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Electricity Reforms

What Some Countries Did Right and Others Can Do Better

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Since 1982 more than half the world's countries have reformed their electricity sectors. Implemented correctly, the standard reform model—with competition, unbundling, and effective regulation—can lead to big gains in performance. But most developing countries lack institutional preconditions for fully adopting the model—and hybrid electricity markets are emerging. Developing pricing schemes that strike a better balance between economic efficiency and social equity remains a big challenge. An even greater challenge is to meet global energy needs while reducing the threat of climate change disruption.

Views about how the electricity supply industry should be owned, organized, and regulated have changed dramatically in the past three decades. Since 1982, when Chile began a radical program of restructuring and privatization, more than half the world's countries have introduced institutional reforms in their electricity sectors. These reform programs have included privatization, vertical and horizontal unbundling, and the introduction of incentive-based regulation by independent regulatory agencies (Newbery 2002).

The introduction of more competition, institutional reforms, and effective, transparent regulation has led to performance gains in many countries. The sectorwide restructuring efforts described in this Note also are critical to providing the basis for substantial private investment opportunities. In addition, they serve as broad principles for other, less researched regulatory interventions, such as reducing entry barriers, simplifying licensing, and improving incentives for investment and generation. Technical assistance for potential private investment is of great importance in navigating novel regulatory and market structures.

The standard reform model

Pressure for change in mature industrial economies grew with the emergence of excess capacity and the disillusionment with expensive, capital-intensive generation projects caused by the oil crisis of the 1970s. Developing countries faced different circumstances. While investment needs were low in mature industrial economies with excess capacity, they were high in many developing countries, most of which had rapid demand growth for electricity, a tight demand-supply balance, and periodic blackouts. While electricity utilities in mature industrial economies had tolerable performance, those in developing countries

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suffered from poor service quality, low labor productivity, chronic revenue inadequacy, deteriorating facilities and equipment, and serious problems of theft and nonpayment (Kessides 2004).

Against this background, a new paradigm emerged for the organizational restructuring of the electricity industry. The reform steps have included some of the following (Joskow 2008):

- Corporatizing and commercializing state-owned utilities to legally separate them from the government and restore financial discipline.
- Enacting laws to provide a legal mandate for the restructuring, and creating independent regulatory agencies with adequate information, capacity, and statutory authority.
- Using vertical and horizontal restructuring to separate potentially competitive generation and retail activities from the natural monopoly segments of transmission and distribution and thus facilitate competitive entry and reduce market power.
- Establishing regulatory rules to promote efficient access to the transmission network and provide signals for the efficient location of generation facilities.
- Privatizing operating entities to restore financial discipline, provide incentives for cost efficiency, and insulate them from damaging political interference.
- Introducing independent power producers (IPPs) to facilitate investment in generation even in the absence of comprehensive sectoral reform.
- Designating an independent system operator to direct the safe, reliable, and economic operation of the interconnected electricity system, determine the order of dispatch, and make arrangements for expanding and enhancing the transmission system.
- Unbundling retail tariffs to separate prices for competitive retail supply activities from the regulated network (transmission and distribution) charges.
- Creating markets and trading arrangements for voluntary energy and ancillary services.

Assessing the reform experience

The standard model notwithstanding, electricity reform in developing and transition economies has been an incomplete, uneven, and irregular process that entails a complex set of interactions between the state and the market. Reforms have progressed furthest in Australia, Canada, the United States, most European countries, and parts of Latin America. They have been slow and unstable in Asia and Eastern Europe and highly problematic in Sub-Saharan Africa. Indeed, no developing country in Africa and very few outside Latin America have fully adopted the standard reform model. Moreover, introducing IPPs has been second only to corporatization as the step most frequently undertaken (Gratwick and Eberhard 2008).

Emerging international evidence suggests that the standard reform model, if implemented correctly, is a sound guide for restructuring electricity markets; significant departures from it are likely to lead to performance problems. This evidence is based on cross-country econometric analyses, firm-level efficiency and productivity assessments, and single-country case studies (Joskow 2008; Jamasb, Newbery, and Pollitt 2004).

Cross-country econometric studies

The literature focusing on cross-country econometric estimation of the effects of electricity reforms is limited. The multifaceted nature of the institutional reforms implemented and the diversity of electricity sectors across countries lead to challenging model specification issues. There are also severe data and measurement problems.

Even so, it is possible to identify a set of empirical regularities on the effects of electricity reforms:

- Efficiency gains (higher labor productivity, higher capacity utilization, lower system losses) from privatization are modest, unstable, and contingent on regulatory efficacy, especially in the absence of competition—efficiency may depend more on the form of regulation than on the form of ownership (Newbery 1995). Private sector participation is beneficial only when coupled with an independent regulator. Independent regulation without privatization (in effect, regulation of state-owned utilities) seems to be ineffective (Zhang, Parker, and Kirkpatrick 2008).
- There is strong evidence that introducing competition leads to significant improvements in performance (Zhang, Parker, and Kirkpatrick 2008).

- Part of the efficiency gains may be passed on to consumers, with prices falling for some classes of electricity users. But liberalization does not always lead to lower retail electricity prices. In many developing countries regulated prices were inefficiently low, and in these countries liberalization should lead to higher prices and better incentives (Nagayama 2007).
- Liberalization has reduced the historical pricing distortions in developing countries. Cross-subsidies from industrial customers to households have been gradually reduced as prices for households are realigned with underlying costs (Kessides 2004).

Country case studies

Analysts generally agree that Latin America is where the standard reform model has been most influential and far-reaching. Most if not all reforming countries in the region implemented incentive-based regulation for setting multiyear tariffs and monitoring the compliance of distribution companies with service quality standards. This mechanism was very effective in Argentina, Chile, El Salvador, and Peru and is largely responsible for the improvements in the operating efficiency of the region's electricity systems.

Chile is often identified as the country that first started electricity reforms. Recognizing the importance of cost recovery in public utility services, it reformed tariffs before privatization. But its postreform market involved less restructuring, less competition, and more regulation than some of the subsequent reform cases. Still, privatization, incentive-based regulation, entry by incumbent suppliers in response to administratively set generation prices, and service obligations imposed by regulation on distribution companies have all contributed to large efficiency gains (Joskow 2008; table 1).

Argentina followed most of the features of the standard reform model: it sought to aggressively reduce horizontal market power and developed one of the world's most competitive wholesale electricity markets. Growing competition led to a substantial decline in the spot price of electricity while investments in generation and network expansion increased rapidly—until the economic crisis in 2002 (Pollitt 2008). Service expansion also accelerated in Peru after reforms were introduced.

Colombia was the first country in Latin America to implement a bidding system for its pool electricity market. The high-powered incentives created by the competitive electricity market led to significant gains in the efficiency of power distribution. As the market was liberalized, US$6 billion in foreign investment took place and additional gas-fired capacity of some 2.5 gigawatts was built, prompted in large part by the capacity charge mechanism put in place (Pombo and Taborda 2006).

The reforms in Brazil were much more cautious and gradual than those in Chile and Argentina. They were characterized by mixed ownership, feeble vertical restructuring, and market competition in some areas. More importantly, in contrast to the sequencing prescribed by the standard reform model, distribution was privatized before an independent regulatory body was established and without a comprehensive blueprint for reform. The distribution and supply companies showed large gains in labor productivity after privatization in 1995 (figure 1). But the reform program was overwhelmed by the drought and long-lasting water shortages that followed—problems whose effects were exacerbated by the incomplete implementation of the reforms. Brazil's experience raises serious doubts about the efficacy of private ownership of generation in countries with large multiuse dams that require coordinated regulation (Newbery 2002).

In India the incentive-based, multiyear regulatory regime (whose performance targets include an allowance on system losses) seems to have provided the right incentives to improve operating efficiency, in an electricity system plagued by significant technical and especially nontechnical losses (Bhatia and Gulati 2004).

Emergence of hybrid power markets

Full implementation of the standard reform model—especially effective regulation, vertical or horizontal unbundling, and wholesale and retail competition—has several institutional prerequisites that most developing countries lack, including issues relating to commitment to reform, scale of the industry, and legal and financial infrastructure. Thus in recent years growing doubts have been expressed about the applicability of the standard template to many

Table 1 **Performance effects of electricity sector reforms**

Country	Studies	Reform program and year	Performance effects
Chile	Fischer, Gutierrez, and Serra 2003; Nagayama 2007	Privatization without vertical or horizontal unbundling; wholesale competition; market liberalization (1982)	*Labor productivity:* increase for Chilectra from 1.4 gigawatt-hours per employee in 1987 to 13.8 in 2002; for Endesa from 6.3 in 1991 to 34.3 in 2002 *Total energy losses:* reduction from 22% in 1982 to 5% in 2009 *Wait time for repair service:* reduction from 5 hours in 1988 to 2 in 1994 *Installed capacity:* increase from 2.7 gigawatts (GW) in 1982 to 6.7 in 2002 *Length of transmission network:* increase from 4,310 kilometers in 1982 to 8,555 in 2002
Argentina	Rudnick and Solezzi 2001; Fischer, Gutierrez, and Serra 2003; Pollitt 2008	Privatization with full-scale vertical and horizontal restructuring (1992)	*Nonavailability of thermal plants:* reduction from 50% in 1992 to 20% in 2002 *Installed capacity:* increase from 13.2 GW in 1992 to 22.8 in 2002 *Distribution losses:* reduction from 20% in 1992 to 10% in 2002 *Spot price of electricity:* reduction from US$50 per megawatt-hour (MWh) in 1992 to US$20 in 2002
Peru	Perez-Reyes and Tovar 2009; Anaya 2010	Partial privatization; vertical and horizontal unbundling; single-buyer model (1993)	*Productivity:* increase from 415 customers per employee in 1993 to 1,210 in 2007 *Coverage:* increase from 48% in 1992 to 80% in 2007 *Distribution losses:* reduction from 22% in 1993 to 8.2% in 2007
Colombia	Pombo and Taborda 2006	Privatization with unbundling; bid-based pool market (1994)	*Interruption time:* reduction from 6.3 hours in 1997 to 2 in 2002
Brazil	Mota 2003	Vertical unbundling; privatization of distribution with generation remaining largely state owned; gradual transition to competition in generation and supply (1995)	*Labor productivity of distribution and supply:* increase of 147% in MWh per employee between 1994 and 2000
India	Bhatia and Gulati 2004	Unbundling and privatization of some state electricity boards (1991)	*Distribution losses:* reduction for Andhra Pradesh State Electricity Board from 38% in 1999 to 20% in 2008; for Delhi Vidyut Board from 53% in 2002 to 15% in 2009
Sub-Saharan Africa	Gratwick and Eberhard 2008; Eberhard and Gratwick 2011	Introduction of IPPs with some unbundling and limited progress in establishing independent regulatory mechanisms; incumbent state-owned utilities still dominant (early 1990s)	Addition of about 4 GW of IPP capacity since early 1990s, with IPPs generally showing better technical performance than region's state-owned incumbent utilities[a]

a. For example, the state-owned Kenya Electricity Generating Company (KenGen) has an average availability factor of 60 percent compared with a 95 percent average for the IPPs in Kenya.

of these countries—especially in Africa. A new hybrid model has emerged in which IPPs play an important role alongside the state-owned utilities (Gratwick and Eberhard 2008).

IPPs have been an important source of new investment in many developing countries. In parts of Africa their introduction has led to a big increase in generating capacity. Moreover, many IPPs have shown better technical performance than the state-owned utilities. But the success of IPP schemes is contingent on a coherent policy framework that pays explicit attention to planning, procurement, and contracting issues. Successful outcomes, for both investors and the host countries, are more likely where effective regulatory governance (characterized by coherence, independence, accountability, transparency, predictability, and capacity) is put in place, preferably before the IPPs are negotiated. Effective regulatory oversight can lead to lower capital costs (per unit of installed IPP capacity) as well as to improved operating efficiencies (Eberhard and Gratwick 2011).

India's experience highlights the importance of credible regulatory and political commitment for the viability of IPP investments. Substantial variation in regulatory systems and political commitment across Indian states has led to enormous

variation in outcomes—ranging from the disastrous Dabhol power project in Maharashtra to the modestly successful GVK project in Andhra Pradesh and Paguthan project in Gujarat (Lamb 2006).

Persisting problems of cost recovery

Underinvestment, driven in large part by underpricing, was one of the most important causes of the secular deterioration in the performance of electricity industries in developing countries before the reform era. The challenge of cost recovery has been widespread. In Africa underpricing and revenue inadequacy have been pervasive. While two-thirds of the region's power utilities set tariffs that cover their operating costs, only a fifth charge prices high enough to cover their full capital costs (Foster and Briceño-Garmendia 2010). Cost-coverage ratios have also been low in many parts of Asia and in Central and Eastern Europe.

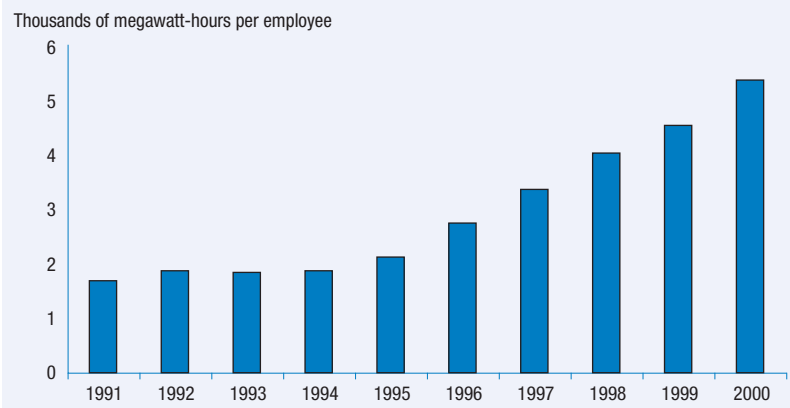
Past public policies in developing and transition economies also led to prices with systematic cross-subsidization—from industrial customers to households. The publicly articulated rationale for these policies was that they fostered desirable social goals (for example, helping classes of customers who would otherwise be disadvantaged). But a large share of the benefits often flowed to those outside the intended beneficiary groups.

As expected, electricity reform—especially privatization—generated pressures for revenue adequacy, which required realigning prices with underlying costs. Moreover, market liberalization undermined the sustainability of cross-subsidies. During the postreform era many countries have gradually reversed the historical policies of underpricing and cross-subsidies.

Distributional effects

In recent years concerns have been expressed about the distributional effects of electricity privatization and market liberalization—especially their effects on the provision of basic services to poor households and other disadvantaged groups. Empirical evidence increasingly shows that these concerns have been largely misplaced. It is true that the reforms led to price increases in countries where prices were inefficiently low. They also had adverse distributional effects because of the large layoffs in the privatized utilities. Still, these effects were more than offset by greater access for poor consumers, better service quality, and changes in public finances that benefited poor people more (McKenzie and Mookherjee 2003).

Figure 1 **Labor productivity of distribution and supply businesses in Brazil, 1991–2000**



Source: Mota 2003.

Lingering concerns about investment

Planning for expansion of transmission has become much more complex in unbundled electricity markets. In these markets the coordinated planning that enabled integrated utilities to adjust generation and transmission capacities and internalize their interdependencies has been replaced by a series of decentralized decisions based in part on prices. This new decision structure involves many independent agents and entails a mix of regulation and market signals. There is an ongoing debate about the ability of liberalized markets to fund the optimal amount of transmission investment (Sauma and Oren 2009). One drawback of unbundled electricity systems is that often no member of the industry has the combination of incentives and ability needed for systemwide planning.

Even greater concerns have been expressed about the ability of competitively restructured electricity markets to provide appropriate incentives for investment in new generating capacity that is socially optimal—in timing, location, and choice of technology (Joskow 2008). In deregulated, competitive electricity markets it is power company investors, not ratepayers, who must bear most of the financial risk of new generating capacity. In this market environment investors will

naturally tend to favor investments that are less capital intensive and have shorter construction lead times (such as combined-cycle gas turbines). But there is no empirical evidence justifying the concerns about too little investment in generating capacity in liberalized markets.

Distributed generation—a paradigm shift?

The centralized electricity supply model with its underlying countrywide network has traditionally offered important economies of scale and, by and large, high reliability. But because of its historical focus on fossil fuels, it has also led to environmental degradation. And in developing countries it has ignored the energy needs of rural areas and poor people (Hiremath and others 2009).

In recent years there has been a resurgence of interest in distributed generation—the production of energy on or very near the site of use by relatively small, modular generating units (typically less than 30 megawatts). In several developing and transition economies distributed generation already accounts for a significant share of the electricity generated. Classic forms of distributed generation include combined heat and power, industrial gas turbines, and small petroleum generators. More recently the definition has expanded to include renewable technologies—solar, wind power, small hydro, biomass, landfill gas to energy, and waste to energy (box 1).

Renewable distributed generation technologies are especially well suited for off-grid remote applications in rural areas where consumption is low and the distance to the nearest distribution center is great. Most of these opportunities are in Africa, Asia, and parts of Latin America. Distributed generation can be effective in protecting households and industries against the risk of costly voltage fluctuations and power outages—especially in developing countries, where these power swings can be extreme. But problems of intermittency persist for wind and solar, and these power sources can still cost significantly more than traditional fossil-fired generation.

Lessons and emerging challenges

There is an emerging consensus, supported by growing empirical evidence, that in the electricity sector:

- When well designed and implemented in proper sequence, a combination of institutional reforms—vertical and horizontal restructuring, privatization, and effective regulation (particularly incentive-based regulation)—can lead to significant improvements in operating performance, in a variety of country settings.
- There is a strong link between good and credible regulation and the objective of securing foreign direct investment—and privately financed investment more generally—while delivering efficient service at sustainable but just and reasonable prices.
- As a consequence of the reforms, retail prices have become more closely aligned with underlying costs, and cross-subsidies have been reduced and in some countries eliminated.
- There is a logical sequence of reforms, and undertaking reforms in the wrong order is costly. Ideally, reforming countries should first raise prices to cost-recovering levels (with a return on capital to finance investment), then create regulatory institutions and restructure the sector, and only after that privatize.

Box 1 Sugar mill cogeneration in India

In India interest in bagasse cogeneration began in the 1980s, when the supply of electricity started falling short of demand. A national program to promote biomass power and bagasse cogeneration was launched in 1992. With policy support and assistance from the Indian government and the U.S. Agency for International Development, state electricity boards began offering sugar mills long-term power purchase contracts at competitive prices and with a large reduction in interconnection fees. By 2009 sugar mills in Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu, and Uttar Pradesh were contributing 2,000 megawatts to the national electricity grid. Today, of the roughly 650 sugar mills in India, 107 have cogeneration plants. Efficient bagasse cogeneration is receiving increased attention in India because of its potential for reducing greenhouse gas emissions and providing other development and environmental benefits.

Source: Haya, Ranganathan, and Kirpekar 2009.

- Many if not most developing and transition economies lack some of the institutional and other preconditions for the full and effective implementation of the standard reform model. In many parts of the world electricity markets have evolved or are evolving into hybrid forms—not completely unbundled, privatized, or competitive.

Pricing reform remains one of the most important and challenging tasks facing policy makers in developing and transition economies. The historical policies of underpricing and cross-subsidies are being reversed but only very gradually. In many countries efforts to rebalance tariffs have been encountering much public opposition on social equity grounds. There is an urgent need to identify pricing schemes that strike a better balance between economic efficiency and social equity.

The world faces an enormous challenge in expanding the availability of adequate, reliable, clean, and competitively priced energy, especially in developing countries. In meeting this challenge, however, the world faces another: the need to lower the threat of climate change disruption by lowering emissions of carbon dioxide and other greenhouse gases. This will require transforming the global energy system and generating a significant share of electricity from renewable sources.

There is widespread agreement that liberalized, unbundled electricity markets are poorly designed to encourage large-scale investment in, and deployment of, renewable and other low-carbon-generating technologies. The transition to renewable energy will give rise to new regulatory and market design issues. It will also lead to important financing challenges because up-front fixed investments account for most of the costs of these technologies. Multilateral institutions could play a much larger role—especially in identifying ways to strengthen existing electricity market arrangements and in designing innovative financing mechanisms. More work is needed to analyze the efficacy of alternative market structures and support mechanisms, remedy the drawbacks of the current market design, identify practical demand-side reforms, and evaluate models for mitigating greenhouse gas emissions.

Note

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