and organizational arrangement emphasizes a shift to decentralized management and oversight through small, highly specialized agencies. The arrangement relies primarily on conflict of interest and carefully designed incentive mechanisms to optimize the efficiency and impartiality of the agencies--or their contractors--in performing the assigned functions.
Chapter 5: THE CHALLENGES TO REFORM

5.1 Even if all the issues brought out in Chapter 2 and discussed in Chapters 3 and 4 are technically resolved, the Reform Committee is likely to face some serious challenges that cannot be addressed by technical studies. The main purpose of this last chapter is to take stock of these challenges.

5.2 Dealing with resistance to change. The international experience and the initially slow development of Brazil's reform process suggest that the first challenge, and perhaps the most difficult to address, is the need to learn how to operate a newly reconfigured system despite the resistance of some of its participants to (at least) some aspects of the reform, which are often due to misunderstandings within the sector. Many participants in public electricity supply systems tend to have difficulty recognizing that electricity only differs from other traded commodities in the details of the arrangement needed to manage it efficiently. Electricity market arrangements are not different from other commodity markets due to the fact that electricity cannot be stored at reasonable cost; nor that it must be transported through a highly coordinated and integrated physical dispatch system with natural monopoly characteristics; nor that the market concepts and instruments used for other commodities that are costly to store and to move cannot be applied to electricity.

5.3 The standard market-based orientation is to minimize moving and storage stages in the producer-to-user supply chain by developing local spot markets that instantly match constantly changing physical demand and supply at diverse locations. Because of the volatility in demand and supply, a centralized clearing process is needed to collect all buy and sell offers at various prices and instruct the successful sellers and buyers of their respective obligations. This is done for many commodities or financial trades and it can and has been done in the electricity sector.

5.4 The challenge for the Brazilian reformers, then, is to convince the relevant government entities to allow the independent management of the clearing house, similar to that for any other stock or commodity market; and to relinquish their current control of the market. To do this, they must cease efforts to perpetrate only cosmetic redesigning of existing utility dispatch and pooling processes.

5.5 If the Government continues trying to intervene—whether through tariff controls for macroeconomic purposes or through direct intervention in the allocation of resources by private investors—information on the number, diversity and costs of generating plant projects and pertinent demand features will be biased when it emerges from the clearing-house mechanism. This will skew the information on the major determinants of long-run costs and needs in the sector, and tend to increase the risks as well as make them inconsistent with the expected rates of return for the sector.

For a clear advocacy of what is needed to get to a competitive electricity industry see Ruff, L. (1994), "Stop Wheeling and Start Dealing: Resolving the Transmission Dilemma," The Electricity Journal, Vol. 7, No. 5, June, pp. 24-43. This paragraph and the next one summarize much of Ruff’s argument.

These considerations matter in the way that the various functions of the sector are unbundled as discussed in Chapter 2.
5.6 Moreover, the private sector—particularly the best-qualified private operators—will be likely to hesitate and avoid participating in the “reformed” sector unless the Government and existing sector enterprises explicitly accept the need to reform the State’s role in the economy. If the reform is successful, the Government will largely cede its role as a supplier (how about Itaipu?) and become primarily a policy maker and a regulator on behalf of the general public’s interest. It will also serve as an arbitrator—through some specified agency—when competition does not work properly. This role is widely accepted by many of the key federal actors in the sector and reflected in the various reform proposals considered by the Special Inter-Ministerial Committee.\textsuperscript{27}

5.7 The second area of challenge is changing the federal-state organization of the sector. Although the power of granting concessions for electricity generation, transmission and distribution in Brazil rests with the federal government, the fact that most States have their own electricity companies under federal concessions imposes some political constraints on the model to be adopted. As discussed below, the impact of this dichotomy is particularly strong on transmission arrangements, as this activity is inter-state by nature. The states are thus key players and many, by virtue of their own critical role in sector activities, have significant leverage on discussions dealing with the overall design of a new system. For instance, the State of São Paulo manages generation, transmission and distribution activities that are roughly equivalent to those managed for all the rest of Brazil! The states of Minas Gerais and Rio de Janeiro are also large by any standard, and other states that are close to the Argentinean border have the option of connecting to alternative systems.

5.8 In parallel with the reform discussions, São Paulo and Minas Gerais State are pressing for their own transmission company, which could conflict with the idea of a single federally-owned transmission company for that interconnected system even if the latter is, as some believe, the most beneficial solution from an efficiency perspective. This situation demonstrates how state initiatives can and will affect the overall redesigning of the system and may limit the nature of some aspects of reform and the speed of its implementation. The challenge at the federal level is to anticipate the areas of potential crisis or impasse—which is possible due to the generally slower pace of restructuring at the state level—and to propose a new model that internalizes many of the states’ major issues without increasing risks to private investors already locked in contracts with the federal government.

5.9 The third challenge stems from the major regional and social disparities that characterize Brazil. The everlasting discussions on the differences between the poor north and the rich south apply to the electricity sector as they do to all others, and subsidies appear as one of the relevant outstanding sub-topics. These issues, and the use of cross-subsidies, are reviewed in the following discussion.

5.10 Many of the potential or actual domestic customers in the North are poor and many are unlikely to be able to afford payment of electricity bills based on full-cost recovery. Meanwhile, subsidies are hardly a feasible option since the tax base of these states is

\textsuperscript{27} It is difficult to resist the temptation of an unlikely quotation picked up from the last paragraph of Keynes’ General Theory: “The ideas which are here expressed so laboriously are extremely simple and should be obvious. The difficulty lies, not with the new ideas, but in escaping from the old ones, which ramify, for those brought up as most of us have been, into every corner of our minds.” (1935)
generally much too limited to enable any significant level of local tax-based financing of targeted subsidies to the poor. This leaves consumer cross-subsidies as the only practical means to providing meaningful public electricity service in the region.

5.11 With the prescience of the cross-subsidy burden that they will have to bear, private investors are unlikely to be attracted to locate in, for example, the nine states comprising Eletronorte’s service territory. One of the few exceptions may be large captive users, such as the aluminum smelter in Pará that is the major electricity consumer in the region.

5.12 Similarly, there is concern about what will happen to rural zones in provinces such as Rio de Janeiro, and to the privatization prospects of the Companhia de Energia de Rio de Janeiro (CERJ)—supplying electricity to impoverished areas traditionally prone to high commercial losses—under a model that emphasizes increasing private sector participation across-the-board. Previously, politicians willingly accepted such large losses for their public companies because of redistributive trade-offs, but private owners are unlikely to continue this practice.

5.13 While consumer class cross-subsidies are economically inefficient and difficult to maintain in a competitive environment (as competitors can easily steal clients that have an obligation to contribute to subsidies for other customers), direct subsidies present serious political problems. Inter-regional subsidization, however, has been one of the prevalent development tools used by the sector. For example, service expansion in the North has typically been financed by electricity consumption or asset-based taxes in the South, which may not have been an unreasonable mechanism in a country where the tax system tends to be regressive. The redistributive challenge is clearly a serious one and it needs to be addressed if the reform is to be sustainable, even if the overriding objectives of the reform are improving efficiency and attracting new sources of financing.

5.14 The fourth challenge revolves around the contracts and commitments made prior to the reforms and which would be too costly to renegotiate. A good example of this kind of contract are those resulting from the creation of Itaipú. Many distribution companies are currently saddled with contracts for power supplied at specific rates from the binational entity. The treatment of Itaipú and its contractual supply agreements if (and only if) the set rates are uncompetitive under a reformed sector is a matter for consideration. Itaipú’s supply contracts with state distribution companies—which were set to cover the hydroelectric project’s large sunk costs—may also give rise to difficulties for the individual states when they try to attract private investors to provide this service, but fail because of the immutable nature of the contracts. This is clearly a difficult, but nonetheless mostly political, challenge. There are various possible economic solutions as discussed in Chapter 4—all based on the simple principle that sunk costs should not matter—but these options will have to be weighed against their political costs.

5.15 The final challenge to discuss is the handling of the excessive employment levels in the sector’s public enterprises. As in many other areas of service currently provided by Brazil’s large public sector, electricity service has tended to be excessively labor intensive, as seen in the Annex. Labor groups, therefore, are mounting a strong lobbying effort against reform, as the proposed changes and introduction of competition would definitely result in streamlining jobs in all sector activities.
5.16 The anticipated reduction of jobs is also a serious social concern that the Government could address proactively, as is being done for the reform of the railways sector. Redundancy packages and the design of their level/scope/value and targeting are important components of any sector restructuring (and RFFSA’s recent effort is a good model) and are likely to impose one of the most difficult challenges to not only the Reform Committee, but also to the GoB’s core economic team. Indeed, as reforms spread to other sectors, labor redundancy is likely to become an increasingly pressing concern as the relative absorptive capacity of regional labor markets shrinks when faced with a rapidly increasing volume of unemployment. Unless enough resources are allocated to the retraining and social needs of these workers, the viability of the reform process will itself be threatened.

5.17 Transition problems. The transition from the existing centralized federal- and state-owned electricity system to a decentralized, mostly privatized system will be, as all transitions are, a costly process. Potential ways to minimize the adjustment costs involved in the transition process deserve immediate analysis at both the federal and state government levels, to prepare for the implementation of the reform program. Two approaches to this issue can be followed: a “big bang” or an incremental approach.

5.18 The big bang approach is an abrupt change in which everything is changed within a relatively short period (i.e., one or two years). This revolutionary approach to ESI restructuring was followed in the cases of England and Wales and of Argentina. The costs of this approach relate mainly to efficiency, because the short time constraint imposed on the reformers forces the adoption of quick, but not necessarily optimal, solutions. The problems arising after the restructuring is completed are then left to be resolved by the market, the Regulatory Entity and/or the government as they arise. The subsequent renegotiation process can, however, be very costly for all involved parties. The benefits of this approach are largely political, but may also eventually result in higher asset sale prices, which is important if fiscal concerns are a motivating factor of the reform. Higher prices normally ensue when the ability of a government to implement a restructuring process within a short period sends a clear signal of the political commitment to reform and subsequently increases investor confidence in the country. Furthermore, a big bang transformation often preempts strong opposition from interest groups both within and outside of the sector. Strong political will and the capacity to impose centralized decisions on all actors in the system are sine qua non conditions for the adoption of this approach.

5.19 The alternative approach is an incremental process which involves taking a long time to discuss the model to be adopted and, once this is decided, changes are gradually and slowly implemented. This approach tends to have fewer inefficiency costs as alternatives are carefully assessed, discussed and modified before implementation. The main cost associated to this alternative is the risk that the process will go on forever as interest groups have more time to organize and mobilize forces in opposition and often request additional time for discussion as a delaying tactic for the whole process.

5.20 The political, institutional and economic conditions in Brazil call for an intermediate approach, as correctly assessed by the Reform Committee. The GoB is conducting careful evaluations of the proposed model while concurrently taking concrete steps
towards restructuring. While this alternative seems to combine the best features of the other approaches, there are nonetheless some inherent risks which should be avoided. For example, the fragmented character of the restructuring process in Brazil and the complexity of the reform creates the risk that measures will be adopted at one level of government that could seriously constrain the progress of the reform process as a whole. In this context, it seems worthwhile to discuss some suggestions on how these risks can be avoided. The suggestions can be divided into two different groups:

- measures that should be taken immediately to allow the process to continue as smoothly as possible.
- measures which should be avoided or at least postponed until a structure is adopted for the ESI.

5.21 The first group includes practical measures related to broad decisions that have already been taken and political decisions which need immediate resolution to allow the process to unfold. These include:

- Separating the accounting for generation, transmission and distribution activities;
- Pricing distribution services;
- Creating an independent Regulatory Entity; and
- Defining and drawing up the contracts to be transferred with the companies.

5.22 Separate accounting. Separate accounting by all electric utilities, as proposed by the Inter-Ministerial Committee, is a task which should be undertaken immediately to facilitate vertical disintegration, a goal already adopted in Brazilian legislation. This task should not only start immediately, but also be concluded within a very short timespan (e.g., six months or so), and is a cornerstone of all major reform programs. Some states (e.g., São Paulo and Minas Gerais) apparently have already started efforts in this area, but all states should quickly follow their initiative.

5.23 Pricing distribution services. A second step towards total accounting separation is to adopt distribution tariffs which are independent from both wholesale (generation and transmission) prices and from supply arrangements. Adopting a pricing mechanism with these characteristics will add transparency to the system, allowing interested parties (large customers) to understand the cost structure in place if they decide to participate in the wholesale market.

5.24 Independent Regulatory Entity. The creation of an independent Regulatory Entity is probably the most crucial political effort which still remains to be taken in Brazil. Although there are various legislative proposals under discussion, these do not seem to fulfill the needs of a reformed electricity sector. The existence of an independent regulatory authority, the way in which its members will be appointed, and the general framework under which it will discharge its duties are of paramount importance for private sector investors. Even if the entire restructuring model is not yet clearly defined, the creation of a Regulatory Entity that is premised upon a fair and reasonable organizational and operational basis as perceived by private investors would add credibility to the whole restructuring process.
Box 5.1 Some Issues with the Draft Law Proposal (December 28, 1995) to Reform DNAEE

Brazil is working hard at trying to reform its electricity sector. The proposal to reform DNAEE is a good illustration of these efforts but it also illustrates the difficulties in reconciling existing institutions with the needs of a restructured sector. The proposal, while very thoughtful on many aspects, raises some significant issues as it stands. The comments below cover the areas where the proposal is inconsistent with the government's hope to establish an effectively independent regulatory entity to avoid conflicts of interest with private and publicly owned utilities (and this is what it needs to do to give a credible commitment to private investor):

(i) the institutional setup of the regulator, its responsibilities, its relationship with the different branches of the Government, and its staffing system need clarification to guarantee the independence of the regulator. For instance, the system to select and remove the key members of the regulatory body has not yet been spelled out. This is needed in order to ensure a mix of professional competencies and to isolate them from short-term political concerns during their term of office. But more importantly, as proposed, the new entity would lack some more basic building blocks of independence such, limits on review and appeal of its decisions; fixed, staggered terms for its members; clear legal mandates to perform its duties; limits on the Government ability to remove members before the end of their terms; prohibition of current and future financial ties to regulated entities; and restrictions on future employment with regulated enterprises. Also, the division of responsibilities between the national regulatory entity and other federal entities needs to be more clearly delineated (the horizontal split). And there is no need to create new players. For instance, the analysis and studies proposed to be carried out by a new Council of Public Services should in fact be performed by the regulator. Such a Council would only undermine the authority and possibly the independence of the regulator. Finally, the division of responsibilities between the national regulatory entity and future state regulatory entities needs to be more clearly delineated (the vertical split).

(ii) the process of regulation, including the procedures to approve tariffs and tariff adjustments should be based on clear and transparent rules, not subject to political interference (or macroeconomic objectives). The regulatory entity needs clear and primary authority to perform the basic regulatory task: tariff setting. To require the regulator to set tariffs following the instructions of the Ministers of Finance and Mines and Energy (Art. 13 of the draft proposal) does not improve on the current situation. Concession and power sales contracts have to be enforced by an independent regulator. If the regulator is not able to enforce the tariffs or tariff formulas contained in those contracts, private investment will come at an unnecessarily high price or not come at all in some cases;

(iii) the procedures to review mergers and other corporate affiliations to preserve competition in the sector. The proposed entity (or some other national government entity) needs to have clear authority in this area; and

(iv) separation of the regulator from activities that can compromise its independence or create conflict of interest. For example, we think it would be unwise for the national regulatory entity to participate in the planning process or perform the technical role of collecting hydrologic data. These functions should be performed by other government bodies. The regulatory entity should only be performing a regulatory role: promoting competition where feasible and monitoring and controlling monopoly enterprises where competition is not feasible.

5.25 Defining and drawing up contracts to be transferred. An additional measure for consideration is to put in place formal contracts between the different segments of the industry prior to its privatization as done in the UK and in Argentina where medium term contracts between generators and distributors are a common feature. Provisions for gradually phasing out these contracts would allow for a smooth transition in the wholesale market. Although not a measure that has to be taken immediately, arrangements of this kind can
facilitate the adaptation process once the system is finally restructured. Setting the right prices for these contracts is not easy and will require careful consideration. At the aggregate level, these contracts will have no effect on the price to be obtained via privatization, but their impact on a particular business unit could be very significant.

5.26 The second group of suggestions aimed at minimizing risks relates to issues that should be avoided until the sectoral framework is clearly defined. Mainly this concerns the states, which are contemplating the privatization of their electric enterprises. The risk for the states is in concluding a concession contract that might later prove inconsistent with the final reform model adopted by the sector, thus leading to costly renegotiation of the contract.

5.27 Avoid privatizing integrated companies. Privatizing vertically-integrated companies is a disastrous mistake that has to be avoided at all costs. Giving property rights to the private sector for vertically-integrated companies can seriously jeopardize the viability of the entire restructuring process (if the company is big enough) or impose large renegotiation costs (for smaller companies). One such case has already occurred with the privatization of ESCELSA by the Federal Government in 1995. Although in this case the contractual clauses are vague enough to allow for major changes to be introduced and there is very little generation involved, the costs of the ensuing renegotiation could have been very high otherwise.

5.28 Adopt a new tariff structure. Given the political pressure to keep the privatization process moving, many states will possibly face the need to privatize their electricity companies in the near future. Adopting a distribution tariff that is independent of wholesale prices and supply arrangements (such as the one discussed above) is a flexible arrangement compatible with any type of wholesale market organization.
ANNEX: A SNAPSHOT OF BRAZIL’S ELECTRICITY SECTOR

This annex provides a brief overview of the current state of Brazil’s electricity sector. It discusses the complex organization of an ESI that is one of the largest in the world and is likely to become even larger. Demand is strong, with the average annual growth in electricity consumption consistently outpacing growth in GDP in recent years. The demand pattern, however, may be biased as a result of distortions in the tariff system. The current tariff system allows complex cross-subsidies which are, however, not always as progressive as could be expected in a country where social concerns are prominently featured in the reform agenda. The pattern also shows that controlled tariff levels are unlikely to be able to finance sector requirements, expected to be about US$6 billion annually in new investments over the next four years to meet forecast demand levels. Tariffs are not the only way of financing the sector, and the Annex illustrates the areas where there is room for cost-cutting measures and improvements in productivity.

A.1 Sector Organization

Power policy making and sector management in Brazil are under the Ministry of Mines and Energy (MME), which formulates the country’s energy policy, enforces and coordinates execution of the policy, supervises and controls the development of hydro and other energy resources, and monitors all activities related to the power sector, especially the rendering of electricity services.\(^{28}\) The MME manages the power sector through three key departments and one government enterprise: (i) the National Water and Electric Energy Department (DNAEE), which submits data required for concessions or permits relevant to providing electric power services, for approval by the MME; establishes tariff levels and structures; monitors and controls electric power utilities; and bestows concessions or permits for the development of potential hydroelectric sites; (ii) the National Energy Development Department (DNDE), which promotes electrification programs and the use of alternative energy sources; (iii) the National Fuels Department (DNC), which oversees the policy and development of hydrocarbon resources, via the national petroleum company (Petrobrás); and (iv) Eletrobrás, a government-owned enterprise who acts as an agent of the federal government in the sector, serves as a federal holding company for other federal utilities, and is in fact the main operator of the sector.

Industry Structure. The Brazilian electricity industry, although made up of more than sixty-five companies, is largely vertically integrated. The companies supplying electricity can be divided into three categories according to the main activity of the company: i.e., generation, combined generation and transmission, and distribution companies. These companies are controlled by six types of owners, as shown in Table A.1.

The federal government directly controls eight companies through Eletrobrás, which has planning and policy execution responsibilities. Other Eletrobrás functions include preparing guidelines for the power sector activities conforming to federal energy policies; coordinating expansion and

operational planning of the distinct electric systems; financing or transferring funds from international credit organizations to the electric utilities; and acting as a holding and investment enterprise. Eletrobrás is also active in the research and development of technologies that are of interest to the power sector, mobilizing engineering companies, manufacturing industries and laboratories through the Electric Energy Research Center (CEPEL) and controlling the capital of NUCLEN, a federal entity which is engaged in basic engineering for nuclear power and in the general development of technologies for use by the power sector.

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<td>Federal</td>
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<tr>
<td>Generation</td>
<td>Itaipú</td>
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<tr>
<td>Holding and planning</td>
<td>Eletrobrás</td>
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<td>Generation</td>
<td>Furnas</td>
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<td>Distribution</td>
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<td>Generation and distribution</td>
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<td>Nuclear engineering</td>
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<tr>
<td></td>
<td>CEPEL</td>
</tr>
<tr>
<td>State</td>
<td></td>
</tr>
<tr>
<td>Generation and distribution</td>
<td>CESP</td>
</tr>
<tr>
<td>Distribution</td>
<td>CEMIG</td>
</tr>
<tr>
<td></td>
<td>COPEL</td>
</tr>
<tr>
<td></td>
<td>CERON, ELETOACRE, CEMAM, CER, CEPASA, COELCE, CERLA, CEA, CEMAR, CELPA, CFO, CELPE, CEM, ENERGITE, CPFL, CELES, CERJ, ELETROPAULO, ENSOR, EBR, CEB, CEE, CELG, CEMAT, COELBA</td>
</tr>
<tr>
<td>Municipal</td>
<td></td>
</tr>
<tr>
<td>Distribution</td>
<td>CELB, DME-PC, COCEL, ELETROCAR, PMJU</td>
</tr>
<tr>
<td>Private</td>
<td></td>
</tr>
<tr>
<td>Distribution</td>
<td>CELTINS, SULGAP, CPLCF, ENERGISAO, ELPSM, ECL, EEB, CAIUA, JAGUARI, CREE MOCOCALFSC, CSPE, EEVP CNEE, EFLUL, HXL, XANXERE, PANAMBI, NOVA PALMA, CESP, ENERGISAO, ESCELSA</td>
</tr>
</tbody>
</table>

government electric companies, twenty-eight in total, make up an important group of utilities largely engaged in distribution. Exceptions include CESP, CEMIG, COPEL, and CEE, which also possess significant generating and transmission systems.
Five small distribution companies are under municipal control. The private sector operates twenty-four distribution companies, but these are small and only account for two percent of the distribution market.

Finally, the GoB, via Eletrobrãs, and the Government of Paraguay own equal shares of the binational hydroelectric complex of Itaipú. Eletrobrãs is responsible for the dominant share of generation (i.e., 49.5 percent of all electricity generation in Brazil, including the electricity imported from Itaipú) and has a large share of the distribution market (20.2 percent). State concessionaires dominate in the distribution area, being responsible for close to 78 percent of the total national distribution.

The regional distribution of electricity supply in Brazil is shown in Figure A.1. There are two main interconnected transmission grids: the North/North East (N/NE) and South/Southeast/Midwest (S/SE/CO). Regional federal companies, in addition to meeting most of the power needs of the distribution companies, are also responsible for regional interconnection service for the two main interconnected grids. In December 1994, a national transmission system, the Sistema Interconectado Nacional de Transmissão Elétrica (SINTREL), was created. Currently it is composed of Eletrobrãs’ subsidiary companies, but it is hoped that SINTREL will become the basis for a single transmission company operating the interconnected system. Under SINTREL, large users (i.e., those with more than 10 MW of peak demand and connected at a voltage of 69 kV or more) are expected to be able to purchase electricity from any supplier in Brazil with access to the SINTREL system.

<table>
<thead>
<tr>
<th>Table A.2 : Shares in Electricity Supply (1993)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Generation</strong></td>
</tr>
<tr>
<td>Eletrobrãs</td>
</tr>
<tr>
<td>Itaipú (Brazilian share)</td>
</tr>
<tr>
<td>Itaipú (imports from Paraguay)</td>
</tr>
<tr>
<td>State Concessionaires</td>
</tr>
<tr>
<td>Municipal Private Concessionaires</td>
</tr>
<tr>
<td>Independent Power Producers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Distribution</strong></th>
<th><strong>Share (%)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Eletrobrãs</td>
<td>20.2</td>
</tr>
<tr>
<td>State Concessionaires</td>
<td>77.7</td>
</tr>
<tr>
<td>Municipal Private Concessionaires</td>
<td>2.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Transmission</strong></th>
<th><strong>Share (%)</strong></th>
</tr>
</thead>
</table>

Source: DNAEE.

The fact that the government has already allowed the creation of IPPs is a good indication that open access legislation is assured, since IPPs will have free access to the transmission network to be able to sell their excess power output. How the transmission system is to specifically evolve under the reform process is one of the key areas under study by the Reform Committee.

Complex inter-company ownership linkages. One of the characteristics of the Brazilian electricity system that may incur notable difficulties in the privatization process is the intricate, multi-layered ownership of assets. For example, in the case of Light, a distribution company serving Rio de Janeiro, Eletrobrãs is the primary owner, holding as much as 82 percent of the shares. This would
suggest that there should be no obstacle to privatizing the company. However, Light also happens to be a main holder of Eletropaulo (48 percent) shares, thus sharing ownership of the larger utility with the state of São Paulo. Therefore, the ease of Light's privatization depends largely on how the Government of São Paulo State perceives the changing of its partner in Eletropaulo! The same sort of problem is arising in many other distribution companies.

Figure A.1

Geographical Organization of the Sector
Summing up the relevant institutional features. This description highlights some of the key institutional features that have to be addressed by the proposals and that serve to define the starting point of the reform vis-à-vis sector institutions. These features include:

- a vertically-integrated structure combining national, regional and state monopolies in a complex network of cross-ownership controlling most generation, transmission and distribution assets;
- an omnipresence of Eletrobrás in all activities of the sector, including banking, investment and technology development;
- little experience in dealing with the private sector, since it has had only a minor role in distribution;
- two interconnected systems that need to be integrated to allow more efficient supply of electricity in the country [is this practical? very high cost?];
- small markets in the North separated by long distances, making local generation a necessity;
- greater compliance with energy-policy guidelines among federal regional companies, and the predominance of local interests in state-level companies; and
- a need for adequate coordination to achieve in a complete and coherent manner both national and local objectives.

A.2 Electricity Demand

As noted earlier, total consumption of electric power in Brazil has grown faster than the country’s economy (see Table A.3). Consumption of electric energy growing at 3.3 percent for 1992 also outpaced the growth in overall energy consumption, estimated at 1.9 percent for the same year. The high demand growth rate can be attributed to population increases, a surge in the use of electrical devices, the modernization and automation of many industries, and to the growth of the informal sector. Things are going to get worse. Maximum demand was about 36,000 MW in 1994, but Eletrobrás expects it to increase to some level between 90,000 and 125,000 MW by 2015. For now, Brazil’s installed capacity is about 53,000 MW (In practice, the relevant capacity is much less, based on the usual limitations relevant to the effectiveness of hydro systems, such as importance of weather conditions; this implies that only a fraction of this potential is in fact available). The gap between future maximum demand and current capacity gives a clear indication as to why there is a serious concern with the need to invest in the sector.

---

Table A.3: Consumption and GDP Growth

<table>
<thead>
<tr>
<th>Period</th>
<th>Consumption annual growth rate (％)</th>
<th>GDP annual growth rate (％)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>13.00</td>
<td>12.40</td>
</tr>
<tr>
<td>1979</td>
<td>12.10</td>
<td>6.70</td>
</tr>
<tr>
<td>1983</td>
<td>6.40</td>
<td>0.40</td>
</tr>
<tr>
<td>1986</td>
<td>8.60</td>
<td>6.90</td>
</tr>
<tr>
<td>1986-1990</td>
<td>4.30</td>
<td>0.60</td>
</tr>
<tr>
<td>1990-1992</td>
<td>3.20</td>
<td>0.14</td>
</tr>
</tbody>
</table>

Note: in 1979/83 and 1986/90, the combination of increases in the share of informal or unaccounted for activities—which are not reflected in national accounts—and of increases in electricity—fully reflected in national accounts—explain in part the very high elasticities observed during these periods.

Consumption patterns. Brazil’s consumption patterns are not very typical as seen in Table A.4. Among the reasons for the differences across countries observed in Table A.4 is the smaller service sector and predominance of energy-intensive industries in Brazil compared to the international average, as well as the smaller share of self-generation among the industries. There are about 3,000 self-generators and their role has changed significantly over time. In 1950, self-producers accounted for 11.2 percent of the supply market (740 GWh) compared to 4.7 percent of the same (11,180 GWh) in 1993. The self-generators are mostly energy-intensive industries (petrochemical, aluminum and steel, paper, and cement industries, for example). Their relative importance is, however, likely to change over time as the share of consumption by the industrial sector declines as Brazil switches to a more service-oriented economy, with less energy-intensive industries.

Presently, industrial consumers account for 50 percent of Brazil’s available energy, while residential consumers represent 24 percent, the rural sector and street lighting together account for 14 percent, and commercial users, 12 percent. Consumption has grown the fastest in the industrial sector, at 8.9 percent, while commercial, and residential consumption grew at 8.4 percent and 7.4 percent.

Table A.4: Electricity Consumption Patterns

<table>
<thead>
<tr>
<th></th>
<th>Brazil</th>
<th>World Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>24%</td>
<td>35%</td>
</tr>
<tr>
<td>Commercial</td>
<td>12%</td>
<td>28%</td>
</tr>
<tr>
<td>Industrial</td>
<td>50%</td>
<td>34%</td>
</tr>
<tr>
<td>Other</td>
<td>14%</td>
<td>3%</td>
</tr>
</tbody>
</table>

Note: The “other” category includes public street and highway lighting, other sales to public authorities and sales to railroads and railways, as well as interdepartmental sales for the world average. Public authorities in Brazil make up a high proportion of total consumption, thereby biasing the estimated share of the “other” category upward compared to the world average.

Table A.5: Regional Distribution of the Brazilian Electricity Market--1993

<table>
<thead>
<tr>
<th>Region</th>
<th>North</th>
<th>Northeast</th>
<th>Southeast</th>
<th>South</th>
<th>Central-West</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Consumption (GWh)</td>
<td>11,131</td>
<td>35,743</td>
<td>137,068</td>
<td>32,886</td>
<td>10,216</td>
</tr>
<tr>
<td>Industrial Consumption (%)</td>
<td>61</td>
<td>54</td>
<td>52</td>
<td>42</td>
<td>24</td>
</tr>
<tr>
<td>Residential Consumption (%)</td>
<td>19</td>
<td>21</td>
<td>23</td>
<td>26</td>
<td>35</td>
</tr>
<tr>
<td>Commercial Consumption (%)</td>
<td>10</td>
<td>10</td>
<td>12</td>
<td>13</td>
<td>18</td>
</tr>
<tr>
<td>No. Employees</td>
<td>9,915</td>
<td>39,299</td>
<td>91,691</td>
<td>30,217</td>
<td>13,410</td>
</tr>
<tr>
<td>No. Consumers (1000)</td>
<td>1,499</td>
<td>7,606</td>
<td>17,734</td>
<td>6,090</td>
<td>2,258</td>
</tr>
<tr>
<td>No. Household Consumers</td>
<td>1,316</td>
<td>6,660</td>
<td>15,448</td>
<td>4,794</td>
<td>1,910</td>
</tr>
<tr>
<td>Household Consumption (kWh)</td>
<td>1.6</td>
<td>1.1</td>
<td>2.1</td>
<td>1.8</td>
<td>1.8</td>
</tr>
<tr>
<td>Employees/GWh</td>
<td>0.89</td>
<td>1.10</td>
<td>0.67</td>
<td>0.92</td>
<td>1.31</td>
</tr>
</tbody>
</table>

Source: DNAEE

Despite the high growth in electricity consumption, Brazil's per capita consumption is among the lowest in the world. In 1993, Brazil consumed 1.5 MWh per consumer, only higher than that of Mexico and Argentina, and well below that of industrialized nations such as Japan, which consumed almost four times the Brazilian rate. Furthermore, there are wide regional variations in consumption patterns, as shown in Table A.5.

The future evolution of demand is an obvious and important concern of the sector. It matters to investment decisions not only regarding transmission, but also regarding the type of regional subsidies that may be required. This is a significant area for improvement in Brazil. Most demand studies only focus on the elasticity with respect to GDP and totally ignore price effects. Yet the main effect of privatization is likely to be related to prices. Eletrobrás is starting to work on correcting this gap, but the work will need to be internalized by the entity in charge of indicative planning after the reform.

Better demand analysis and better price signals should reduce the permanent bias towards overestimating ex-ante consumption growth rates. On the other hand, hydro plants have long maturation periods which range from four to eight years. Moreover, as in most developing countries, the opportunity cost of capital in Brazil is very high. Adequate long-term signals to investors are of such paramount importance due to the high social costs associated with over-investment in just one sector. This situation, combined with technological network externalities, seems to call for some level of indicative planning as a way of coordinating investment decisions among the different actors in a restructured electricity sector. The design of—and assignment of responsibilities for—indicative planning is therefore a challenge that needs to be addressed by reform proposals.

Summing up the relevant demand issues. The data discussed above points to the following salient features of the demand for electricity:
• high growth in consumption of electricity is expected to continue (according to the Plan presented by Eletrobrás) but the pattern of consumption will be more even with the industrial sector consuming less energy as it switches to less energy-intensive technologies as demand management policies start to have an impact in the country;

• need for large investments in capacity expansion (generation and transmission) to meet these high consumption rates;

• more self-generation in region where it would not pay off to extend the grid and search for alternate technologies to conserve energy, manage demand, and minimize environmental consequences of energy consumption; and

• the price sensitivity of consumers will have to be built in some of the strategic decisions for the sector.

Table A.6: Comparison of 1977 to 1993 Tariff Structures

<table>
<thead>
<tr>
<th>1977 Tariff System</th>
<th>1993 Tariff System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uniform tariff applied across the country without regard to region or structure of production</td>
<td>Tariffs set by individual companies after approval by Regulatory Entity</td>
</tr>
<tr>
<td>Tariffs set to attain a minimum of 10 percent and maximum of 12 percent rate of return on operational assets and adjusted by government to control inflation</td>
<td>Tariffs based on costs of service for each company adjusted regularly using a formula including inputs for energy costs, O&amp;M, taxes, and return of and on capital</td>
</tr>
<tr>
<td>Compensation system (CRC) such that more efficient companies subsidize less efficient ones in a profit equalization plan</td>
<td>CRC compensation system eliminated</td>
</tr>
</tbody>
</table>

A.3 The Tariff System

In the past 15 years, the electricity industry suffered from downward pressure on tariffs as the government used tariff policies to hold down inflation. The tariff system currently in use was put in place in 1993, replacing the old system designed in 1977. The two systems are compared in Table A.6.

Under the old system, tariffs were set by the federal government through DNAEE under Law No. 5,644. During that period, a single uniform tariff was set for all companies on a national basis regardless of the cost and capital structures of individual companies or regional cost differences for generation, transmission and distribution. A system of compensation, known as CRC (Conta de Resultado a Compensar), was put in place to effectively transfer income across the system to equalize any price or cost differentials among utilities. The rationale was that the more efficient companies would subsidize less efficient ones through a profit equalization plan, and the system as a whole would remain viable and profitable. Companies had no
incentives to reduce costs and they almost all earned returns below 10 percent. Furthermore, prior to the reform, the government manipulated tariffs to control inflation, keeping tariff increases well below cost growth. The result was tariff rates well below international levels, leading to an extraordinarily high level of indebtedness in the industry as distribution companies accumulated large unpaid debt to generating companies, which in turn could not meet their debt obligations. The sector’s capital investment deteriorated as the debt service requirements increased to almost 100 percent of the current expenditures of the sector by 1989 and investment fell to less than 30 percent of the total.

**Distribution tariffs.** Average national tariffs after the 1993 reform increased from a low of about US$ 34/MWh in April 1993 to a more realistic average of US$ 60/MWh in December 1993 (an 80 percent increase almost reaching the level required to provide a 10 percent yield on the system’s operational assets, then estimated at US$ 65/MWh). This increase was also in line with international tariffs, which were around US$ 65/MWh; but considering the average 40-day term on receivables and the inflation rate, the effective tariff by the end of 1993 was US$ 43/MWh. There have been other tariff-related problems. For instance, changes in tariffs between 1990 and 1994 were very different from changes in the largest share of recurrent expenditures: personnel costs. For the Eletronorte system, the average tariff was $22.54 in 1990 and $22.52 in 1994. In the meantime, personnel was cut from 6,671 to 5,527, but total personnel costs increased by about 30 percent.

**Generation pricing.** With respect to generation, there are two different wholesale prices in the system. One is for the energy delivered by Itaipu at a current price of about US$ 37/MWh. For the rest of the system, the average current price is equivalent to about US$ 26/MWh, which is perceived as being too low. The price differential between Itaipu and energy from other systems is due to: (i) Itaipu’s high debt amortization costs, and (ii) the depressed tariff levels charged by the companies in the rest of the system.

**Transmission pricing.** For now, transmission prices are fixed as an average system price and are not related to the costs of transmission. Companies like CEMIG currently charge their customers US$ 3/MWh for transmission. There is only one case (the Igarapava plant) where transmission prices have been defined in three different categories: capacity, energy and distance. However, this is the only example of this type of pricing structure.

**Structure of cross-subsidies.** Tariffs in Brazil are low by international standards, but mask wide differences across regions and user categories. The share of long-run marginal costs (LRMC) in electricity supply recovered from each category of user and across each region varies widely (see Table A.7). Users in the North and Northeast regions are generally subsidized by those in the South, Southeast and Central-West. High-tension users meet a greater share of the LRMC than low-tension users.

This pattern can be partly explained by the differential in performance across companies. Since companies are mostly vertically integrated and do not face competition, they have no incentives to reduce costs. Furthermore, users in a particular category or region—-even large users—are captive to the local distribution enterprises,

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30 This huge hydroelectric plant was 100-percent financed with foreign loans and represents about 40 percent of Eletrobrás’ system debt.
partly because of the lack of an integrated transmission system, the low share of self-generation, and inadequate development of alternate sources of energy.

<table>
<thead>
<tr>
<th>Tariffs Group</th>
<th>Average Tariffs for Electricity Supply (July 1994) $/MWh</th>
<th>Long-Run Marginal Costs of Electricity Supply (July 1994) $/MWh</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>NE</td>
</tr>
<tr>
<td>Gr. A</td>
<td>29.80</td>
<td>48.30</td>
</tr>
<tr>
<td>A1</td>
<td>20.80</td>
<td>27.00</td>
</tr>
<tr>
<td>A2</td>
<td>40.40</td>
<td>0.00</td>
</tr>
<tr>
<td>A3</td>
<td>47.50</td>
<td>46.70</td>
</tr>
<tr>
<td>A3a</td>
<td>84.10</td>
<td>59.90</td>
</tr>
<tr>
<td>A4</td>
<td>74.10</td>
<td>68.30</td>
</tr>
<tr>
<td>A5</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Gr. B</td>
<td>85.70</td>
<td>73.60</td>
</tr>
<tr>
<td>B1</td>
<td>72.70</td>
<td>59.90</td>
</tr>
<tr>
<td>B2</td>
<td>65.40</td>
<td>65.80</td>
</tr>
<tr>
<td>B3</td>
<td>109.00</td>
<td>103.40</td>
</tr>
<tr>
<td>B4</td>
<td>58.10</td>
<td>56.10</td>
</tr>
<tr>
<td>A+B</td>
<td>41.50</td>
<td>59.10</td>
</tr>
</tbody>
</table>

Tariffs and marginal costs from Fernandes, 1994; A tariffs are for high tensions (A1 > 230 kV, A2 = 88 kV to 138, A3=69, A3a =30 to 44, A4: 2.3 to 25; B tariffs are for low tension; B1 = residential, B2 = rural, B3, other; B4 = street lighting.

There is a significant difference between tariffs charged by different types of companies. Municipal companies—such as CELB, DME-PC, and COCEL—charge significantly higher tariffs for high-tension users relative to state companies; and private and municipal companies charge significantly lower tariffs for low-tension users relative to state companies. Similarly, tariffs in the north for high-tension users are significantly higher than in other regions, while those in the southeast for the same category of users are significantly lower. Over the long run, tariffs are expected to converge as Itaipú’s debt is repaid and rates for the rest of the system are adjusted upwards.

Summing up the relevant tariff issues. The main lesson of this brief overview is that the deregulated tariff system is a step in the right direction but that the Government should allow tariffs for generation? and distribution to be more consistent with costs while making sure that firms have an incentive to keep costs to a minimum. How this can effectively be achieved depends on the specific form of regulation selected. The reform will also have to address the high poverty level in various parts of the country and recognize that
tariff designs can be very effective at this but that it may not be the most effective.

A.4 Service Performance
Quality of service varies across companies and regions just as tariffs do. For instance, the weighted duration of interruption per consumer (DEC) varies from 8.238 hours for CPFL to 68.15 hours for CEMAT. The weighted frequency of interruption varies from 6.5 for CPFL to 101.65 for CEMAT. Quality of service in terms of interruptions to service is better in the southeast (the average power cuts and frequency of cuts—DEC and FEC—are significantly lower for southeast consumers) and worse for users in the northeast (power cuts last longer in the northeast since DM is significantly higher in the northeast). Commercial losses also tend to be higher on average than in other large countries such as Mexico. This reflects poor maintenance of meters, lack of metering devices, loose audit control, high costs of connection, and long periods of service interruption. There is, however, a wide dispersion in this respect across companies. For instance, CEMIG’s loss levels are low by any standard.

Table A.8 shows that Brazilian companies are over-staffed in comparison to those in Mexico, Paraguay and Argentina. Brazilian companies also serve much fewer customers per employee than Argentina and Mexico. The recent Argentinean experience shows how effective privatization can be in quickly improving labor productivity. If private operators decided to operate the Brazilian companies at the Mexican benchmark, labor redundancy would be between 20 and 30 percent in the sector. For the sample covered here, this means between 30,000 and 50,000 people! This is just an illustrative scenario, of course, but it points to the importance of this issue.

These results could be interpreted in terms of risk to potential investors. The companies that represent low risk in generation are federal companies in the southeast (Furnas), while all companies in the southeast present minimal risk to the investor in the short run. However, the other companies have more room for improvement and hence present investors with better prospects for profits in the long-term.

Issues with respect to performance. Performance may be the most important area of concern to private investors as, once they have a clear idea on relevant tariffs, it provides an indication as to where their profit margin will be derived. It is also important to the Regulatory Entity in the sense that it suggests a need to ensure that distribution companies have lots of margin to quickly generate huge monopoly rents. The existence of these potential rents should influence the design of tariff regulation.

More specifically, the main stylized facts relevant to the reform that regulators should keep in mind include:

- There is high variance in companies’ performance in Brazil. It varies from CEMIG—with its high level of performance, even by international standards, seen in the low level of system losses and good employee per GWh ratios—to CEMAT and CEB, where there is clear room for improvement;

- Competition in generation and supply could improve the efficiency of the relevant companies. The high projected growth in demand for electricity will increase the attractiveness of Brazilian electricity markets to private investors,
including many of the worst performers; and

- The high-employment levels suggest that there is a quick way of cutting costs by cutting

These decisions are, however, becoming less easy to take as many public enterprises are considering staff reductions, thus increasing

the future political costs of doing so and increasing the difficulty that private operators will have in dealing with this issue.

Table A.8: Inter-company and International Comparison of Performance

<table>
<thead>
<tr>
<th>Company</th>
<th>Customers per employee</th>
</tr>
</thead>
<tbody>
<tr>
<td>CESP</td>
<td>88</td>
</tr>
<tr>
<td>ESCELSA</td>
<td>230</td>
</tr>
<tr>
<td>LIGHT</td>
<td>234</td>
</tr>
<tr>
<td>CEMIG</td>
<td>210</td>
</tr>
<tr>
<td>COPEL</td>
<td>232</td>
</tr>
<tr>
<td>CPFL</td>
<td>277</td>
</tr>
<tr>
<td>CELESC</td>
<td>205</td>
</tr>
<tr>
<td>CERJ</td>
<td>197</td>
</tr>
<tr>
<td>ELETROPAULO</td>
<td>269</td>
</tr>
<tr>
<td>ENERSUL</td>
<td>186</td>
</tr>
<tr>
<td>CEB</td>
<td>232</td>
</tr>
<tr>
<td>CEEE</td>
<td>-</td>
</tr>
<tr>
<td>CEMAT</td>
<td>155</td>
</tr>
<tr>
<td>COELBA</td>
<td>300</td>
</tr>
<tr>
<td>CELG</td>
<td>252</td>
</tr>
<tr>
<td>BRAZIL</td>
<td>146</td>
</tr>
<tr>
<td>PARAGUAY</td>
<td>136</td>
</tr>
<tr>
<td>MEXICO</td>
<td>186</td>
</tr>
<tr>
<td>ARGENTINA</td>
<td>175</td>
</tr>
</tbody>
</table>