Electricity Sectors in CAREC Countries

A Diagnostic Review of Regulatory Approaches and Challenges

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FOREWORD

The Central Asia Regional Economic Cooperation (CAREC) Program was initiated by the Asian Development Bank (ADB) in 1997, and is now supported by an alliance of major multilateral development institutions. The Program's main objective is to promote economic growth and raise living standards by encouraging economic cooperation among the participating countries—Azerbaijan, People's Republic of China (PRC), Kazakhstan, Kyrgyz Republic, Mongolia, Tajikistan, and Uzbekistan.

The priority of the CAREC Program in the energy sector is to promote efficient and rational use of energy within the region. To that end, this study was undertaken to provide a foundation upon which the CAREC Members Electricity Regulators Forum (CMERF) would be established, and to identify the key challenges that this Forum must address. CMERF and this study serve both regional and domestic objectives. The following brief explanation will help frame the discussions in the main text.

CAREC countries, particularly Kazakhstan, Kyrgyz Republic, Tajikistan, and Uzbekistan, possess significant complementary energy resources. Deeper regional trade, particularly in electricity, would provide significant economic benefits. It would permit countries to save their fossil fuel resources for future exploitation at higher prices; increase the availability of energy, especially during winter; reduce the environmental damage currently experienced due to the limited flexibility of water releases at hydroelectric plants; and generally reduce the cost of meeting the region's energy needs. A competitive regional power market could also be sustained, which would bring significant benefits. However, attempts to increase trade by restoring the cross-border Soviet energy transmission infrastructure and negotiating long-term agreements concerning its use have yet to yield results.

Given the apparent benefits from energy trade, this study set out to ask why electricity trade has not developed organically. The initial diagnosis was that national policies prioritizing energy self-sufficiency coupled with international political disputes lay at the heart of the matter. In this context, it was hoped that CMERF could move the debate toward a more technocratic assessment of the benefits of trade and take an incremental approach to establishing trade linkages.

When we began the preparations for CMERF, we already knew that financial problems due to a lack of reforms at the energy utilities were exacerbating international political tensions because imports could not always be paid for on time. However, the evidence in this study shows that the connections between the need for domestic reforms and the resistance to regional power trade are a lot deeper and more structural than previously understood. Once in the field, the focus of the study team therefore shifted from regional to domestic issues as a matter of necessity.

With the exception of the PRC, and in some regard, Kazakhstan, power sectors in the CAREC region are plagued with commercial failures. These failures result from serious management problems and corruption—especially, in distribution and retail operations—which are often aggravated by inappropriate industry structures. This study finds that the magnitude of commercial problems in most CAREC countries dwarfs all other considerations. Electricity is often not paid for at the prices mandated by regulators, which are often too low anyway. This leads to several problems: (i) financial and physical deterioration of the sector, (ii) excessive demand for power because consumers face weak price signals to conserve electricity, and (iii) poor supply responses because potential investors face inadequate or irrelevant prices and an uncertain investment environment. These problems, in turn, distort incentives in the sector, which this study argues, help explain why power trade remains undeveloped. Even if their impact on power trade is discounted, the weak commercial and economic management of most CAREC power sectors is a significant problem requiring immediate attention. In response, CAREC countries have attempted a wide variety of approaches to solving the problems outlined above.

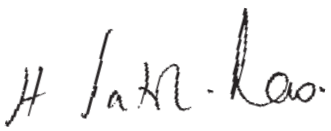
This study documents the conditions and problems in each power sector and utilizes the comparisons that emerged from country experiences to qualitatively assess the impact of different approaches to reform. Potential solutions identified include improvements in transparency; sector restructuring; and the design of clear and appropriate roles for electricity regulators, policymakers, and utility managers and owners. A key theme is that policy and regulatory responses for the CAREC countries must focus far more on altering incentives in the sector, than on command-and-control approaches. Tariff reforms must also be accompanied by systematic and public measurements of service quality, which must improve to facilitate tariff increases. In the PRC and Kazakhstan, the key concerns are to develop greater competition and attract private investment on reasonable terms to meet growing power demand.

This study surveys the power sectors of the CAREC region to identify relevant challenges. It does not seek to discuss problems in detail, nor does it aim to devise solutions as these tasks are left to more detailed studies to be undertaken under CMERF and elsewhere.

The study caters to a diverse readership, which includes regulators and policymakers in the region, practitioners at development agencies, academics—and in keeping with the study's emphasis on the importance of transparency—journalists and the general public. This diversity is reflected in the structure of the report, which consists of three components. The first three chapters define and discuss economic concepts and principles relating to the rationales for, roles in, and common approaches to electricity sector management. Application in CAREC countries is emphasized. Chapters IV to X provide country-specific assessments. For each country, the study team looked at the industry structure, regulatory framework, approaches to and challenges involved in regulation, and the reform efforts undertaken. Finally, Chapter XI shows how the domestic problems outlined in the study hold back regional power trade.

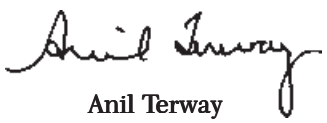
The first three chapters serve four purposes: First, they detail the arguments underlying the comments and criticisms made in the country chapters, so the latter need not be repeated unnecessarily. Second, they lay bare the biases of the study team in order to contextualize the critiques in the country chapters. Third, they serve a didactic function, ensuring readers with a limited economics background can appreciate the comparisons and arguments made later in the main text. Finally, standard treatments of power regulation assume profit-driven firms, binding prices, and regulators with clearly defined roles and mandates—conditions conspicuously absent in most of the region. The discussion in these paragraphs attempts to broaden this canonical treatment of natural monopoly regulation to include discussion of the market failures most endemic in the region.

In keeping with the member-driven spirit of the CAREC Program, most of the data used in these chapters were provided by the countries themselves in the form of official documents and reports, and interviews with concerned government officials and utility personnel. Other data were drawn from reports compiled by ADB and its development partners. Sector officials also identified most of the regulatory challenges discussed in the study. The study team, editor, and contributors are acknowledged separately. We gratefully acknowledge financial support for this study from the Public-Private Infrastructure Advisory Facility.



Satish Rao

Director General
East and Central Asia Department
Asian Development Bank



Anil Terway

Director, Energy Division
East and Central Asia Department
Asian Development Bank

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ABBREVIATIONS

AAMP	Agency on Antimonopoly Policy (Tajikistan)
AMP	Anti-monopoly Agency (Kazakhstan)
APC	Almaty Power Consolidated (Kazakhstan)
AREM	Agency for the Regulation of Natural Monopolies (Kazakhstan)
BESP	Beijing Electric Power Corporation
CAPS	Central Asia Power System
CAR	Central Asian republic
CAREC	Central Asia Regional Economic Cooperation
CHP	combined heat and power
CMERF	CAREC Members Electricity Regulators Forum
COM	Council of Ministers
CPC	Competition Protection Committee (Kazakhstan)
CRETC	Central Regional Electricity Transmission Company (Mongolia)
DFID	Department for International Development (United Kingdom)
DISCO	distribution company
DSM	demand side management
EBRD	European Bank for Reconstruction and Development
EIU	Economic Intelligence Unit
ERA	Energy Regulatory Authority (Mongolia)
ESC	electricity supply companies (Tajikistan)
ESS	electricity supply station (PRC)
GDP	gross domestic product
GENCO	generation company
GWh	gigawatt-hour
HV	high voltage
IPP	independent power producer
JSC	joint stock company
JSCNG	JSC National Grid (Kyrgyz Republic)
KCM	thousand cubic meters
KEGOC	Kazakhstan Electricity Grid Operating Company
km^2	square kilometer
KOREM	Kazakhstan Wholesale Electric Power Market
kV	kilovolt
kVA	kilovolt ampere
kVAh	kilovolt ampere-hour
kW	kilowatt
kWh	kilowatt-hour
LRAC	long-run average cost
LRMC	long-run marginal cost
MEMR	Ministry of Energy and Mineral Resources (Kazakhstan)
MFE	Ministry of Fuel and Energy (Mongolia)
MIE	Ministry of Industry and Energy (Azerbaijan)
MIT	Ministry of Industry and Trade (Kazakhstan and Kyrgyz Republic)
MNT	Mongolian togrog

MOE	Ministry of Energy (Uzbekistan)
MOED	Ministry of Economic Development (Azerbaijan)
MOF	Ministry of Finance
MW	megawatt
MWh	megawatt-hour
NDRC	National Development and Reform Commission (PRC)
NLDC	National Load Dispatch Center (Mongolia)
PBR	performance-based regulation
PPA	power purchase agreement
PRC	People's Republic of China
PSC	power supply company (PRC)
ROR	rate of return
SBM	single buyer market (Mongolia)
SCDCD	State Committee on De-monopolization and Competition Development (Uzbekistan)
SEA	State Energy Agency (Kyrgyz Republic)
SERC	State Electricity Regulatory Commission (PRC)
SGC	State Grid Corporation (PRC)
SOCAR	State Oil Company of the Azerbaijan Republic
SPC	Sate Property Committee (Mongolia)
SPC	State Power Corporation (PRC)
SRAC	short-run average cost
SRMC	short-run marginal cost
TOU	time-of-use
TWh	terawatt-hour
UB DISCO	Ulaanbaatar Distribution Company
UES	Unified Energy System (Russia)
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
WB	The World Bank

NOTES

(i) In this publication, "$" refers to US dollars.

(ii) "CAREC countries" refers to all members of the CAREC Program and "Central Asia" denotes all CAREC countries, except the People's Republic of China and Mongolia.

(iii) Tables and figures in the main text whose sources are not identified are from the study team.

CENTRAL ASIA REGIONAL ECONOMIC COOPERATION (CAREC)
MEMBER COUNTRIES

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Executive Summary

This study assesses the regulatory approaches and challenges in the electricity sectors of the Central Asia Regional Economic Cooperation (CAREC) Program member countries—Azerbaijan, People's Republic of China (PRC), Kazakhstan, Kyrgyz Republic, Mongolia, Tajikistan, and Uzbekistan.

Industry Structure

A variety of industry structures of varying degrees of sophistication have developed in the energy sectors of CAREC countries (Table 1). Tajikistan's energy sector is entirely vertically integrated and held publicly under the close supervision of the Ministry of Energy. Uzbekistan has commercialized and vertically unbundled its energy sector on paper, but in practice, subsidiaries are supervised by UzbekEnergo—a state-owned vertically integrated monopoly. Azerbaijan maintains an integrated public generation and transmission company, but has privatized its distribution and retail functions. While retaining almost exclusive public ownership, the Kyrgyz Republic and Mongolia have both vertically unbundled their power companies. The PRC, on the other hand, has long been open to private investment in generation while retaining public ownership of transmission and distribution. It is also developing wholesale electricity markets. Finally, Kazakhstan has privatized most of its power sector with the exception of high-voltage transmission. Wholesale prices are determined by a market for tradable long-term contracts and development of retail competition is currently being pursued by the Government.

Table 1: Ownership Structure of Electricity Sectors in CAREC Countries

Item	Azerbaijan	China, Peoples Republic of	Kazakhstan	Kyrgyz Republic	Mongolia	Tajikistan	Uzbekistan
Generation	State-owned under Azerenergy	90% state-owned but there are many IPPs with diverse local and international ownership	Largely privately owned	Hydro-power is the dominant source and all major stations are government-owned.	State-owned, mostly CHPs	Mainly hydropower Owned by BT except in Pamirs. BT is a state-owned, vertically integrated company controlled by MOE.	16 state-owned JSCs under the UzbekEnergo board UzbekEnergo is publicly owned.
Transmission	Bundled with generation in publicly owned Azerenergy	Publicly owned SGC	Publicly owned KEGOC	Publicly owned JSC National Grid	Public monopolies; one for each system, Central Region is the largest.	Publicly held under BT	UzelectroSet is a subsidiary of state-owned UzbekEnergo.
Distribution	Local monopoly concessions given to two private companies—Barmek and Bayva	Subsidiaries of SGC	A mix of public and private local monopolies; largely private	Publicly owned regional distribution monopolies	Public local monopolies except for Darkhan, which is under private management	Mostly public under BT. One region (Pamir) has a vertically integrated system operated by the Aga Khan Foundation.	15 state-owned DISCOs are subsidiaries of UzbekEnergo.
Retail Services	Bundled with distribution under Barmek and Bayva	Bundled with distribution under SGC	Mostly private	Bundled with distribution under regional DISCOs	Bundled with distribution, public except for Darkhan	Publicly held ESCs under BT (except Pamir)	Underprovided by regional DISCOs under UzbekEnergo

BT= Barki Tojik, CHP = combined heat and power plant, DISCO = distribution company, ESC = electricity sales company, IPP = independent power producer, JSC = joint stock company, KEGOC = Kazakhstan Electricity Grid Operating Company, MOE = Ministry of Energy, SGC = State Grid Company, UB = Ulaanbaatar.

Tariff Structure and Pricing

Progress in eliminating regulated cross-subsidies[1] varies greatly among CAREC countries (Table 2). Kazakhstan, Mongolia, and Uzbekistan have few cross-subsidies. Azerbaijan and Tajikistan have the largest, with residential consumers being subsidized at the expense of commercial establishments, and to a lesser extent, private industry. Meanwhile, the PRC offers moderate cross-subsidies to residential and agricultural consumers. In each of these countries, however, the actual cross-subsidies differ from those mandated by the regulator because metering, billing, and collection rates vary across consumer classes.

In an attempt to deal with the social consequences of tariff reform, Kyrgyz Republic, Mongolia, and Tajikistan have implemented lifeline tariffs. Expenditure support payments to low-income consumers are also used in Kazakhstan and Tajikistan when the rising costs of utility bills become onerous. However, in Tajikistan, there are allegations that "leaky bucket" problems limit the effectiveness of this scheme.

Recognition of the importance of demand side management (DSM) has encouraged the use of sophisticated tariff structures (e.g., time-of-use tariffs, seasonal tariffs, and capacity charges), which are becoming more common in the CAREC region. Time-of-use tariffs are applied to large consumers in the PRC and are available to Mongolian consumers with appropriate meters. Seasonal tariffs are utilized extensively to deal with winter capacity constraints in Tajikistan where discounts on already low tariff levels are provided during summer. While the relative price change is helpful, its effects are undermined because summer discounts are used instead of higher winter charges, reducing the already low average tariff level. Capacity charges for large consumers are also now widely used in the region.

The institutional framework for regulatory activities varies substantially across CAREC countries, as does the range of regulatory objectives (Table 3). In general, regulators that experience the least government oversight and are responsible for meeting the clearest and smallest number of objectives have made the greatest progress toward cost-recovery tariffs. Regulated tariffs in the PRC and Kazakhstan come closest to achieving financial cost recovery. Mongolia and Uzbekistan, which have made approaching cost recovery one goal of tariff setting, have made significant progress. However, Azerbaijan, Kyrgyz Republic, Tajikistan, and Uzbekistan also struggle to improve commercial discipline to ensure that tariff hikes do not simply lead to lower distribution, billing, and collection efficiencies.

Azerbaijan has chosen to fix the problem of commercial discipline in the sector, and is also raising prices for other public services (most notably, gas) before tackling electricity tariff reform. It is also seeking to replace the current Tariff Council—an interim body which involves multiple interested parties—with a more permanent electricity regulator. Tajikistan and Uzbekistan have attempted to raise tariffs toward cost-recovery levels, but are hindered by considerations of social affordability and the usual commercial difficulties.

Classification of tariff setting methodologies in CAREC countries is difficult. Kyrgyz Republic, Mongolia, and Tajikistan describe schemes that resemble rate-of-return (ROR) methods designed to capture reasonable costs. However, the reality is that tariffs in these countries do not adequately cover average costs or approximate the long-run marginal costs of electricity provision. The tariffs calculated in this way are therefore best viewed as inputs into the broader political process of tariff setting. Even in cases where tariffs are said to cover costs, they frequently do not include provisions for future rehabilitation requirements or debt service obligations. In Azerbaijan, Tajikistan, and Uzbekistan, the government's recognition that tariffs are inadequate led to plans for phased tariff increases, subject to political considerations. Therefore, in all CAREC countries except the PRC and Kazakhstan, final regulated prices appear to be the result of political and social compromises rather than specific methodologies. Only transmission losses appear to be commonly subject to performance-based regulation methods, with transmission companies being encouraged to progressively lower their level of losses yearly.

Specific information on how tariffs in the PRC are calculated is not publicly available, although application of ROR principles is legally required. Tariff levels are the result of a long and unfolding process of

[1] The term "cross-subsidy" is used loosely because most prices are below cost. A cross-subsidy here refers to the fact that some consumers pay much higher prices than others for reasons unrelated to the cost of serving each class.

Table 2: Electricity Tariff Structure in CAREC Countries

Item	Azerbaijan	China, People's Republic of	Kazakhstan	Kyrgyz Republic	Mongolia	Tajikistan	Uzbekistan
Structure	Generation and transmission tariffs are bundled. Distribution tariffs are separate.	Transmission, distribution, and retail are bundled. Generation tariff is separate.	Situation varies with industry structure. Unbundled tariffs are preferred, but are not possible in vertically integrated service areas.	Unbundled	Unbundled	Bundled	Bundled
Generation tariff ($/KWh)	0.014 (including transmission)	Varies, 0.037 may be taken as a crude average.	Set by contracts and spot market	—	0.0282–0.0366	—	—
Transmission tariff	—	—	Varies with distance under 600 km. $ 0.0039/kVh for over 600 km.	—	—	—	—
Retail tariff levels ($/KWh)	Residential: 0.020 Industrial: 0.030 Commercial: 0.060	Varies, 0.053 may be taken as a crude average.	0.0271–0.0284 in Astana. Tariffs vary by location.	Residential: 0.0115 Industrial: 0.0173 Commercial: 0.0189 Agricultural and Government: 0.0184	0.0410	Regular/Summer: Higher rate Industrial: 0.0089 Agricultural: 0.0166 Pumps: 0.0056/ 0.0028 Commercial: 0.0166 Budget 0.0056/ 0.0028 Municipal 0.0056 Municipal transport 0.017 TADAZ: 0.0094/ 0.005	Average: 0.0285 Residential: 0.0239
Number of consumer classes for tariff purposes	3	7	8	5	3	10	5
Lowest reported retail usage tariff ($/KWh)[a]	Residential: 0.020	Fertilizer (Beijing): 0.0341	Industry (Astana): 0.0271	Residential (Sever): 0.0115	Central system, Ger residents: 0.044	Pumps: 0.0056 May-Sep: 0.0028	0.0239
Highest retail usage tariff ($/KWh)[a]	Commercial: 0.060	Commercial at 10 and 35 kV: 0.0819	Others (Astana): 0.0284	Commercial (Osh): 0.0205	Central system, Apartments: 0.046	Agriculture and non-budget organizations: 0.016	Commercial: 0.0325
Lifeline tariff policy	None	None	None. Social protection policy separately administered by local authorities	Everybody is entitled.	Administrative decision on who qualifies	Everybody is entitled. Separate budgetary support for utility bills of the poor also exists.	None
Lifeline tariff level ($/kWh)	—	—	—	0.0108	Varies across and domicile type, roughly 20% discount on marginal tariff	Usually: 0.0053 May to Sep.: 0.0026	—
Lifeline amount (kWh/ month)	—	—	—	150	Varies across DISCOs and domicile type, 30–75	250	—

DISCO = distribution company, kV = kilovolt, kWh = kilowatt-hour, TADAZ = Tursonzoda aluminium smelter.

[a] Tariffs for all regions and consumer classes were not available in each country. These figures provide an indication of the range of tariffs in effect.

Table 3: Institutional Framework for Tariff Setting in CAREC Countries

Item	Azerbaijan	China, People's Republic of	Kazakhstan	Kyrgyz Republic	Mongolia	Tajikistan	Uzbekistan
Agency clearing tariffs	President, on advice bythe Tariff Council	Provincial authority submits tariffs to NDRC for approval	AREM for wholesale tariffs; CPC for retail tariffs	Government, on advice by SEA	ERA	President, on advice of AAMP	Pricing Department of MOF (but political approval required)
Objectives in setting tariffs	Recover some percentage of costs	Mix of objectives including cost recovery and political/ social concerns	Promote competition	Abolish cross-subsidies and approach economic cost recovery; in the meantime, cover variable costs	Mixed objectives including cost recovery and political and social concerns; aiming to reach efficient tariffs	Defend consumers, keep costs of production low, ensure production is profitable; encourage investment	Recover a higher percentage of production costs (which are subsidized through lower gas prices)

AAMP = Agency on Antimonopoly Policy and Entrepreneurship, AREM = Agency for the Regulation of Natural Monopolies, CPC = Competition Protection Committee; ERA = Energy Regulatory Authority, MOF = Ministry of Finance, NDRC = National Development and Reform Commission, SEA = State Energy Authority.

negotiation between the National Development and Reform Commission and its provincial counterparts, resulting in phased increases in tariffs over the last two decades. Cost recovery is identified as a goal and appears to have been achieved recently. Once wholesale markets become fully operational, generation tariffs will be market-determined, with the State Electricity Regulatory Commission taking responsibility for regulating the wholesale markets.

Transmission tariffs in Kazakhstan are set to permit recovery of reasonable costs, including accrual of a budget for future investments and adjustments for permissible losses by distance. Until recently, retail tariffs were approved by local branches of the Agency for the Regulation of Natural Monopolies. These were supposed to be determined on a cost-recovery basis. However, the methodology was reportedly not consistently applied to all local branches. Retail tariff setting authority has recently been shifted to the Competition Protection Committee, in anticipation of the establishment of retail competition.

Cash Flow and Transparency

State-owned distribution companies (DISCOs) in Azerbaijan, Kyrgyz Republic, Mongolia, Tajikistan, and Uzbekistan have historically failed on a massive scale to stem losses, meter consumption, issue accurate bills, and collect cash (Table 4).[2] As a result, the cash flow in their electricity sectors is insufficient to sustain efficient delivery of electricity. This represents a commercial failure, which should be resolved by shareholders (i.e., the government).

There have been some attempts to solve this cash flow problem. Aggressive campaigns to increase end-user metering are underway in Kyrgyz Republic, Tajikistan, and Uzbekistan. This is important for introducing DSM to cope with costly capacity constraints and save fuel resources. Tajikistan and Uzbekistan also claim significant progress in loss reduction. Azerbaijan has awarded concessions to run its DISCOs and Mongolia has done the same for one DISCO. Nevertheless, based on the findings of the individual country assessments, the cash flow positions of all CAREC country power sectors—except the PRC and Kazakhstan—remain weak and unstable.

The lack of discipline among DISCOs and retail companies greatly reduces the power of the regulator to provide direction to the sector through tariff decisions. The inability to make some consumers pay mandated tariffs renders these tariffs irrelevant to them. For producers or potential investors who do not anticipate receiving the amounts due them at official tariff levels, these tariff levels can become similarly irrelevant. Thus, a key challenge for governments is to empower regulators and ensure that tariffs obtain traction on the sector by improving discipline in the distribution and retail companies.

The government's inability to improve DISCO performance has forced regulators to take on roles that they should not be involved with. For example,

[2] The data in Table 4 for Azerbaijan correspond to rates reported since it has issued concessions for private management of its DISCOs.

Table 4: Power Losses in CAREC Countries

Item	Azerbaijan	PRC	Kazakhstan	Kyrgyz Republic	Mongolia	Tajikistan	Uzbekistan
Year of estimate	2004	2004	2002	2004	2003	2002	2002
T and D losses (% of net generation that is not billed)	20.9[a]	6.93	19.3[b]	42.0[c]	21.9[d]	21.7[e]	17.2[f]
Transmission (%)	5.2[g]	5[h]	NSI	6.3[i]	4.0[j]	NSI	NSI
Distribution (%)	15.7[k]	1.93	NSI	38[l]	National average NSI. UB distribution losses 30.64[m]	NSI	NSI
Collection rate (% of billings collected)	53.3[k]	—	92[n]	86.6[l]	97[n]	70[n]	74[n]
Noncash collection rate (% of collection not in cash)		—	45[n]	55[n] (2002 figure) 2004 figures show 51.2-80.9%[o] of billings not collected in cash	—	60[n]	45[n]

NSI = not separately identified, T and D = transmission and distribution, UB = Ulaanbaatar.

Sources:

[a] State Statistical Bureau of Azerbaijan Republic. *Balance of Fuel-Energy and Material Resources.*

[b] Calculated from the World Bank (WB) figures of 15% technical losses and 5% non-billing.

[c] Based on calculation from T and D losses. Note that T and D loss numbers are from different sources.

[d] Mongolia's Energy Regulatory Authority. 2003. *Annual Report*. Ulaanbaatar.

[e] Calculated from WB figures of 11% technical losses and 12% non-billing.

[f] Calculated from WB figures of 10% technical losses and 8% non-billing.

[g] Imputed from total losses and distribution losses.

[h] Study team's estimate based on 2003 data on losses by voltage level from: ADB. 2004. *Technical Assistance to the PRC on Power Pricing Strategy*. Manila.

[i] Officials of Joint Stock Company National Grid.

[j] Officials of Central Grid Company.

[k] Presentation by Ministry of Industry and Energy at the CAREC Members' Electricity Regulators' Forum 2005 meeting.

[l] UK Department for International Development (DFID) personnel.

[m] Ulaanbaatar Distribution Company. 2004. *Annual Report.* Ulaanbaatar.

[n] WB. 2004. *Regional Electricity Export Potential Study*. Washington, D.C.

[o] DFID personnel. Note that these figures are not comparable to others in this row. Whereas for other countries, non-cash collection is expressed as a percentage of total collections, these figures express it as a function of total billings.

regulators in the Kyrgyz Republic and Mongolia have become involved in the distribution of scarce cash among power companies. The linkage between the performance of their DISCOs and their share in the cash distribution needs to be strengthened to provide performance incentives. Because the amounts owed when calculated at the mandated tariffs are seldom actually paid, the cash shares are more relevant than tariffs to some companies in the sector. Azerbaijan has developed a sound approach to the distribution of cash. Percentages of the cash owed by the DISCO to the generation-transmission utility were decided several years before the concessions were awarded. DISCOs are responsible for ensuring payment of these percentages that they owe. They may keep any cash collected in excess of these targets for a specified number of years. The Government funds the shortfall in what is owed to Azerenergy. The scheme has resulted in increased collections by the DISCOs, but some of them are allegedly not meeting their upstream payment obligations in full, citing the refusal of some government agencies to pay their power bills. This experience suggests the importance of a zero-tolerance policy on nonpayment by government entities, if concessions are to work. The scheme also highlights the importance of external financing, probably from the government, to ensure that cash flows are adequate in the interim.

Other technological solutions (e.g., circuit breakers to limit power demand and time-of-day metering) to better manage capacity constraints are not yet in use outside of the PRC. Mongolia is now implementing peak and off-peak tariff charges. Prepaid meters have proven successful in improving the commercial performance of the DISCOs and cutting losses in the PRC. Given the difficulties with attracting investments in capacity expansions in most CAREC countries, regulators will need to examine the

feasibility of such technologies from the point of view of consumer protection and cost considerations.

In the vertically integrated sectors of Tajikistan and Uzbekistan (only in practice), transparency is a problem because tariffs are not unbundled into generation, transmission, and distribution components. Cash is disbursed within the sector according to rules determined by the company management. Prospective investors therefore may not have a clear sense of what to expect if they do enter the market. Attracting investors under these conditions is likely to involve the government bearing a substantial amount of commercial risk on behalf of investors.

Countries whose power sector has the greatest transparency in its operations appear to have had greater success in improving overall sector performance (PRC, Kazakhstan, and Mongolia). Conversely, the percentage of power generated that results in payment to the utility is lowest in the sectors with the least transparency (Tajikistan and Uzbekistan). Similarly, countries which have properly unbundled their sectors (PRC, Kazakhstan, Kyrgyz Republic, and Mongolia) were able to identify successfully the sources of their sector's problems, but not necessarily solve them.

Proper unbundling requires that each subsidiary have independent commercial incentives to improve its performance and ensure that the improvements are observable by the public, or at a minimum, by the regulator and commercial managers. This requires electricity and cash flows among subsidiaries becoming public information; and publication of transfer prices between generation, transmission, and distribution. Improved transparency appears to be a necessary condition for improving overall sector performance, but it is not sufficient as shown by the experience of the Kyrgyz Republic and Mongolia. It must be noted that vertical unbundling need not necessarily proceed toward the same industry structure for every country. The costs of unbundling schemes should be weighed against the potential for efficiency improvements.

Incentives to improve the commercial performance of subsidiaries may be enhanced further if the above transparency improvements are supported by commercial, possibly private management. This can be particularly important for DISCOs as demonstrated by the fairly positive experiences in the private management of distribution and retail in Azerbaijan, Kazakhstan, and Mongolia (only one company). However, Azerbaijan's experience, wherein the private DISCO is involved in a dispute with the Government and is refusing to pay the generation-transmission company what it owes, urges caution. Proper dispute resolution systems are required when privatizing parts of the system. This example might also suggest that Azerbaijan requires an independent regulator with an effective mandate to settle disputes and enforce its decisions.

The PRC's experience with DISCOs run by local bureaucracies provides a counter example. Through application of a zero-tolerance policy on nonpayment with solid commitment from the Government, independent monitoring of hard commercial targets, and management structures that provide solid incentives to perform, the commercial performance of DISCOs has been maintained at very high levels.

Conversely, all the publicly run transmission companies whose performances are readily observable have made significant efficiency improvements (Kazakhstan, Kyrgyz Republic, and Mongolia), or have maintained a high level of performance (the PRC). The stark contrast in the performance of distribution/retail and transmission companies under public management appears to be due to the relative complexity, in terms of human management issues, of managing a DISCO or a retail company.

Regulatory Issues

The overall picture that emerges from these comparisons is clear. Countries vary with respect to the sequencing of sector reforms. However, the elements of these reform packages either already include or are likely to include the following: (i) improvements in transparency, with proper publicly available tracking of power losses and cash flow in the system; (ii) vertical unbundling, which includes measures to make the performance of each company transparent and to publish transfer prices among generation, transmission, and distribution; (iii) commercialization, and often, privatization of at least some DISCO functions; (iv) increased regulatory independence; (v) reduction in the number of competing objectives regulators are required to meet; and (vi) tariff reforms accompanied by budget support and/or lifeline tariffs for poor consumers.

Many CAREC countries are also interested in establishing market mechanisms for determining wholesale power prices as Kazakhstan has done and the PRC is doing. Whether this will be feasible or not depends on the underlying cost structure of each country's power sector. The Kyrgyz Republic and Tajikistan, where generation is dominated by large cascades of hydroelectric generators—most of which have limited storage capacity—would find it difficult to establish robust national electricity markets. Regional wholesale markets provide a much more practical option to obtain benefits from trading power.

A further difficulty in designing power markets in the region is the pricing of outputs from combined heat and power (CHP) plants. Kazakhstan, for instance, has market-determined wholesale electricity tariffs and is seeking to refine its tariff setting methods for heat from CHPs. Mongolia, whose central grid is dominated by five CHPs often obliged to run to provide heat and steam locally, is having difficulty ascertaining the correct principles for economic dispatch of power and pricing the outputs of the combined plants.

It is clear that in some CAREC countries, a large number of consumers cannot afford to pay tariffs that fully recover the costs of running and maintaining the power system. Where previously this has been supported through costly implicit subsidies, there is an urgent need now to make subsidies explicit and non-distortionary through the use of lifeline tariffs or discounted connection charges. Subsidies must also be properly funded by governments and should not prevent the utilities from covering reasonable costs and accruing funds for future maintenance, rehabilitation, and upgrading. Serious policy debate is required regarding the level and quality of electricity service that governments would like to support.

Finally, in most CAREC countries, restoring the ability of tariffs to provide economic incentives to consumers and producers is critical. Without proper price signals, transition to market-determined pricing cannot be made, DSM cannot take root, and private investors cannot be enticed to enter the sector. As indicated above, this means that the problems of the DISCOs must be fixed with all due haste in order to force consumers to pay regulated prices. While weak DISCO performance is primarily the responsibility of DISCO shareholders and management, and cannot be solved without strong government commitment, it weakens the regulators who have a role to play in fixing the problems. As consumer advocates, regulators must consider whether to publish data on commercial performance. In the same capacity, they must be able to offer well-informed opinions to policymakers on potential policy solutions to these problems. Finally, when called upon to arbitrate on disputes regarding the distribution of cash, the regulators must do so in a manner that is predictable and undermines the price signals provided by tariffs as little as possible.

Regional Power Trade

High levels of electricity losses and low billing and collection rates suggest that there are considerable economic rents being generated in most power sectors in the CAREC region. It is impossible to measure these rents or see how they are distributed because of the low accuracy of existing metering systems. Power losses "vanish", so they remain unknowable. It is possible that these rents act as a frictional force against formalized power trade. Formalizing power trade would result in significant changes in the level and distribution of rents, largely because of the improved metering of electricity flows both within and across borders. This is yet another argument for increasing transparency in the sectors.

Finally, inappropriate industry structures pose a significant barrier to the development of regional power trade. If the transmission company and some generators are government-owned, it seems unlikely that cheaper power will be imported from abroad while local generators remain idle. Regional energy trade will therefore require the commercial interests of the transmission companies and their managers to be completely separated from those of the generators.

I. Overview of Basic Regulatory Principles

A. Rationales and Roles for Economic Regulation

The goal of electricity regulation is to induce firms involved in the production, transmission, and distribution of electricity to serve the public interest as defined by the government. Central Asia Regional Economic Cooperation (CAREC) country electricity regulators have different understandings of how to serve the public interest (e.g., minimize costs, protect consumers, provide adequate returns on investments, provide low-cost power to promote economic growth, etc.). The assumption of this report is that the public interest, including these specific objectives identified by the regulators, is best served when the electricity sector is run with a view to meeting the requirements of consumers in an economically efficient and financially sustainable fashion.

The specific rationale for regulation in each country depends on the underlying economic conditions in the sector and the economy at large. The appropriate role of the regulator and the method of regulation vary with these conditions. Regulators can only perform their job well if they, and the policymakers who provide their mandate, understand the rationale for their activity clearly. This, in turn, requires the regulators to have a clear grasp of the economic reasoning for regulation of economic activity. The remainder of this section therefore lays out the rationales for regulatory involvement under different economic circumstances.

A consensus has been reached among power sector professionals that, where possible, consumers' requirements for the provision of goods and services are best met when many independent firms compete vigorously to provide them. Competition among "for-profit" firms forces them to seek the approval and interest of customers. In order to gain that approval, firms constantly improve the quality of their output, target it to better fit the requirements of consumers, and reduce prices to the greatest extent possible. Competition regulates many aspects of market behavior because transactions only take place if both parties believe they will be better off. While for a long time it was thought that competition in electricity was impossible, there are now many examples of competition bringing benefits to electric power consumers.

It is also widely accepted that competition requires several conditions to work well, particularly in the electric power sector. When these conditions are not met, there may be a rationale for regulatory and/or policy intervention to backstop the operations of the market. To explore the various rationales for regulation and/or policy intervention, it is useful to review four[1] of these conditions in some detail.

Many Firms in the Market. First, competition requires that there are many firms in the market. Essentially, this boils down to asking whether the cost of providing a particular good or service is lowest when the task is fulfilled by one or many firms. If costs are lowest when the task is fulfilled by many firms, then these firms are likely to compete with each other by dropping prices until they fall to the minimum average cost of providing the good or service.

For example, in a national power network relying on thermal generation with modest and slightly geographically diffuse demand, the cost of meeting generation needs could be minimized by having several plants in different locations. These firms could be placed under separate management structures and allowed to compete with each other.

For some activities, however, the cost of providing service is lowest when it is done by a single firm. For instance, transfer of electricity through a system of wires would be most cheaply accomplished using only a single set of wires. If additional firms were to enter the market by setting up parallel systems of wires, the average cost of production would rise. Therefore, only one can survive in this market. This condition, where

1 The fifth requirement for competition to be efficient is the lack of externalities. Externalities include costs, like pollution, that are not included in the market prices of goods and services but impose costs on parties external to the transaction. Externalities are best addressed by allocating property rights or setting taxes and subsidies. These tools are held by the government, not the regulator, and are therefore not addressed here.

costs are lowest if the task is fulfilled by one firm, is known as cost *sub-additivity*, and a firm that displays cost sub-additivity is known as a natural monopoly. Profit-maximizing monopolists (i.e., most private monopolists) tend to produce less and lower quality output than is optimal in order to maintain high prices, lower costs, and raise profits.[2]

In some situations, costs are minimized when a small number of independent firms supply the product. For example, if a nation derives its electricity from hydropower on two or three cascades and most of its dams lack storage capacity, there can only be two or three effectively independent firms. Such a situation cannot usually sustain robust competition and is referred to as a natural oligopoly.

If an activity's cost structure cannot sustain enough firms to maintain proper competition, regulation may be called for to ensure that prices are reduced toward efficient levels and that appropriate standards of service are maintained. This provides the rationale for the most common regulatory activities—tariff setting, licensing, auditing, and monitoring of service quality.

Free Entry and Exit. Second, firms must be free to enter or exit the market. Free entry and exit permit better technologies, managers, and business models to replace those that do not perform well. They also ensure that when incumbent firms are making excessive profits, new entrants can step in to provide better service and/or lower prices. Thus, free entry has the impact of increasing consumer choice, reducing industry costs and prices, and improving the quality of service.

Despite their critical role in facilitating competition and efficiency, free entry and exit are not easy to guarantee in electricity markets. Substantial barriers to entry exist in the form of (i) restrictions on access to the network; (ii) investment risks due to uncertainty regarding future policies or regulatory standards; (iii) high capital requirements; and (iv) lack of instruments for managing commercial risks due to fluctuations in demand, prices of inputs, and exchange rates.

The rationale for regulation with respect to the first two of these barriers is clear. Monopolies (natural or otherwise) in complementary parts of the network are often used to prevent the entry of new firms. For example, when the owners of the transmission or distribution networks also own generators, they may favor power generated by their own assets. Alternatively, if they own retail companies, they may fail to provide high-quality transmission and distribution services to competing retailers. The regulator should have a clear mandate to prevent such behavior.

Firms cannot be asked to bear the risks of unexpected changes in policy and regulatory conditions. The regulator has a clear role to play in ensuring the stability of the rules by which the sector operates. If regulations need to change, it is the responsibility of the regulator to ensure that firms are informed of these changes in advance to mitigate the impact of any possible loss on their performance. When policy changes are required, the regulator's role is to assist the government in doing the same.

However, the third and fourth barriers to entry and exit do not necessarily provide a rationale for regulation. Beyond ensuring proper price signals and the relative sanctity of contracts, regulators should not be expected to assist firms in raising capital. If capital markets are not working properly, the government bears the primary responsibility for addressing the issue.

Regulators should likewise resist the frequently advanced justifications for them to protect firms from generic commercial risks. Commercial risks should be borne primarily by the commercial enterprise—the investor. Where commercial risks may be influenced by a government policy (e.g., exchange rate risk and demand risk), there is a rationale for some of them to be borne by the government. Finally, some commercial risks, which cannot all be absorbed by firms (e.g., fuel price risk) should be mostly borne by consumers. The regulator cannot eliminate all these risks for potential entrants. Rather, the regulator should allocate them judiciously among investors, the government, and the consumers so that the party with the strongest potential to manage a particular risk is given the right incentive to do so. The regulator should provide incentives for investors to manage business risks, governments to maintain sensible long-term exchange rate policies, and customers to conserve energy.

2 A monopolistic firm may also be the only buyer of inputs (called a *monopsony*) and may demand less than the optimal input levels to hold down input prices. This further reduces output and increases profits at the expense of consumer welfare.

Adequate Information Flow. Third, adequate information flow is required for competition to work. Information permits consumers to make informed choices and allows potential entrants and incumbents to identify commercial opportunities to better serve customers.

Firms often have strong financial incentives to keep information confidential or publish misleading information. The regulator, therefore, has a role to play in promoting transparency by ensuring that information is accurately revealed and published. The nature of this role, however, may vary depending on whether the firms in question are privately or publicly owned. The details of how electricity regulators can promote transparency in different situations are numerous, and are addressed throughout this study. One of the most important roles of the regulator in terms of ensuring access to information in the CAREC region stems from the impediment to competition discussed next.

Proper Commercial Objectives. Fourth, competition requires that firms have proper commercial objectives. Commercial incentives drive firms to cut most types of costs, set prices below their competitors', and strive to meet consumer demands because doing these things increases their profit margins.

The absence of proper commercial incentives is not usually discussed in textbooks on regulation prepared for developed economies. However, it is of immense significance in defining the rationale and role of regulation in most CAREC countries. Most of the electricity sectors in these countries are owned by public companies. Historically, the government has entrusted these companies with numerous, and often, contradictory goals: (i) ensuring the availability of cheap power to key industries and residential consumers, (ii) reducing the costs of meeting power requirements, (iii) providing revenues for the state, and (iv) achieving energy self-sufficiency. This already complex set of objectives has been further complicated by other objectives that have crept into the system: (v) creating jobs in the power sector; (vi) providing favors to politically important consumers; and (vii) ensuring a parallel, unreported income stream to officials.

The difficulties created by this mixture of objectives are apparent to policymakers in all CAREC countries. Most have recognized that responsibility for ensuring that the managers of publicly owned companies strive toward proper commercial objectives rests with the firms' shareholders—the government. Some CAREC countries have made serious efforts to commercialize their utility firms. However, when these efforts fall short, regulators are often called upon to ensure that companies reduce their commercial losses and improve their financial management. This role should not exist because it requires regulators to assume responsibilities that rightfully should be undertaken by the company shareholders. However, when shareholders fail to perform their responsibilities, regulatory intervention becomes necessary.

In order to deal with this situation, the regulator's key function is to promote transparency. By ensuring that information on utility performance is properly recorded and published, the regulator can cut down on the capacity of the utilities to serve objectives that are not sanctioned by taxpayers and the government. Transparency, therefore, shifts the focus to consumers' objectives and away from those of firm managers. Improvements in transparency are highly politically contentious. However, this study concludes that increasing transparency is the first step to begin the process of reviving or expanding most CAREC countries' power sectors, and to deepen the regional power market.

The regulator's second function as a purely practical matter is to adjudicate on the distribution of scarce cash within the system, and in doing so, induce higher cash collections by the use of incentive-based cash distribution mechanisms. Again, this report emphasizes that the task of reducing the scarcity of cash in the sector should ideally fall to the shareholders of these companies and not the regulator. However, given that the shareholders are failing to work effectively toward this end, regulators must step in to manage the cash shortage. Not doing so results in cash being distributed in an *ad hoc* fashion, rendering the price signals that regulators have designed for the sector irrelevant.

The above discussion indicates the circumstances under which regulatory and/or policy oversight of power market operations is required. Policymakers are supposed to chart the overall direction in which the sector should be taken. The regulator is responsible for providing the detailed inputs and oversight necessary to achieve the policymakers' vision.

B. Unbundling, Functional Separation, and the Regulation of Networks

The process of delivering electricity through networks can be usefully broken down into four activities as depicted in Figure 1: (i) generators transform energy sources into electricity; (ii) the transmission system transports electricity long distances through high-voltage (HV) lines; (iii) the distribution companies (DISCOs) provide the network for carrying the power to households; and (iv) retail companies interface with customers—taking care of connections and disconnections, end user metering, billing, bill collection, and miscellaneous customer service tasks. In all CAREC countries, retail and distribution activities are provided by the same company commonly referred to as a DISCO.[3] Each of these activities carries completely different cost and risk structures and requires different investor profiles.

Electricity sectors contain activities that are potentially competitive (e.g., generation and retail services) and noncompetitive (e.g., provision of transmission and distribution networks). These activities are complementary because they must operate at the same time or none will be of any use. Multiple activities owned by the same organization are described as bundled. As explained in Section A, bundling can permit a monopolist in one activity (e.g., transmission and distribution) to suppress competition and derive monopoly power in another activity (e.g., generation or retail).

Bundled sectors do not permit much transparency. They make it very difficult for the regulator to assess the performance of individual functions, and consequently, devise regulatory strategies to leverage improvements. For example, when transmission and distribution systems are bundled, power entering the distribution system that cannot be accounted for is often written off as a transmission loss. Therefore, inducing the DISCOs to enforce discipline among their meter readers and line managers becomes a challenging task for their shareholders and the regulator. Another adverse consequence of the lack of transparency that comes with bundling is that attracting private capital to the sector is extremely difficult. Potential investors who cannot determine the sector's real technical performance or financial position require very costly guarantees, or are unwilling to enter the sector at all.

Finally, utilities that own assets in one competitive activity and in another which is subject to rate of return regulation have a strong financial incentive to pretend that assets used for the competitive activity are actually part of the capital base in the regulated activity. This permits them to justify higher rates. For instance, a DISCO may go into the business of manufacturing meters. Regulators will find it hard to identify which of its meter shops are for repairing distribution equipment (and are therefore a legitimate part of the DISCO's capital rate base), and which are for the potentially competitive manufacturing enterprise.

Therefore, the regulation of a service bundled with a noncompetitive network will be more difficult than the regulation of either function alone. A bundled company can easily manipulate information and the regulatory process to increase its profits, hide waste and graft, and obstruct competition. Vertical unbundling—defined as the separation of the ownership and management of the core network activities from other potentially competitive services—is therefore an integral step in most power sector reforms.

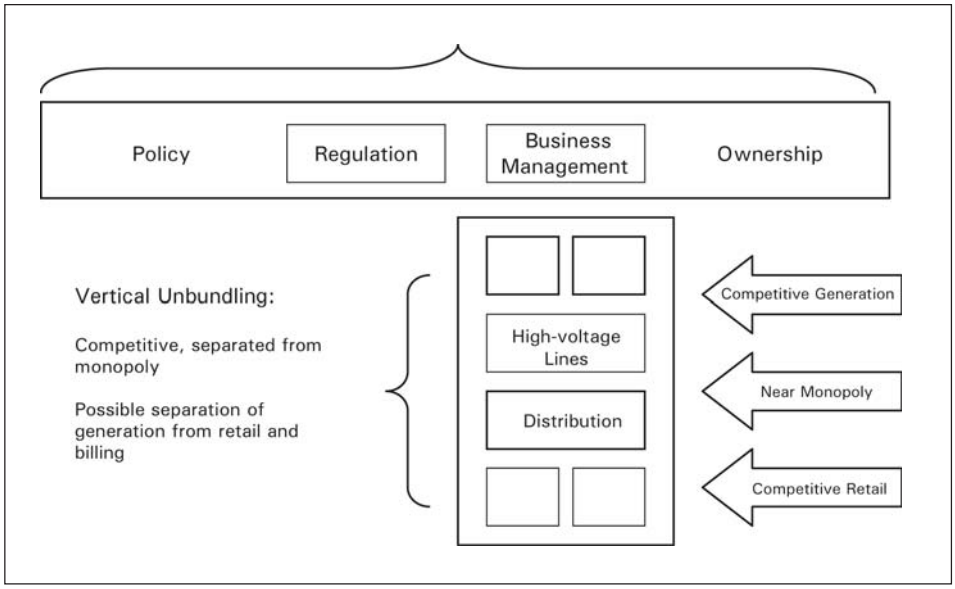
This discussion shows that constraints on the availability of information allow the utilities to control sector management, while transparency shifts power from the regulated party to the regulator. This study finds that the most fundamental challenge facing regulators in the least reformed CAREC electricity sectors is to regain influence by inducing utilities to provide accurate information. The above arguments, each of which has relevance for CAREC countries, indicate that effectively reducing cross-ownership and/or cross-management of generation, transmission, and distribution facilities is indispensable for meeting this challenge. Comparisons between Tajikistan and Uzbekistan, on one hand, and the Kyrgyz Republic and Mongolia, on the other, provide some powerful lessons on how unbundling can be carried out to improve transparency.

The Kyrgyz and Mongolian experiences—while showing the transparency improvements that unbundling can bring—also demonstrate that vertical unbundling alone is not the same thing as sector reform. Unbundling only permits the transparency

3 The People's Republic of China (PRC) and Kazakhstan are in the process of designing a framework for splitting the DISCOs up into distribution grid and retail companies, and introducing competition into the retail business.

Figure 1: Functional Separation and Vertical Unbundling

Functional Separation:
Policy, regulation, business management, and ownership in different organizations



necessary for identifying which reforms to pursue and monitoring the implementation of these reforms. Without further serious reforms, however, unbundling is unlikely to improve sector performance.

Vertical unbundling requires that each firm (i) have autonomous management and shareholder oversight, (ii) interact separately with the regulator or market to permit setting of publicly known transfer prices, (iii) maintain individual publicly verifiable books of accounts, and (iv) have sufficient power meters at its nodes to ensure that it can be held individually accountable for the power it receives. In some CAREC countries none of these elements of separation have been undertaken and vertical unbundling cannot realistically be presumed to have taken place.

In addition to the above benefits, vertical unbundling also carries costs. Specifically, it requires certain overhead costs to be duplicated. Some of these costs can be consolidated and reduced by outsourcing the functions to external organizations who can serve all the utilities in the sector. Others, most notably the role of board oversight, must be specific to the firm if unbundling is to be meaningful. It follows that the appropriate degree of vertical unbundling will vary with the size of the sector, level of inefficiency and corruption, and potential for introducing competition.

It is not just the different management functions in the power sector that may need to be separated. Policy making, regulation, business management, and ownership functions in most developed power sectors are allocated to different organizations even though all four functions may be ultimately handled by the state. This allocation is usually called functional separation and is illustrated in Figure 1. The purpose of functional separation is to create greater transparency of operations and advice, as well as better defined responsibilities and accountability.

C. Structural and Behavioral Approaches to Regulation

Structural Regulation. Regulation broadly takes two complementary forms.[4] Structural regulation sets out rules regarding who may own which sector assets and conduct which sector functions to minimize the firms' incentives to impede competition or engage in illegal activities. It also involves stringent financial reporting standards and other measures to improve transparency.

4 Organisation for Economic Co-operation and Development (OECD). 2001. *Recommendation of the Council Concerning Structural Separation in Regulated Industries*. OECD: Paris.

These regulations serve to define the industry architecture and structure; hence, the term.

Vertical unbundling can be a highly effective form of structural regulation. For example, consider the case described above (of extreme relevance for some CAREC countries) where bundled distribution and transmission companies hide commercial distribution losses as transmission losses. The government (or regulator) can require the companies to unbundle by implementing the measures described in Section B, and the companies may each be permitted to keep the cash gained through their success in reducing losses. In this case, the rules will align the incentives of the companies and the regulator. The transmission company will no longer accept responsibility for losses incurred in the distribution system and the DISCO will increase its profits if it is energetic in reducing losses.

In fact, the realignment of incentives brought about by vertical unbundling goes well beyond loss reduction. The transmission company's revenue increases as it carries more power. It will, therefore, increase its revenue if it accepts power from all generators. By contrast, it will lose revenue if it helps any one generator to reduce supply from competitors and raise consumer prices.

In an unbundled structure, firms have incentives to comply with the rules because by doing so, the respective businesses will be most profitable. Natural monopoly transmission and distribution companies will have an incentive to maximize access and traffic because they charge on the basis of traffic. Generation companies (GENCOs) will have incentives to keep prices low and increase efficiency in order to be dispatched. Retail companies have an incentive to offer good service at competitive prices to discourage their customers from seeking out other retailers. In this way, the incentives created by the unbundled structure align the interests of the regulator, regulated utilities, consumers, and the government.

Another potential structural change is de-monopolization, where the generation or retail monopoly is broken up into a number of smaller competing companies to give them incentives to reduce costs, lower prices, and improve service quality. De-monopolization is crucial to the success of any attempt to introduce competitive pricing, and for most forms of performance-based regulation (see Section II.A).

Privatization and concession[5] of DISCOs are also forms of structural regulation because they improve the incentives of the firm to issue electricity bills and collect payments properly.

A key advantage of structural approaches to regulation is that they do not require the regulator to possess too much detailed information on sector activity. Because the regulator knows that the firm has incentives to comply with laws and regulatory rules and regulations, it does not need to oversee the firm's every decision, and consequently, need not know about all of them.

Behavioral Regulation. Where structural regulation realigns incentives to comply with policy directives by regulating the structure of the industry; behavioral regulation uses the legal system, administrative rules, and penalties to force compliance by companies, taking this industry structure as given. The regulator persuades the firm to comply with government policy even though these policies may be contrary to the firm's commercial interests. For example, a government policy may mandate that large consumers be permitted to choose which generator to purchase their electricity from to promote competition. The regulator of a bundled generation-transmission company using a behavioral regulatory approach would have to persuade this firm to allow competing generators access to its lines and customers. The bundled company possesses far more information about its businesses than the regulator. It could therefore defy the regulator, denying its competitor access for a number of ostensibly technical reasons. These companies could even challenge the competitor or the regulator before a judicial or a quasi-judicial court to discredit the accusation that they are engaging in an anti-competitive conduct.

Behavioral regulation can be used against an anti-competitive conduct only if a case is proven by the regulator or a court. To gather evidence for an anti-competitive conduct, the regulator must accurately observe, record, and interpret the behavior of a firm and its outcome. This is expensive, time consuming, and not always feasible. The utility has financial

5 Concession involves auctioning off the rights to manage and keep the profits from a company's operations for a defined period. The difference between concession and privatization is that under a concession agreement, the government retains ownership of the company and is entitled to take over management when the concession expires, or if the concession terms are violated.

incentives to frustrate the regulator's work. With the passage of time, the customer may put up with unsatisfactory service rather than waste time on a regulatory battle. The regulator—unable to collect or interpret the information—may also give up.

Under these circumstances, therefore, structural regulation may be more effective than behavioral regulation in implementing government policy. If the transmission system is forced to sell its generation assets, it loses the incentive to treat other generators unfairly.

Structural regulation and behavioral regulation are sometimes called *ex-ante* and *ex-post* regulation, respectively. A well-designed ex-ante industry structure reduces the need for ex-post behavioral regulation. Potentially competitive parts of the business may be set free from tariff regulation as firms in these sectors compete, improving service quality and reducing prices to seek consumer approval. However, the monopoly components of the system—those displaying cost subadditivity—would still be subject to behavioral regulation. Therefore, structural regulation cannot eliminate the need for behavioral regulation, but should be thought of as reducing the need for and scope of behavioral regulation.

Formulation and implementation of structural regulatory measures are often not within the mandate of the regulator, though such measures render the regulator's job substantially easier. In such cases, the role of the regulator is to advise policymakers on how to devise such measures. This is extremely important in countries whose electricity sectors are in transition.

All CAREC countries engage in a mix of structural and behavioral approaches to regulation. Each has pursued some degree of functional separation.[6] In some cases, the electricity utility has been, or will be, vertically unbundled so that those parts that are potentially competitive (i.e., generation and energy retailing) and those that are potentially monopolistic (i.e., HV transmission and lower-voltage distribution) can be regulated under regimes that reflect the underlying cost structure of the activity. However, as this report has identified, significant scope for further structural regulation remains, beginning with (i) more (or more effective) vertical unbundling in Azerbaijan, Tajikistan, and Uzbekistan; (ii) privatization of some aspects of power distribution and retailing in the Kyrgyz Republic and Mongolia; and (iii) clarification of who actually owns generation capacity in the People's Republic of China (PRC).

D. Regulatory Independence

All regulators are required to consider the views and interests of all parties involved in the sector. However, a regulator that can take and implement regulatory decisions without having to accede to the wishes or vested interests of political leaders, regulated entities, consumer lobby groups or lending institutions, is said to be independent. Some of the factors that promote regulatory independence are discussed below.

Mandate and Role. A clear definition of what the regulator is mandated to do promotes independence, especially if it is prescribed by law. It frees the regulator of the need to deal with politically motivated directives and conflicts with other government entities over regulatory and policy roles. For instance, if full responsibility for tariff setting is clearly lodged with the regulator, attempts by other government entities to get involved may easily be denied. Further, a mandate prescribed by law imbues the job of the regulator with some form of security and stability. Defining it through a special directive or a ministry decision makes it predisposed to frequent changes or revisions, and thus susceptible to unwanted influence.

Structure. Independence is also enhanced when the regulatory agency is structured in such a way that makes it subject to less oversight. The presence of an oversight body in the form of a ministry or a governing board, whose members are usually composed of political appointees, lessens the freedom of the regulator to act independently of political considerations. This is crucial, especially when making tariff decisions. As this report finds, CAREC regulators operating with the most oversight from the political branch have generally had to pursue multiple contradictory goals, and faced considerable difficulty in implementing economically rational tariffs.

The argument that instituting checks and balances requires that the regulator be supervised by a higher authority raises the issue of extended accountability because this higher authority is, in turn, answerable to the political leader or head of the state.

6 Kazakhstan and Mongolia have gone the farthest and Azerbaijan, Tajikistan, and Uzbekistan have the longest distance to travel.

Accountability has to stop somewhere because the farther it goes, the less autonomous the regulator becomes. In practice, it may be more helpful to permit regulators to be held accountable to consumers and producers through the court system. Even in this case, the types of suits that may be brought must be limited, and the basis of such litigation must be restricted to failure to properly apply relevant laws and rules specific to power regulation.

Leadership. Independence requires that leaders or high officials of a regulatory agency be appointed based on the principle of merit and fitness, given a fixed term of office (most countries utilize 4–6-year terms), and granted tenure arrangements that allow for their removal only on just cause. These rules for tenure and termination of regulators insulate them from political influence. Similarly, the requirement of merit and fitness ensures that regulators are technically capable of carrying out their responsibilities. Competence ensures that regulators formulate sound rules and regulations and make them work under different circumstances. Further, it can also give the regulator some leverage over the regulated entities.

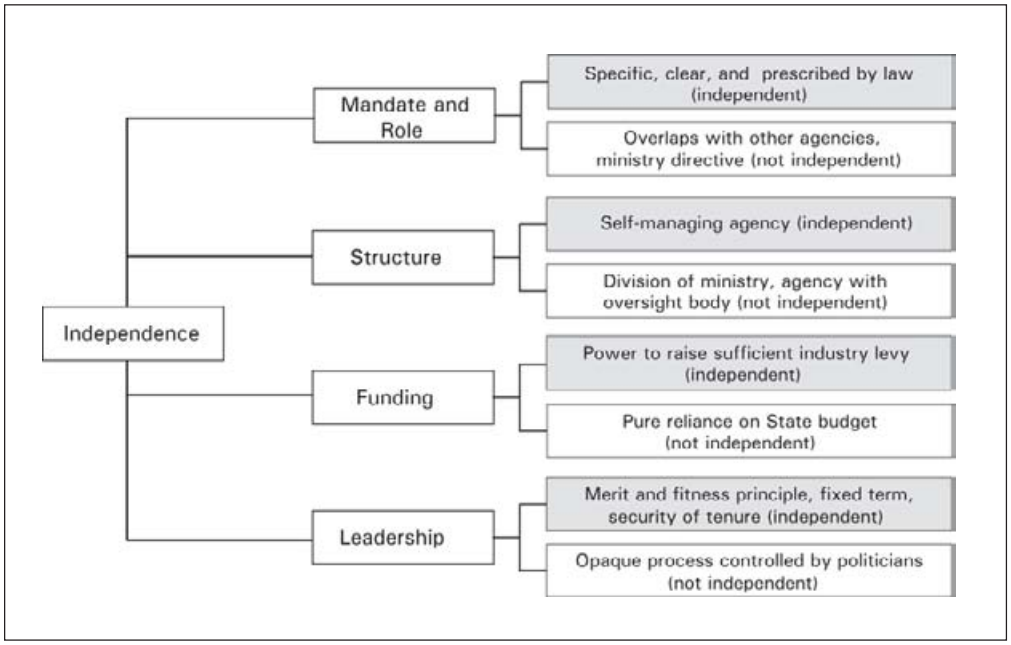
Fiscal Autonomy. One factor often related to regulatory independence is financial freedom or self-sufficiency. However, while this freedom can definitely promote regulatory independence, developing country examples of fully fiscal autonomous electricity regulators are rare. Self-sufficient government agencies such as customs or social insurance systems generate adequate revenues to fully finance their operations. For a developing country regulator, adequate regulatory taxes may be difficult to levy because affordability of power is a major constraint—as in CAREC countries—or because only a few market players may be taxed. Consumers may argue that income taxes and other charges should already cover the costs of government and regulatory supervision of the sector. Nevertheless, if coupled with other strong measures to guarantee independence as well as a visible increase in public participation in regulatory affairs, it may be possible to overcome these difficulties in CAREC countries. Figure 2 depicts what constitutes an independent regulator.

Regulatory independence is important for meeting the requirements of utilities and investors. It facilitates the creation of predictable rules and regulations and a financially sustainable sector. Independence enhances predictability because it permits consistent application of laws, rules, and regulations. Financial sustainability is improved because the independent regulator is more likely to set electricity prices that reflect market realities and permit reasonable rates of returns (ROR) on investments. Only an independent regulator can make this happen because doing the opposite is often popular with consumers, and therefore, politically convenient. This in turn permits potential investors to maintain an adequate level of confidence in their ability to make reasonable returns. Regulatory independence will therefore be very helpful for CAREC country power sectors because almost all of them will require significant private investments for rehabilitation, repair, and construction of new infrastructure in the next few years.

Independence also serves the needs of electricity consumers. In the long term, it does so by ensuring that the sector is run in a sustainable fashion as described above. In the short term, the independent regulator can serve as an honest broker in bringing consumers and producers together to forge the painful compromises necessary to genuinely balance the needs of different consumer classes with the financial requirements of the sector. It can do so by encouraging a regulatory approach that is transparent and participatory. Neither of these traits has proven popular among the regulators in CAREC countries yet, although some Mongolian regulatory officials are keen to increase the frequency of regulatory public hearings.

Finally, independent regulation could serve some of the needs of the very governments that oppose it. It could permit governments to distance themselves from politically unattractive but necessary tariff increases. Also, independent regulators could assist the government in promoting transparency and creating the incentive structure necessary to crack down on utility mismanagement. This is an important part of the political calculus in a region where the utilities are centers of significant political and financial power and are owed political consideration by many government officials.

Figure 2: Regulatory Independence



Source: Adaptation of ideas from Frontier Economics, 2003.

E. Limitations of Regulation

The power sectors in CAREC countries face many problems that call for a wide variety of policy instruments. Effective electricity regulation is only one tool available. Discussions of electricity regulation in CAREC countries need to reflect realistic expectations regarding what regulation can and cannot accomplish:

(i) Regulatory regimes operate best if they are based on the understanding that competition, where feasible, is the best regulator of economic activity in the sector.

(ii) Regulation through competitive markets cannot ensure that prices fall. Switching to competition necessarily involves the government and regulators ceding control of prices to the corresponding markets. There are examples of attempts to establish markets during times of supply shortages, which have led power prices to rise, not fall.

(iii) Structural regulation, which relies on a well-designed industry structure to align the incentives faced by the regulated party with the policy objectives of the government, produces the best results. However, most structural regulatory tools are not held by the regulator. Formalizing an institutional framework for the regulator to publicly share its opinions on structural options with policymakers will be important.

(iv) Beyond promoting transparency, regulators cannot do much to ensure sensible commercial management of utilities. This is the task of the utilities' shareholders, which in most CAREC countries are the governments. If regulators are called upon to distribute cash in the sector, they must do so cognizant of the fact that these cash distributions will replace tariffs as the primary determinants of incentives in the sector.

(v) Comparisons between the regulatory frameworks and degree of regulatory success in CAREC countries visibly show that the regulator requires a clear mandate, a limited set of objectives, and ownership of policy instruments necessary to realize these objectives. From this perspective, reducing electricity prices in the short term is not an appropriate regulatory objective. This could only be done in CAREC countries in a

financially sustainable manner if the sector would receive fiscal subsidies. However, regulators do not have control over the needed funding. As a consequence, those regulatory regimes which have taken this as an objective have failed on two counts. First, their sectors are not financially stable. Second, low prices have stimulated power demand growth, exacerbating the losses to the economy of lost load.

The danger of regulatory failure must also be recognized. One form of regulatory failure is regulatory capture, wherein the regulator becomes dependent on the expertise and information provided by the utilities and ceases to serve consumer interests. This is of particular importance for CAREC countries, most of which have relatively recently converted their energy ministries into utilities. As almost all qualified personnel became employed by the utilities, there are few good independent sources of expertise. Significant regulatory capacity building is already underway. However, much stronger technical, economic, and financial skills are required before the human resources held by the regulator will be able to match those of the regulated utilities.

II. Common Approaches to Basic Regulatory Tasks

A. Tariff Determination

Tariff structures, when designed and implemented with creativity and effort, can serve multiple objectives simultaneously. The Asian Development Bank (ADB) promotes the use of tariff structures, which seek to ensure that social protections are maintained alongside tariff reforms that promote efficient resource allocations and financial viability of the sector.[1]

In order to clearly explain the pros and cons of different approaches to tariff determination, it is necessary to introduce several concepts sequentially. Section A.1 introduces and defines a few crucial economic concepts, Section A.2 defines the potential objectives of tariff setting, and Section A.3 explains how appropriate tariff structures can meet these objectives. Ways of realizing such tariff structures are described in Section A.4 for the case of a regulated natural monopoly, and in Section A.5, for a potentially competitive service. Finally, Section A.6 briefly discusses the rationales for raising or lowering marginal tariffs.

1. Economic Concepts Relevant for Tariff Regulation

a. Cost and Financial Cost

The term "cost" in the following discussion refers to economic social cost. Economic social costs include all the costs borne by every member of society from an economic activity. These include the direct costs borne by the firm responsible for the activity as well as the costs of environmental damage, unpaid costs of utilizing natural resources, and costs resulting from congestion of infrastructure. In contrast, financial cost is used to refer only to the costs that register on a firm's income statement.

b. Marginal Cost

The marginal cost of providing a service is the value of additional resources that must be utilized to increase output by a single unit. Thus, in the case of electrical energy, the marginal cost is the value of the additional resources that could be saved if one kilowatt-hour (kWh) less of electricity were provided. Alternatively, it can refer to the value of additional resources required to increase output by 1 kWh. It is critical to recognize that in the electricity sector, marginal costs vary tremendously with the time of day and year. This is because the sourcing of power varies with demand and climatic conditions to meet demand at the lowest possible cost.

c. Long-Run and Short-Run Marginal Costs

There is a potential distinction between the long-run and short-run marginal costs of a system. The short-run marginal cost (SRMC) is the value of resources used to increase output by one unit today, taking the capacity of the system and other difficult-to-adjust input levels as given. This usually involves the cost of additional fuel required, and perhaps, a little extra labor. In contrast, the long-run marginal cost (LRMC) is the cost of increasing output by one unit, assuming that all input levels, including system capacity, can be adjusted in the interim. Systems with excess capacity achieve increases in output most cost-effectively simply by increasing inputs that are variable immediately. Therefore, in such systems the marginal capacity costs are roughly zero, and the LRMC and SRMC are roughly the same.

d. Marginal Benefit and Demand Curve

The marginal benefit experienced from consuming, say, the 50th unit of electricity in a billing cycle, is the highest price at which a consumer will consume 50 units. (If the price were even slightly higher, less than 50 units would be consumed.)[2] The line

1 A key document in this regard is ADB Economic Research Department's Technical Note No. 10: *Beyond Cost Recovery: Setting User Charges for Financial, Economic and Social Goals*, by David Dole and Ian Bartlett, January 2004.

2 While economists do worry about the distinctions between marginal benefits and the prices consumers are willing to pay, these can be ignored in the electricity sector. Marginal social benefits would only deviate from the price consumers are willing to pay if a consumer's electricity consumption provided benefits to other consumers.

depicting the amount of electricity that consumers are willing to buy at each price is called a demand curve.

e. Average Cost, Short-Run Average Cost, and Long-Run Average Cost

The average cost of electricity provision is simply the total economic cost divided by all the units of the resource provided. The short-run average cost (SRAC) is the average cost given current levels of difficult-to-adjust inputs (primarily capacity in the electricity context). The long-run average cost (LRAC) is the average cost given that difficult-to-adjust inputs such as capacity can be adjusted given sufficient time. LRAC is always lower than SRAC because adjustments to difficult-to-adjust inputs would only be undertaken if they reduced costs.

There are many possibilities regarding the relative size of LRMC, SRMC, LRAC, and SRAC. For purposes of this discussion, it is useful to single out two empirically relevant possibilities that occur with some frequency in electricity sectors. Each of these situations is depicted graphically in Figure 3.

First, systems with excess capacity (Figure 3a), by definition, do not require large capacity adjustments to alter output so that the distinction between long- and short-run cost structures can become negligible. In such systems, expansions in output tend to be achievable at constant marginal costs.[3] It follows that the average costs of production for most firms, and therefore for the sector as a whole, will exceed their marginal costs.

Second, in systems that are capacity constrained (Figure 3b), making new investments in capacity reduces the cost of output increases. Therefore, LRMC can be lower than SRMC. A classic example of this is when a capacity-constrained system that utilizes its peaking plants extensively adds new base-load capacity. Because base load plants have lower fuel costs, the investment reduces system marginal costs.

Also, because cheaper alternatives for expanding capacity tend to have already been exploited, the costs of new capacity can be larger than they have been historically. Therefore, in capacity-constrained systems, the LRAC of power provision tends to rise with the output required. It also follows that the LRMC of meeting new demand (which consists primarily of large capacity expansion costs) are high relative to LRAC (which are low because old capacity is considerably cheaper than new capacity).[4]

2. Objectives of Tariff Regulation

a. Economic Efficiency

Different tariff structures can be utilized to achieve different objectives. Economic efficiency of resource allocation or optimal conservation of resources, requires that no resource should be used if the cost of using it exceeds the benefits to society from using it. Conversely, economic efficiency also requires that when the benefits of using a set of resources exceed the cost of using it, such resource should be utilized. Economically efficient outcomes in the electricity sector are therefore obtained if output is set to the consumption level where the LRMC curve intersects the demand curve.

b. Financial Cost Recovery

Financial cost recovery requires that tariff revenues are sufficient to maintain the financial viability of the utilities and finance any future investments that may be required.

c. Fairness

Fairness is a subjective term closely tied to the affordability of service. It requires that consumers' utility bills are not excessive relative to their income levels and given the impact of their consumption on the total cost of providing service to society as a whole.

3. Types of Tariff Structures

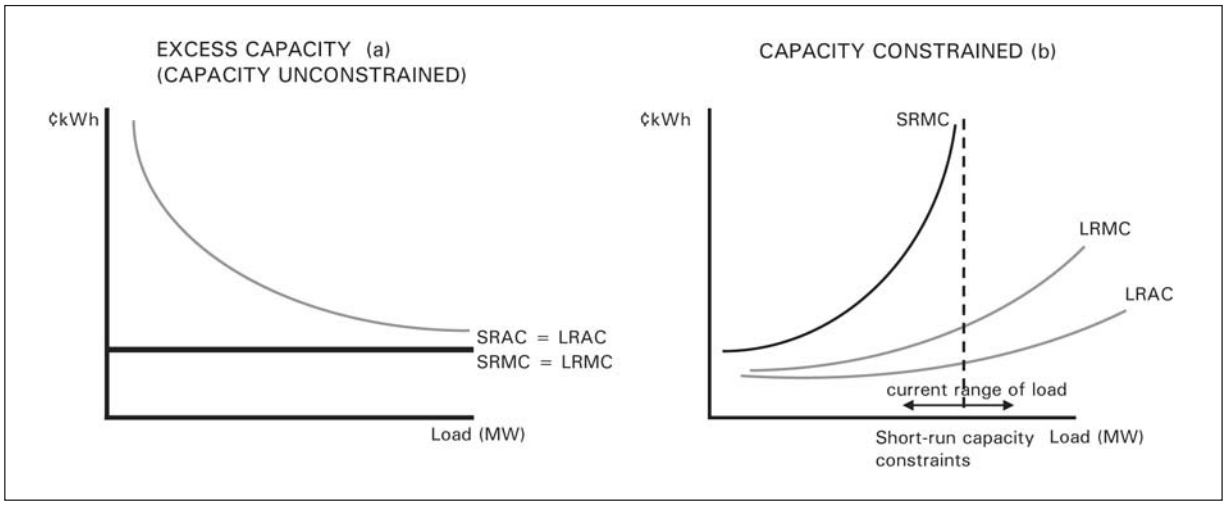
a. Multi-Part Tariffs

The most flexible tariff structures can involve a combination of marginal tariffs, lifeline tariffs, and access charges. The marginal tariff is the price paid by the consumer for each of the last few units of electricity consumed. Lifeline tariffs are the prices paid by consumers for each of the first few units of

3 These conditions must be carefully distinguished from those of natural monopoly because if the capacity costs could be practically borne by several firms, cost sub-additivity would not be implied.

4 For simple, general discussions of the relationships between long- and short-run marginal costs, the reader is referred to: Sexton, R., P. Graves, and D. Lee. 1993. The Short- and Long-Run Marginal Cost Curve: A Pedagogical Note. *Journal of Economic Education*. (Winter): 3437; and Boyd, L. and D. Boyd.1994. The Short and Long-Run Marginal Cost Curves: An Alternative Explanation. *Journal of Economic Education*. (Summer): 261-265.

Figure 3: Marginal and Average Costs



kWh=kilowatt-hour, LRAC = long-run average cost, LRMC = long-run marginal cost, MW = megawatt, SRAC = short-run average cost, SRMC = short-run marginal cost.

electricity consumed. Marginal and lifeline tariffs collectively determine usage charges to the consumer that vary with the amount of electricity used. The access charge is the price paid by consumers for being connected to the network.

In order to show how such structures can be used to meet the goals listed above, we turn next to the two empirical situations described previously. In each example, it is assumed that utilities pay the full cost of their activities to society (i.e., including environmental costs, resource depletion costs, etc.), so that there is no difference between financial and economic costs.

Consider first a system with excess capacity (Figure 3a). Efficiency is achieved by ensuring that per unit tariff (the usage charge) is set equal to the marginal cost of electricity provision. This way, consumers will have an incentive to conserve extra units of electricity that they do not really value at the extra cost of producing them.

However, because the average cost of providing electricity in an excess capacity environment is above the marginal cost, this per unit tariff level is insufficient to recover the financial costs of the sector. The access charges can then be set so that the total access charge collected from all consumers covers the shortfall, ensuring that financial cost recovery is also achieved. However, because some consumers cannot afford to pay the resulting high bill, access charges for poor customers can be made lower than those paid by rich customers. As long as the total access charge collected is sufficient to eliminate the financial shortfall of the sector, modest adjustments in the distribution of access charges between consumers do not really matter. Such adjustments and cross-subsidies in the access charge can therefore be used to ensure affordability without compromising efficiency or cost recovery.[5]

Even in the case of a capacity-constrained system (Figure 3b), the marginal tariff must be set equal to LRMC to encourage efficiency for exactly the reasons expressed above. However, LRMC typically exceeds LRAC in a capacity-constrained system. Therefore, if consumers were charged the LRMC for every unit they consume, the utility firms would make windfall profits and electricity would be unaffordable to the poor. These objectives can be dealt with through the use of graduated lifeline tariffs that permit consumers to obtain the first few units of electricity at below LRMC. The difference between LRMC and lifelines, added up over all the units sold to all consumers, should be set equal to the windfall profit to just ensure cost recovery. By targeting lifelines to the poorest

5 In principle, the access charge can even be negative for the poorest consumers. However, this should be avoided when there are a large number of consumers not connected to the grid. Large access charge subsidies in such a situation could cause customers who would be more efficiently served by off-grid mechanisms, to link to the electricity grid.

consumers, fairness can be achieved. In theory, even the poorest consumers should pay a marginal tariff equal to LRMC to discourage waste. Lifelines should not apply to the last units of power consumed.[6]

The design and implementation of such non-distortionary lump sum cross-subsidies requires the capacity to distinguish between classes of consumer types. This is often difficult, especially because some consumer types, wishing to either avoid higher access charges or avail themselves of lifelines, may pretend to belong to a subsidized consumer class. In addition to devising effective means of discerning which consumers are which, it will be critical to provide incentives to consumers to report their consumer class honestly. For example, rich consumers may be unwilling to accept less reliable power service, restrictions on their monthly energy consumption (in kWh), restrictions on their instantaneous consumption (in kilowatt [kW]), or a requirement to pay their electricity bills in advance. By tying lifelines or reduced access charges to such differentials in the quality of service, the tariff structure can induce consumers to declare their type voluntarily.

Which quality differential to use depends on what is scarce in the sector. In capacity-constrained sectors, kW or hours of on-peak service can be limited to consumers choosing to avail of such benefits. In fuel-constrained sectors, total kWh restrictions can be used. If bill collection is a problem, then, requiring prepayment of bills addresses a problem that already exists. In any of these cases, such a policy actually assists the sector in dealing predictably with a shortage that would otherwise result in a haphazard rationing of the scarce resource through unpredictable blackouts and brownouts.

b. Single-Part Tariffs

Despite the benefits of multi-part tariffs, it is also important to remember that any tariff structure must be transparent and easy to understand and implement. This is the reason sometimes given for using single part tariff structures. They indeed have the advantage of simplicity, and can be of two types:

(i) When utilized and set equal to LRMC, a flat usage fee (without access charges) will result in economically efficient outcomes, providing consumers with strong incentives to use power wisely. If the system has excess capacity so that LRAC exceeds LRMC, it will result in losses to the utilities and will not be sustainable. If the system is capacity constrained and LRMC exceeds LRAC, the utilities would receive windfall profits at the expense of consumers. In either case, no social objectives can be pursued using a usage fee while maintaining economic efficiency.

(ii) A single-part tariff with only an access fee (and no usage charges) is perhaps the worst possible scheme because it leaves consumers no incentive to conserve energy. This is true even if the access fee paid for the connection is linked to consumer characteristics, say, the square footage of the home. While using only access fees can achieve social or financial goals, such a scheme is hopelessly economically inefficient and results in tremendous waste of resources. Metering consumption is critical because it makes usage charges and conservation incentives possible. In this regard, the common argument that marginal costs of electricity provision are too low to justify metering requires serious numerical scrutiny. Recognizing the high energy intensities of their sectors, many CAREC countries have embarked on ambitious consumer metering drives to enable charging of usage fees.

4. Tariff Regulation for Natural Monopolies

After determining the objectives and conceptual structure of an optimal tariff, the regulator must pick the actual price levels. While the technical details of how to measure cost structures are arduous and beyond the purpose of this study, it is important to understand the economic ramifications of different approaches to picking price levels.

Rate-of-Return (ROR) Regulation. Under ROR regulation, the utility seeks the regulator's permission before adjusting tariffs and access fees. This requires

6 A comment has been made that poor consumers' electricity demand is not particularly sensitive to the price charged. If this is true, then, accidentally providing excessively large lifelines would not cause consumers to change their demand much, and consequently, would not create much waste. Resolution of this issue requires an accurate assessment of how price sensitive electricity demand is among the consumers in question.

the regulator to scrutinize the utility's cost structure. Non-capital costs are valued at market prices. The utility then decides whether the proposed tariff structure permits recovery of financial costs when capital invested in the firm is permitted to earn a reasonable ROR. While this method is typically utilized to determine single-part tariffs for financial cost recovery, implementation of LRMC pricing using a multi-part tariff also involves calculation of a reasonable ROR. Specifically, even when using a multi-part tariff, a determination of financial (including capital) costs is required and capital must be valued to determine LRMC and the total financial cost.

It has been argued that the use of ROR on capital to limit a utility's commercial choices has two key shortcomings. First, when the regulator's valuation of capital does not coincide with the firm's, it creates incentives to utilize inefficient input mixes to increase the operating profits permitted. Specifically, when a regulator overvalues capital, utilities will over-utilize it relative to other inputs. If the regulator undervalues capital, financial cost recovery is not possible and the utility may allow the system to deteriorate by withholding investment.[7] Second, ROR regulation takes the costs of delivering power as given. Thus, it can overestimate the minimum (financial) LRAC and may not impose adequate financial discipline on the utility. As a result, inefficient practices might become sustainable. It should be noted, however, that this latter criticism of ROR regulation is controversial. Standard economic theory shows that, the Averch-Johnson critique aside, a profit maximizing firm should always try to minimize costs, whether it is making large profits or not.[8]

Price Caps. Price caps have been suggested to deal with the first shortcoming of ROR regulation. Under this system, the regulator does not relate the prices it permits to the utility's input profile. Rather, it simply announces a price cap. Because price caps do not explicitly link maximum permissible profits to the amount of any particular input utilized, they do not distort the production decisions of utilities.

However, price caps must be occasionally adjusted to align the tariff structure with the financial needs of the sector. Through these realignments, the maximum permitted tariff becomes dependent upon the input mix utilized. Therefore, in the long run, price cap regulation of a natural monopoly becomes indistinguishable from ROR regulation and susceptible to the same criticisms on the latter.

Performance-Based Regulation (PBR). Under PBR the regulator does not align price caps with actual costs in the short term. Instead, the regulator sets a cost-based starting point for a fair level of prices or revenue, but after that, sets a predetermined path that encourages the utility to do better. For as long as the regulator can put off reassessing the price path in light of the utility's costs, PBR provides greater incentive for the utility to make efficiency improvements than ROR regulation does. In addition, efficiency improvements will be made by the utility even if the regulator has insufficient information to know what these efficiency improvements will be. This is because profit maximizing firms always seek to minimize their costs as long as higher costs do not permit higher prices (as they do under ROR). PBR has the additional advantage of not requiring frequent costly audits to assess costs.

5. Tariff Determination in Potentially Competitive Markets

When the cost structure of a business does not display cost sub-additivity (generation and retail being the most likely candidates), this activity is at least potentially competitive. In such a situation, it is ideal to permit markets to determine tariffs, if possible. Competition has three useful properties:

(i) If the market functions well, firms will opt to produce the level of output at which marginal costs of production equal the market price (because units of output that cost more than the market price to produce will not be profitable, and therefore, will not be produced).

(ii) In the long run, inefficient firms will be unable to cover their costs at market prices and will shut down, efficient firms will enter the market, the average cost of production will be minimized sector-wide, and the tariff

7 This theoretical result, much debated in the literature on economic regulation, was first proposed in: Averch, H. and L. Johnson. 1962. Behavior of the Firm Under Regulatory Constraint. *American Economic Review* 52: 1053-1069. US: American Economic Association.

8 For a clear explanation of this point, see: Trane, K. 1997. *Optimal Regulation: The Economic Theory of Natural Monopoly*. Cambridge, Massachusetts: The MIT Press.

per kWh will fall to this minimum average cost of production. Thus, competition will lead to usage charges in the long run that just permit cost recovery. Putting these results together, one notes that competition should lead to a market structure in which the usage charges required for economic efficiency (which will vary with time of day and season) ensure financial cost recovery.[9] A combination of offsetting access fees and lifeline tariffs can then be used to tackle social goals.

(iii) All these benefits can be achieved without the regulator requiring either information on the firms' costs, or the capability of recalculating LRMC each time the marginal cost changes.

Competition requires a large number of firms that are small relative to the market. If this condition is not met, a single firm or a coalition of firms could collude to prevent power from reaching the market, thereby causing prices to go above LRMC.

One way to prevent such behavior is for the regulator to reserve power capacity at its disposal that it can release onto the market whenever it has reasons to suspect unacceptable practices. The mere threat of such action can be enough to prevent market manipulation. However, this reserve capacity is expensive, and it may be that in some CAREC countries, the industry structure that would result from a competitive process would be so concentrated that the prospect of collusion or the high costs of preventing it would eliminate the possibility of competition. In other words, such a sector, while not displaying cost sub-additivity, may display something approximating it.

Once a monopoly is broken up, there is often an intervening period before a market is introduced. There are also situations when the responsibility for setting tariffs is taken on by the regulator because there are too few firms for a genuine market to function. In such cases, price caps are often utilized. If the price caps are set taking into account the costs of all firms in the sector, they may permit even the least efficient firms to stay in business. For this reason, a forward price path that begins with a tariff level suitable for the current set of firms can be utilized. This price can gradually move toward an estimate of the true LRAC. As this is done, inefficient firms should exit the market and be replaced by more efficient ones. Such a process, which is a form of PBR, will then reveal the minimum cost-recovery tariff possible. This process can also be used to smooth the transition from a high ROR tariff to a lower market price in a sector with excess capacity.

6. Tariff Adjustments

Section A.3 explains the rationales for using particular tariff structures, which may involve a mix of marginal tariffs (paid on each of the last few units consumed), lifeline tariffs (paid on each of the first few units consumed), and access charges. We now turn to a discussion of whether tariffs need to adjust. Given the preceding theoretical foundations, these considerations are now relatively simple.

Suppose that a multi-part tariff is utilized to achieve efficiency and social goals. In this case, the role of the marginal tariff is to encourage consumers to conserve any unit of power that costs more to deliver than it is worth to them. Thus, the marginal tariff should be set equal to LRMC. If the current marginal tariff is less than LRMC, it should be raised. The lifeline tariff level and quantity are used to maintain the affordability of power, provided they can accommodate the financial solvency of the sector. If the government perceives that electricity is not affordable given either the current structure or a planned marginal tariff hike, it can reduce the lifeline tariff or access charges. However, should this leave the sector insolvent, the government would need to make up for the shortfall through a direct lump sum subsidy to cover these transfers to consumers. It follows that when economic efficiency is pursued as a goal, marginal tariffs can be reduced in response to any changes that reduce LRMC below the current marginal tariff level (reductions in labor or fuel cost; new, low marginal cost facilities coming on-line; or reductions in demand in capacity-constrained systems – see Figure 3b). In most CAREC countries, there are no likely reasons to reduce marginal tariffs as they are already below LRMC.

If a single-part tariff is utilized to maintain economic efficiency (i.e., only a flat usage fee is

9 This fascinating result that efficiency and cost recovery will be achieved at the same level of usage tariff (i.e., price = LRMC = LRAC in the long run in a competitive market) is due to the fact that competition induces firms to expand and contract to minimize their average production cost, thereby exhausting all firm-specific scale economies. In other words, there can be neither excess nor insufficient capacity in a competitive market in long-run equilibrium.

charged per unit), the arguments for raising or lowering tariffs would be identical to those provided for raising or lowering marginal tariffs, as discussed in the previous paragraph.

If a single-part tariff (usually a usage fee) is utilized to maintain financial cost recovery, tariffs must be raised in response to anything that raises the average financial cost of power provision (e.g., fuel price or wage increases, building new and expensive capacity, or inflation).

If a single-part tariff (a usage fee) is utilized to maintain the affordability of power, the only rationale for adjusting tariffs would be changes in the disposable income of the poor. In practice, whenever affordability is being targeted with a single-part tariff, governments also seek to maintain financial solvency. In this case, changes in the difference between total sector costs and revenues need to be offset by compensating subsidies to the poor from the government or rich consumers.

One set of issues that is often misunderstood is the tariff implications of implementing an energy conservation program. Governments often ask what the impact of such a program on single-part usage tariffs would be, given the objectives of financial cost recovery and affordability. In this case, the solution presented in the previous paragraph is completely inappropriate. Even if the conservation program reduces average production costs, reducing tariffs while attempting to conserve energy is illogical. Energy conservation programs only make sense if a government is interested in moving toward optimal energy conservation. Achieving optimal energy conservation is equivalent to achieving efficient energy consumption levels (Section A.2). And as argued above, this requires the use of marginal tariffs equal to LRMC. Similarly, targeting efficient consumption requires that social and financial goals either be set aside (if a single-part tariff scheme is to be maintained), or that a multi-part tariff structure be utilized. Ideally, then, governments should adjust marginal tariffs to LRMC (usually this involves raising them because energy efficiency programs tend to be implemented in capacity-constrained systems whose LRMC exceeds LRAC) while adjusting lifelines, access charges, and government transfers to the sector to achieve social and financial goals.

B. Licensing

Licenses serve a variety of functions. They take different forms and confer different rights and responsibilities on licensees, depending on the function they are intend to serve. The first and most generic function of licensing is to enable the government to maintain a census of economic activity and to levy taxes on enterprises. Such licenses are widely issued. The only responsibility implied is to report and meet one's tax obligations. If licenses in the power sector were purely intended to serve this function, they could simply be issued by the ministry of commerce or a related agency. Licenses issued to power providers serve wider functions.

The most obvious function of a power company license is to ensure that technical requirements for being connected safely to the grid are met. If this were the only function of power sector licensing, the license could be issued by the system operator rather than the regulator.

The need to regulate electricity implies two further rationales for licenses. First, while regulatory law will typically require power companies to submit to regulatory oversight, the requirement for these companies to have a license provides the regulator with leverage to ensure that they conform to rules. If a firm does not live up to its obligations in terms of service quality, competitive behavior, transparency, or conformity to tariff decisions, the regulator may withdraw the license. A second regulatory function served by licensing is to reduce the informational costs of regulation. Because power companies need licenses, which they must secure from the regulator, the costs of collecting information necessary for regulation can be shifted to them. Each of these rationales requires that the regulator be provided with the authority to issue and revoke licenses.

Licenses often also serve to reinforce property rights. Investors in power companies often worry about political risks—expropriation of property, restrictions on repatriating profits, damages from civil unrest, and breach of contract. If the generic property rights regime in the country does not provide comfort in this regard, the license can reinforce these property rights. Licenses for this purpose can be issued by the regulator. However, for the regulator to provide an adequate sense of security, it must have a clear legal mandate from the government to issue such assurances.

So far, the licensing functions mentioned above require that the regulator only assess the firms' compliance with technical, fiscal, tariff, and service quality standards. None of the above rationales implies a need for the regulator to study a firm's financial position or business model. Indeed, if the firm is one of the many entities operating in a contestable sector (e.g., generation or retail), there is no need for the regulator to study the financial viability of a potential licensee. That is, after all, the firm's concern, and while the firm has most of the information necessary to arrive at a sound commercial decision, the regulator would have to incur significant costs to obtain this information. The same logic holds for a firm regulated according to a strict PBR scheme.

However, if the firm serves a natural monopoly function—for instance, transmission or generation—and some form of ROR regulation is applied, then the regulator would be well advised to study the firm's business model and cost structure carefully and to compare it to all the feasible alternatives for meeting service requirements. The rationale for this is simple. If the new capacity to be licensed does not represent the least cost solution to meeting power needs, then ROR regulated power prices will be higher than they need to be. In fact, the Averch-Johnson critique of ROR regulation outlined in Section A.4 implies that regulators might expect non-least-cost projects to be proposed for meeting capacity requirement. Thus, the regulator should be able to identify suitable economic alternatives to proposed capacity additions.

C. Franchise and Concession Management

DISCOs are often granted permission to operate exclusively in a particular area. This is known as franchising. If a company is given the right to operate a firm for a time but is not given full ownership of the firm's assets, it is said to enter into a concession agreement. In some CAREC countries the question of franchises and concessions is important because private management of DISCOs is currently being tried, or at least considered. Kazakhstan has privatized some of its DISCOs and plans to introduce retail competition soon. Azerbaijan has awarded concessions on all four of its DISCOs. Mongolia has franchised one DISCO to a private company, and is considering further DISCO privatizations. Other countries are considering similar arrangements.

The issues to be considered when awarding distribution to a concessionaire or franchise holder include:

(i) **Length of Concession**. While no consensus exists on the right duration for a concession contract, it is clear that if the concession period is too short, the concessionaire will not have incentives to take a long-term interest in the project. Investment would then be withheld. Conversely, if the period is too long, the market could not be reasonably regarded as contestable and incentives to provide high-quality service would be weak.

(ii) **Tariff Determination**. The contracts should provide for regular adjustments to the level and structure of tariffs. Some form of PBR is most appropriate. Caps on prices for a given period of time make it worthwhile for the concessionaire to reduce the cost of delivery, but adjustments are required periodically to cope with increases in costs that the DISCO cannot control such as changes in the price of HV electricity.[10]

(iii) **Franchise Area**. Whether exclusivity should apply in the franchise area or not, and if so, for how long, depends on how imminent the possibility of retail competition is. This possibility may not seem relevant to the regulator of an insolvent distributor in the Kyrgyz Republic, but it is already an issue in Kazakhstan.

(iv) **Availability of Service**. The expectations of the authority that issues the franchise with respect to the availability of services must be specified. Will there be an unqualified obligation to supply all consumers? Will there be alternative arrangements for very remote locations, and will there be some form of cost sharing across consumers? If there is, will it be an explicit subsidy, an implicit cross-subsidy, or a tax concession?

(v) **Quality of Service**. The contract should contain an indication of the required service

10 If wholesale power prices are market-determined, it should not be possible to pass on 100% of such cost changes to consumers because this would leave the distributor with no incentive to manage wholesale price risk.

quality standards including interruptions that are acceptable and how soon and to what extent these can be reduced. Achievement of these standards must be linked to the concessionaire's financial rewards. As indicated in Section D, this will also require an agreement on how service quality is to be measured.

(vi) **Payment**. If the DISCO is currently unable to pay for the electricity received from the generator due to poor management prior to franchising, poor metering, billing and collection infrastructure or a lack of bill-paying culture, how soon should it be expected to pay? What proportion of revenues would be fair for the concessionaire to keep as a reward? As noted throughout this study, such arrangements profoundly influence the DISCO's incentives to collect cash.

These issues should be considered carefully before the franchise is issued. Ideally, the bidding documents should be framed in such a way that bidders are required to commit to performance targets. Care must be taken to ensure that the bids when received, can be compared, which means that the data requested from bidders must be specified with some precision.

After the franchise is issued, the regulator's concern shifts to monitoring the performance of the concessionaire against the provisions of the contract, and the feedback received from consumers or the concessionaire itself. This concern relates to the next session regarding performance.

D. Performance Tracking and Publication

Assessment of sector performance requires that regulators are able to track important data. In vertically integrated systems, performance tracking and publication of results is minimal, and information may even be distorted deliberately. Precise and accurate metering of bulk power flows and end-user consumption are critical to power sector reform.

When consumers do not have meters, they face zero conservation incentive. This not only wastes energy, it also leads to excessive capacity constraints. Therefore, regulators should make it a priority to encourage the installation of end-use meters. To do this, consumers must find themselves better off under metered tariffs. Therefore, regulators will often find it necessary to raise un-metered tariff rates to encourage cooperation of customers in the installation of meters. It also means that the cost of installing meters should not be borne by the newly metered consumers, particularly the poor. Metering is a cost of running an electricity distribution system, just like wires and transformers. Consumers are not asked to pay separately for the wires to their homes, or for their own transformers.[11] More importantly, if consumers are required to purchase their own meters, a black market for stolen meters often develops. Regulators need to recognize metering as a legitimate system cost to be included in the utilities' asset base when determining appropriate tariffs.

A comprehensive set of bulk power meters also needs to be maintained and the information publicized in disaggregated form. The increase in transparency will permit consumers and regulators to identify where and when power losses and service interruptions occur, and hold utility personnel responsible for reducing them. This is crucial irrespective of whether the utilities are publicly or privately owned.

Metering information and statistics indicate the quality of performance of the utility. In CAREC countries, the emphasis must be on spreading and measuring the availability and reliability of service and reducing losses. For example, useful measurements may include:

(i) cash collection as a fraction of total collections, collection as a percentage of total power billed, and billing as a percentage of power delivered;

(ii) energy balances from generation to retail, enabling the performance of each link in the chain to be measured and the source of major losses identified;

(ii) electricity supplied per capita disaggregated across regions, urban versus rural consumers, and location within cities;

11 The argument is sometimes made that adding a new consumer requires a costly meter but not new wires and transformers, so meters should be paid for. This argument is misleading because it only applies to consumers not currently drawing power from the grid. For almost all CAREC country consumers, the prevalence of consumer metering is already inefficiently low. Charging scarcity prices for meters therefore makes the system less efficient, not more efficient.

(iii) percentage of homes with access to electrical appliances (e.g., electric iron, radio, and television);

(iv) gross generation losses (total generation less transmitted energy), gross transmission losses (total transmitted less energy metered at the intersection of transmission and distribution), and gross distribution losses; and

(v) capacity load curves for generation and wires.

In sophisticated systems, more indicators can be collected but they require particular caution when applied to developing countries because the figures can be manipulated to flatter the concessionaire. Among the figures that can be collected are:

(i) **System Average Interruption Duration Index**. This is a measure of the average total time in minutes per year that each customer is without supply.

(ii) **System Average Interruption Frequency Index**. This is the average number of interruptions every customer experiences in a year.

(iii) **Customer Average Interruption Duration Index**. It measures the average duration of each interruption. A customer with average interruption duration index of 60 faces average interruptions of 60 minutes each, reflecting the length of time to locate and repair a fault.

The above measurements provide a good indication of the financial and technical performance of the sector. They also measure the electricity intensity of the community which is extremely useful for planning purposes, and over the longer term, reflect the confidence of the population in the quality of electricity service. These figures can be collected by an independent party, particularly if there is a utility with an economic motive to suppress unpleasant information. It is often an appropriate regulatory function to collect and collate these indicators of utility performance. However, experts in information systems and security maintain that obtaining accurate information on power flows will be impossible if the utilities take measures to avoid it. Significant pressure from governments is therefore required if reliable data on critical aspects of sector performance are to be accurately publicized.

E. Incentives to Improve Cash Collections and Cope with Corruption

Inefficiency is not the only hazard faced by electricity sectors in CAREC countries. While very little of the literature about Central Asia mentions the problem, there are indications that theft and other corrupt practices are endemic in the sector.

It is true that in almost every CAREC country, salaries of government officials and employees are very low compared to the private sector. And not only are salaries low, in many cases, they are so low that a second income is almost essential to meet basic costs of living. It is also known that many domestic and international transactions involving the sector are undertaken through barter exchanges or fiscal offsets, making the valuation of goods and services exchanged difficult to determine. All these factors combine with the lack of transparency in power metering and financial reporting to make the sector vulnerable to corrupt practices. They reduce the relevance of prices and cause income loss and erosion of the resources in the sector.

Enhanced transparency of operations, more realistic tariffs, and improved cash flows will all contribute to paying workers' salaries appropriate to their responsibilities and skills, and making corrupt practices less publicly acceptable. As discussed earlier, regulators are involved in improving transparency and ensuring tariff adequacy. However, the responsibility for ensuring proper incentives to promote honesty in the sector lies with the shareholders (i.e., the government). The government can require publication of more disaggregated data to measure performance and ensure that incompetent or corrupt managers are penalized accordingly. Higher salaries, together with a higher probability of forfeiting them for engaging in corrupt practices, provide strong incentives to behave well.

The regulator can also build incentives to curtail corrupt practices. First, the publication of tariff deliberations and utilities' commercial performance will help improve transparency and accountability. Second, enforcing proper vertical unbundling in the sector with the help of policymakers will reduce the

possibilities of hiding graft. Better bulk metering will be extremely helpful in this regard for some CAREC countries.

Finally, in vertically unbundled sectors with visible cash flow problems, the decision a regulator takes can have serious consequences if it is called upon to adjudicate in the distribution of cash. Tariff levels lose much of their relevance because generation and transmission companies do not actually envision receiving the funds that DISCOs should pay them based on the regulated tariff levels. The amount of the cash collected by the sector that is actually paid to transmission and generation replaces mandated tariffs as their key source of incentives. It is therefore vital for regulators to work out and announce formulas linking the amount of cash received by a firm to the performance of that firm. While several CAREC regulators claim to be using such a scheme, in reality, the shares are renegotiated periodically, and are therefore, not predictable.

Only Azerbaijan (Chapter IV) has implemented a conceptually sound scheme for balancing the need to ensure that each firm receives a bare minimum amount of cash, while providing the DISCO robust incentives to improve cash collection. The PBR system that Azerbaijan utilizes is simple and sensible. Each year, the DISCO is given a target. This is a percentage of the amount owed from upstream companies that must be settled in cash in the same year. Any amount of revenues collected beyond this target is for the DISCOS to keep. This system provides strong incentives for the DISCO to improve management and cut graft to boost collections beyond the target level. The following year, the DISCO's target is increased, regardless of past performance. Because this scheme allows the DISCO to realize 100% of any improvement in revenues beyond the target, the DISCO aggressively targets these improvements.[12]

Suppose, in contrast, the DISCO knows it is only permitted to keep 20 units of every extra 100 units of currency collected. This will severely dampen its incentives to collect more. The persistent poor performance of DISCOs in the Kyrgyz Republic and Mongolia shows what happens when DISCO managers have inadequate financial incentives to perform well.

It is only through the improvement of incentive structures that sector performance may be enhanced. This requires greater accessibility of data, some amount of sector restructuring (including vertical unbundling), and tariff determination schemes that do not reward bad commercial decisions. Similarly, corruption and indiscipline must be dealt with squarely and seriously by governments. In addition to improving transparency to create the correct incentives for dealing with these problems, governments must take punitive actions against corrupt officials and consumers who do not pay their power bills. Privatization of some management functions is also required. Undertaking these measures will be vital for restoring the cash flow and the financial viability of the sector. Unless these measures are undertaken, many consumers will not pay regulated prices and the regulator's ability to perform its given task of ensuring a sensible utilization of energy resources will not improve.

12 It should be noted, however, that the implementation of this conceptually sound scheme has been quite problematic in Azerbaijan as explained in Chapter IV. While the privately managed DISCOs have definitely improved their collections, disputes have arisen over allegations that they are not paying the transmission-generation company what they owe.

III. DEFLATING SOME COMMON MISCONCEPTIONS

In the course of producing this study, a few fundamental misconceptions regarding the economics of power sectors were heard with alarming frequency. This chapter aims to clarify the most serious of these.

Misconception 1: *Utilities that were profitable before unbundling often become unprofitable after unbundling.*

Unbundling does not typically cause financial problems. It enables them to be measured. The distribution arms of vertically integrated utilities are always making financial losses due to poor billing and collections, high electrical losses, and inadequate tariffs. These financial losses are typically covered by transfers from profitable international sales, hidden as transmission losses, funded by postponing investment, or covered by funding infrastructure rehabilitation with loans from international donors. Unbundling reveals the true position of DISCOs and serious management, structural regulation, and policy decisions must be made to tackle the underlying problems. This has been the experience in the Kyrgyz Republic and Mongolia. Figures cited in the country chapters suggest that Tajikistan and Uzbekistan may experience the same if they decide to pursue unbundling further.

Unbundling can lead to some loss of scale economies as it requires the fixed costs of some overheads to be covered for each company. However, these efficiency losses are widely acknowledged to be small[1] and could not possibly explain the financial problems in most CAREC power sectors. In the smallest sectors, however, these costs need to be considered when determining exactly how far the system should be unbundled.

Misconception 2: *Variations in the cost structures of generators preclude the development of a competitive wholesale market.*

Figure 4 will help expose this misconception. The explanation of why this statement is false begins with economic dispatch. In a system with economic dispatch, low marginal cost generators will be dispatched first, and will therefore have the highest load factors. At a point in time, there will be a single market price paid to all generators regardless of type. The low marginal cost operators also make larger operating margins as evidenced by the difference between the price and their marginal costs.

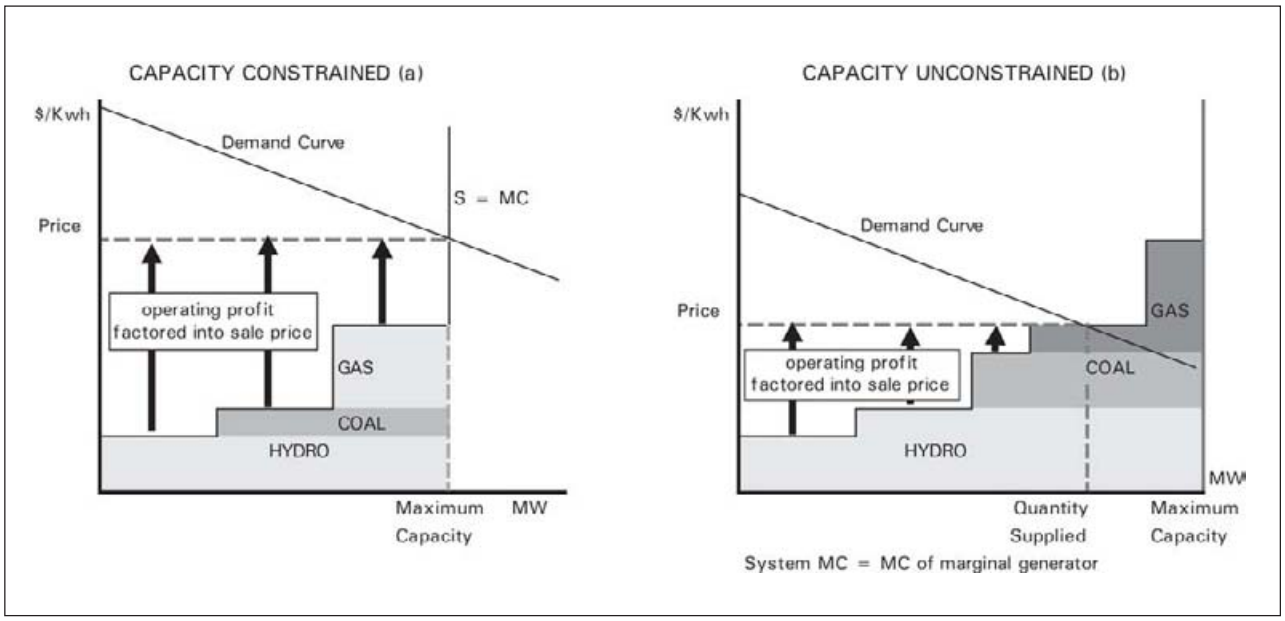
Figure 4b depicts the situation where the system is not capacity constrained. In this case, the marginal cost of the last generator brought on-line sets the market price. This last generator receives a price equal to its marginal cost, and therefore, earns no operating profit at this time. If the system never becomes capacity constrained, the marginal generator would never be able to cover its fixed costs. This is exactly what has been happening in Kazakhstan until recently—demand has slumped during the post-independence era. The situation may be taken as a signal that there is excess capacity in the system and it may be a good thing for some plants to exit the market for a time.

Figure 4a shows what happens if the system is capacity constrained. In this case, the market price of electricity will be equal to whatever consumers are willing to pay for the last unit of power available. Both base and peak load stations will be generating. As a result, the highest marginal cost generator receives prices above its marginal costs, which may permit it to cover its fixed costs.

In either case (i.e., capacity constrained or not), low marginal cost generators will have higher load factors and operating profit margins. However, this does not mean that the higher marginal cost firms cannot compete. It simply means that they will have smaller operating profits in the long run. These higher marginal cost firms may also have lower fixed costs. It is therefore not clear which firms will enjoy the highest economic profits (operating profits minus fixed costs). Nevertheless, it is correct to note that under economic dispatch, some generators will enjoy higher economic profits than others. However, this does not preclude

1 For example, CAREC country and international regulatory experts who attended the Annual Meeting of the CAREC Members Electricity Regulators Forum held in Beijing in July 2005 arrived at a consensus that loss of scale economies due to vertical unbundling increased electricity costs by less than 8%. This seems reasonable given the high component of fuel and capital relative to management costs in power provision.

Figure 4: Economic Dispatch with Different Plant Marginal Costs



kWh = kilowatt-hour, MC = marginal cost, MW = megawatt.

competition. Neither does it necessarily preclude even the least profitable plants from operating under competition. It simply means that some power plants will be more highly valued than others.

Now, presume that these plants are all effectively held by a single government-owned utility. If the plants were privatized prior to the introduction of competition, the higher valued plants would fetch a higher price when sold.

Instead of privatization, the government may choose to simply unbundle each of the plants. Each plant will need to be allocated a share of the liabilities of the previously integrated utility. The higher value plants should bear a higher share because they will be best placed to service these liabilities out of their higher future profits.

To summarize, variations in cost do not preclude competition. They simply result in some firms being more profitable than others, and unnecessary or hopelessly inefficient plants going out of business. Some plants will have higher load factors than others. Some will be more profitable than others. These differences in profitability need only be reflected in the valuation of the plants' assets.

Misconception 3: *If consumers receive cross-subsidies when the system is unbundled, these cross-subsidies must be reflected in tariffs paid to generators. This policy requires matching of generators with consumers.*

This is needlessly complicated. The role of retail tariffs is to ensure that consumers pay the marginal cost of electricity service and have proper incentives to save electricity. The role of generation tariffs, on the other hand, is to provide price signals to power plants to induce them to produce the amount of electricity needed. Passing on consumer cross-subsidies to power plants will confuse the price signals given to them. This will make it difficult to ensure efficient balancing of supply with demand. The power plants should receive the same tariff regardless of which consumer group their output is sold to.

Electricity is essentially a homogeneous good, which means that consumers are unable to distinguish between the electricity supplied by different generators. Individual generators are usually not even able to control who receives their output. It is difficult to see therefore how it makes sense to reflect consumer cross-subsidies in prices received by specific producers.

If cross-subsidies are required, the weighted average price across consumers must leave the distributor or retailer with an adequate margin to pay for the electricity it purchases and the transmission and distribution costs.

IV. AZERBAIJAN

Map 1: Azerbaijan

A. Country Overview

Azerbaijan is a landlocked country bordered by Russia and Georgia to the north, Iran to the south, Armenia and Turkey to the west, and the Caspian Sea to the east. Among the seven CAREC countries, it has the smallest land area at 86,600 square kilometers ($km^{2)}$. Its population is 8.3 million, roughly 51% of whom are urban dwellers.

In the 1990s, Azerbaijan experienced political tensions with its neighbors. Furthermore, a long military and diplomatic fight with neighboring Armenia depleted its resources and caused massive economic dislocation. Large employers such as companies manufacturing plastic, chemicals, and equipment for the oil sector vanished between 1990 and 1996. However, large-scale foreign direct investment in the oil and gas sector has continued to facilitate rapid growth since 1997. Real growth of gross domestic product (GDP) since 2000 has averaged over 10% per year. Power demand has grown with GDP and electricity consumption increased by 12% in 2004.[1]

Azerbaijan is an energy-rich country. The value of its oil and gas export revenues between 2004 and 2024 is estimated at a minimum of $70 billion. It has an extensive power transmission system connected to those of its neighbors, which allows import of power from Russia, Turkey, and Iran. In May 2004, Russia's electricity group—Unified Energy System (UES)—

1 Economic Intelligence Unit (EIU). 2005. *Country Profile: Azerbaijan*. Available at: http://db.eiu.com and ADB. 2004. *Country Strategy Program Update* (2005-2006)*: Republic of Azerbaijan*. Manila.

signed a draft agreement with Azerbaijan and Iran that intends to optimize the use of this international grid.[2]

Electricity prices in Azerbaijan are set by the Tariff Council. Energy policy formulation is the purview of the Prime Minister's Office and the Ministry of Industry and Energy (MIE).

B. Generation

With the exception of two hydroelectric plants run by the private sector, all generation and transmission assets are held by Azerenergy, a state-owned enterprise. During peak periods, electricity amounting to 3–5% of total consumption is imported from Russia.[3] The nameplate generating capacity is approximately 5.1 gigawatts (GW).[4] Estimates of how much of this is actually available vary from 3.1[5] to 4.5 GW[6]. Peak demand is estimated at 4.8 GW.[7]

Eight state-owned thermal plants account for roughly 80% of total generating capacity. They use a feedstock mix of 70% gas and 30% mazout. Many power stations operate with both types of fuel. In addition, the country has eight small hydroelectric plants, two of which are run by the private sector. Mingechevir is the largest plant located between Tbilisi (Georgia) and Baku. However, it is only operating at 65% of its 2,400 megawatt (MW) nameplate capacity.

Azerenergy is pursuing plans to develop the country's generation capacity because most of its generation units are outdated and expensive to run. International donors—European Bank for Reconstruction and Development (EBRD), Islamic Development Bank, European Union, and the World Bank (WB)—have undertaken several projects to restore the existing power plants and build new capacity.

Azerenergy's generators are subsidized by the Government. They are billed for gas at its true cost of $60 per 1,000 cubic meters (KCM), but the Government pays the State Oil Company of Azerbaijan Republic (SOCAR)—the state gas company—for whatever Azerenergy cannot afford to pay. According to Azerenergy, the subsidy in 2004 amounts to 60–65% of the total cost of gas, or some $400 million. Azerenergy believes the subsidy is justifiable and necessary because of the low tariff it receives for power delivered by the transmission system.

C. Transmission

As explained above, the generation and transmission facilities in Azerbaijan are together owned by the state through Azerenergy.

A crucial issue in generation and transmission is the location of power plants. Under the Soviet rule, much of Azerbaijan's power needs were imported from the Russian grid. Most Azeri generation plants lie some distance from Baku and were intended to supply power to Armenia and Georgia. Due to the changes ushered in by the post-independence international relations, these power plants had to switch to Azeri gas as a fuel source, which is poorly refined and moist. This and some financial problems have contributed to the deterioration of the gas pipelines fueling these plants. In addition, the power from these plants is now used mostly to meet domestic demand while power imports from the Russian grid are low. However, the transmission lines connecting several of Azerbaijan's larger power plants to the Baku area were not built to handle the current high loads.

According to a report commissioned by EBRD[8] the transmission grid represents the largest risk of systemic and catastrophic failure. Overloading and malfunctioning protective relays have been major contributors to winter blackouts.[9] There is a high risk of transmission system failure because of the poor location of generators relative to demand, and the consequent reliance on long transmission lines. Investment in a modern transmission control system such as Supervisory Control and Data Acquisition (SCADA), including an energy management system and telecommunication upgrades, can reduce the risk

2 PetroEnergy Information Network. 2004. *Azerbaijan, Iran and Russia coordinate power-system synchronization deal.* Available at: http://www.gasandoil.com/goc/company/cnm44938.htm.
3 Presentation by the Azerbaijan Ministry of Industry and Energy at the Annual Meeting of CAREC Members Electricity Regulators Forum held in Beijing from 4 to 6 July 2005.
4 ADB. 2005. *Rapid Assessment of Energy Sector in Azerbaijan*. Manila.
5 World Bank (WB). 2004. *Azerbaijan: Issues and Options Associated with Energy Sector Reform*. Washington, D.C.
6 Burns and Roe Enterprises, Inc. 2003. *Republic of Azerbaijan: Prioritization of Investment Needs for Power Generation and Transmission*.
7 See footnote 4.
8 See footnote 6.
9 In July 2002, a fire on the ground and poor transmission line maintenance caused short-circuits of both the 500 kV and the parallel 330 kV power lines between the Azgres thermal power station at Mingevechir and Baku, causing a blackout in the entire country.

of failure and improve economic dispatch. Thus, WB and Azerenergy are currently preparing a power transmission project to improve the system control and complete some upgrades. Germany's development agency, Kreditanstalt fur Wiederaufbau (KfW), is also providing a €15 million credit to support the upgrade of substations because replacement of the central dispatch center was identified as an integral part of the program.

Azerenergy now has meters at the beginning and end of the transmission lines to allow more accurate reading of transmission losses and ensure that the DISCOs are charged properly for the power they receive. Defective meters are being replaced by both imported and locally manufactured units.

D. Distribution

Distribution was contracted out to two private companies under 25-year concession agreements. The Baku and North (Sumqayit) networks were awarded in January 2002 to Barmek, a Turkish company with no previous experience managing a distribution concession. In November of the same year, concessions for the South (Ali Bayramli) and West (Ganja) networks were awarded to Bayva, a local private company also with little prior experience in power distribution. Under the concession arrangements, Barmek and Bayva are entitled to keep the profits they earn, subject to regulatory and contractual terms. The concession agreements were negotiated by the Government. International development agencies helped train the officials that negotiated the contract.

Changes in the composition of Azerbaijan's power demand are causing significant technical problems for the distribution system. Consumers have switched to electrical heating due to the deteriorating quality and reliability of gas supplies and the consequent collapse of the district heating systems. Higher voltage lines, which used to service industrial areas, are now underutilized while low voltage lines in residential areas are overloaded. Many households, particularly those comprising internally displaced persons, have no legal connections and many more do not have meters. Such customers have no incentive to reduce load or shift it to off-peak periods. The DISCOs serving these consumers are also able to ascribe losses to un-metered consumers regardless of where the missing power really went. The mismatch between supply and demand, as well as poor metering, has led to high levels of distribution loss.

As a consequence, and perhaps due also to the lack of commercial incentives to serve marginal consumers well, electricity service is frequently interrupted. It is reported that even in some suburbs of Baku, service can be interrupted for 15 hours a day.

Barmek has undertaken changes in personnel management to improve billing and reduce non payment. It has reduced the number and raised the salaries of its employees to ensure that they do not need to rely on side payments for survival. Third-party contractors undertake all legal and physical work associated with the disconnection of nonpaying consumers, as well as construction and repairs. The company claims that its computer generates lists of nonpayers, which are accessed directly by these contractors to prevent any possible interference by company employees in implementing disconnections. Despite this, anecdotal evidence coupled with the continued existence of a large number of residential customers who do not pay their electricity bills indicates that Barmek's policy may not be as tightly implemented as it claims. However, there is little doubt that the collection situation has improved substantially.

Overloading of the system and cost recovery considerations have forced the DISCOs to actively pursue installation of consumer meters. In 2003, DISCOs were able to install 126,270 meters.[10] Barmek now has 750,000 metered customers; about half of them received meters between 2001 and 2004. For 2005, Barmek requires additional 200,000 meters. These are being purchased from PRC, Europe, and Turkey. In 2006, Barmek will begin replacing the meters with electronic and prepaid meters or even with meters capable of being monitored remotely. Prepayment would improve collection rates and eliminate the need for billing. Electronic and remote metering systems would permit the eventual use of time-of-day pricing, which Barmek hopes would greatly improve load management.

10 United Nations Development Programme (UNDP). 2005. *State Programme on Poverty Reduction and Economic Development: Progress Report 2003-2004.*

E. Power Losses and Cash Flows

Power, natural gas, and heat distribution systems in Azerbaijan are all prone to high losses, although estimates of losses vary across sources. In an interview with the study team, Barmek has claimed that its losses, billing, and collection rates are treated as commercial secrets because its tariffs are not based on these results. Azerenergy also did not provide an estimate of its transmission losses. However, the State Statistical Committee of the Azerbaijan Republic reports total system losses of 20.9% in 2004. According to MIE data (Tables 5 and 6), the release of which contradicts Barmek's assertions of confidentiality, aggregate distribution losses in 2004 were 15.7% of the power entering the distribution network. This suggests total transmission losses of only 5.2%, which seems low given the problems described in Section C. MIE's figures also show declining distribution loss levels since the concessions were granted. This improvement was also reflected in discussions with consumers and Barmek.

Table 5: Distribution Loss Rates, 2002–2004

	Year		
Distribution Company	2002	2003	2004
Barmek	20.1	16.7	15.3
Bayva	16.6	17.7	16.1
Average	18.4	17.2	15.7

Source: Presentation by the Azerbaijan Ministry of Industry and Energy at the Annual Meeting of CAREC Members Electricity Regulators Forum, Beijing, 4–6 July 2005.

Also in contrast with Barmek's assertion that its collection rates are confidential, MIE has released data on Barmek's collections (Table 6). These data are consistent with the collection levels that Azerenergy claims Barmek has achieved. They demonstrate substantial progress in improving collections. Even the still anemic residential collection rate is actually more than double its pre-concession level of 12%.[11]

The Azerbaijan power sector suffers from a cash flow shortage due to the still weak billing and collection rates and fairly high losses. The mechanism for dealing with this problem underpins the incentive structures in the sector, and is presented in Figure 5. It begins with consumers paying the DISCOs.

Next, the DISCOs pay Azerenergy according to a system for allocating scarce cash collections in the sector that was included in the concession contracts. This system specifies percentages of the amount owed by the DISCOs to Azerenergy at the mandated tariff level, which must actually be paid on time. As long as a DISCO makes these payments, the remainder of its payables to Azerenergy are deferred (interest free) until specified dates between 2007 and 2010. For example, in 2005, Barmek is obliged to make timely payments of 70% of what it owes Azerenergy. As long as it fulfills this obligation, it may collect as little or as much as it likes. The Government provides a lump sum transfer to Azerenergy equal to the amount deferred. According to Azerenergy, the transfer amounted to $350 million in 2004.

The percentages that may be deferred by the DISCOs will increase according to a predetermined schedule. By the end of 2006, Barmek is contractually obliged to pay Azerenergy for 100% of the power it receives for sale in Baku. The deadline is 2010 for Sumgayit. Bayva is required to pay Azerenergy in full by 2010 for power purchased for both Ganja and Ali-

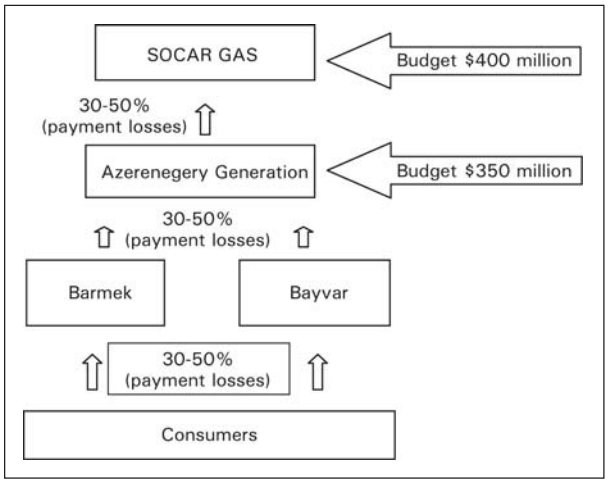
Table 6: Collection Rates, 2003–2004

	2003				2004			
Distribution Company	Residential	Trade and Service	Others	Total	Residential	Trade and Service	Others	Total
Barmek	25.0	100.5[12]	77.3	**54.6**	30.0	93.8	83.8	**60.7**
Bayva	18.6	83.0	80.2	**35.5**	24.8	89.7	86.5	**43.5**
Aggregate	21.4	100.1	78.1	**45.8**	27.2	92.9	84.6	**53.3**

Source: Presentation by the Azerbaijan Ministry of Industry and Energy at the Annual Meeting of CAREC Members Electricity Regulators Forum, Beijing, 4–6 July 2005.

11 Pre-concession collection rate reported by Azerenergy officials.
12 Collection rates in excess of 100% would be achievable if adequate past receivables are collected.

Figure 5: Cash Flows in the Power Sector



SOCAR = State Oil Company of Azerbaijan Republic.

Bayramli.[13] Once these 100% payment targets are reached, the DISCOS will also have to begin paying back the deferred amounts.

Because a cash distribution mechanism generally overrides any incentive created by the tariff structure, it is important to ensure that all parties have the right incentives. The Azeri system is quite good in this regard as confirmed by the collections data. Barmek may keep temporarily all money collected beyond the payment obligation. This is a generous incentive to collect, as the deferred interest on the balance of collections is a pure profit increase to the DISCO. In contrast to the situation in the Kyrgyz Republic and Mongolia, Barmek can keep all the fruits of its collection efforts in cash. In the meantime, the shortfall is made up directly from the Government budget.

Finally, even with the lump sum transfer from the Government, Azerenergy cannot afford to pay for its gas use at the mandated price. The Government therefore pays SOCAR for the unmet portions of the gas bill. This amount was estimated to be $400 million in 2004.

It is unclear whether privately managed DISCOs are meeting their limited payment obligations to Azerenergy. Government officials claim that though Bayva is not meeting its payment conditions for its contract in the western region, overall, both concessionaires are fulfilling their payment obligations. Azeri media, on the other hand, reports that despite robust collections, Barmek is significantly in arrears with Azerenergy.[14] Barmek officials justify the nonpayment, arguing that it is not appropriate to expect their company to pay Azerenergy in full because their client government entities, particularly the transportation and water utilities, do not pay their power bills.

F. Tariffs

Table 7 shows the current tariff structure in Azerbaijan. Generation and transmission tariffs are bundled, but distribution tariffs are separate. Commercial and industrial consumers pay significantly more than households do and no lifeline tariff is offered to low-income consumers. The tariff structure does not encourage DSM by offering off-peak tariffs or imposing capacity charges. Neither does it permit seasonal variations to cope with winter peaks or geographic variation to allow variations in costs. The tariffs received by Azerenergy do not cover the costs of generation and transmission. As a result, the Government is required to subsidize Azerenergy's gas consumption. The Government is aware of the problem and has an agreement with WB to increase tariffs to cost-recovery levels by 2010.

Currently, DISCOs buy power for $0.014 per kWh. They sell it to residential customers for $0.02, to industry for $0.03, and to commercial entities for $0.06. This selling price could leave the DISCOs with a reasonable profit margin, except perhaps on the rate for residential consumers. The minimal distribution margin on power distributed to residential customers, together with the high cost of issuing and collecting bills from them, likely explains why residential collection levels remain stubbornly below those for commercial and industrial customers.

A tariff decree has been approved to reduce large cross-subsidies by decreasing commercial and industrial tariffs and increasing residential tariffs. The removal of these cross-subsidies can have two essential effects: (i) it will reduce power costs to and revenues from commercial customers, and (ii) it will provide a stronger profit motive for DISCOs to ensure that residential consumers are legally connected, billed and pay for more power, and perhaps, even receive a higher quality of service.

13 From meetings with MIE and Azerenergy officials and WB. 2004. *Azerbaijan: Issues and Options Associated with Energy Sector Reform*. Washington, DC.

14 See, for instance, a series of reports published by the TURAN News Agency, Baku, between 4 and 7 July 2005.

Table 7: Analysis of Tariffs

Item	Potentially Competitive Generation	Noncompetitive Retail	Transmission	Distribution
Regulatory Authority	President, on advice	President, on advice	Not separately identified	Not separately identified
Tariff Levels (2005)	$0.014/kWh including transmission	Residential: $0.02/kWh Industry: $0.03/kWh Commercial:$0.06/kWh	$0.014/kWh, including generation	Not identified
Customer Classes/Voltage		Three main classes		
Period of Adjustment	Irregular	Irregular	Irregular	Irregular
Basis of Adjustment	Recover percentage of costs	Recover percentage of costs		
Geographic Variation	None	None	None	None
Seasonal Variation	None	None	None	None
Lifeline Tariffs	None	None	None	None
Capacity Charges	None	None	None	None

kWh = kilowatt-hour.
Source: Azeri officials.

When the power price adjustments take effect, they may also allow for morning, day, and night rates if available technology permits. This will be a great improvement on flat rate charges because currently, consumers have no incentive to shift their use of electricity to off-peak periods. Stronger signals are required in a capacity constrained system like Azerbaijan's.

Tariff adjustments prior to the creation of the Tariff Council in 2002 were irregular and ad hoc. Increasing power prices was a low priority despite high levels of inflation. Tariffs capped below cost-recovery rates have complemented endemic nonpayment by customers, leaving Azerbaijan's power sector without the required capital to upgrade aging power generation, transmission, and distribution infrastructure. The sector has also had inadequate funding to perform essential maintenance functions. The result has been deterioration in the quality of infrastructure and service.

G. Industry Structure

Azerbaijan's electricity sector is unbundled between publicly owned generation and transmission, and DISCOs managed by the private sector through concession arrangements. Unbundling was necessary to permit awarding of concessions, but has also improved transparency. Because DISCOs have commercial incentives separate from those of Azerenergy, information regarding the flows of cash and electricity between the transmission and distribution systems is more widely available.

In contrast, the incentives of the transmission and generation departments of Azerenergy have not been separated.[15] This situation makes it impossible for the regulators to accurately assess sector costs and efficiency. More importantly, it makes it difficult for the firm's owners (i.e., the people of Azerbaijan represented by their government) to accurately assess the performance of firm managers. The lack of an unbundled and independent transmission company means that any private investment in new generation capacity will come at a higher cost than necessary, if ever it comes at all.

Azerenergy and the DISCOs are also still financially dependent on the Government for approximately $750 million annually, clouding incentives further. As discussed previously, there is a direct $400 million subsidy paid to SOCAR for Azerenergy's gas supplies. The Government also makes up for the shortfall in the payables of DISCOs to Azerenergy. These interest free deferments or loans are estimated at $350 million annually. As the DISCOs are in theory only deferring these amounts, the Government will presumably be paid back in the future and only the interest on these shortfalls should be considered a subsidy to the DISCOs.[16]

15 The study team was not able to access disaggregated information on power losses and the allocation of cash within Azerenergy. While with further requests such information would probably be made available, the fact is that it is not, by default, in the public domain.

16 According to Azerenergy, improvements in collections have been dramatic and large subsidies are no longer required. However, it is important to note that if improving collections resulted in reduced subsidies, it would act as a disincentive to improve collections.

Some multilateral institutions have complained that many of these transfers are not properly documented or that they are not monetized, but are instead transacted as offsets. This would compromise the financial independence of the state-owned companies and the reliability of their financial reporting. However, none of the companies or ministries involved acknowledged these practices in discussions with the study team.

Apart from the benefits of improved collections, government officials report that Barmek is now one of the largest taxpayers in Azerbaijan. This study cannot ascertain, however, whether the taxes paid by Barmek exceed the subsidy it receives through the Government's coverage of the interest free deferment of part of its payables.

H. Regulatory Objectives and Approaches

While there has been a degree of functional separation of institutions responsible for policy, business management, ownership, and regulation, responsibilities and chains of command for each function are overlapping and shared among several institutions. Table 8 shows the large number of organizations with roles in electricity regulation and policy.

The Tariff Council permits the views of MIE and the Ministry of Economic Development (MOED) to be heard, and recommends tariff levels to the President. The Council of Ministers (COM) provides policy oversight on tariff recommendations while the State Energy Control Agency extends technical oversight. Finally, tariff adjustments are made law through Presidential decrees.

It is not entirely clear what the regulatory objectives of each of these organizations are. The number of agencies involved creates coordination problems. Generally, MOED is interested in the country's fiscal position and the viability of the energy sector. COM broadly supports a similar agenda, but in addition, it supports and implements policy decisions of the President. MIE is adjusting its role in sector management. Where previously, it provided targets and plans, it must now become a sector-focused policy agency and strengthen its role as a source of sector knowledge. Azerenergy is not only the principal target of regulation, but also the main source of technical expertise and policy advice. Finally, the Tariff Council is focused exclusively on raising tariffs to at least cover costs.

To encourage a more systematic approach to tariff setting, the Tariff Council was mandated to analyze and approve tariffs for all utility industries including telecommunications, water, gas, electricity, postal services, and railways. The Council consists of representatives from several agencies including MOED and MIE. Interested organizations may provide experts to advise the Council, but they are not allowed to vote or act as representatives of their organization. For example, Azerenergy can advise, but as a regulated entity, it cannot take part in any decision making.

A letter of Intent was sent by the President to WB in April 2003 outlining plans to establish a utility regulatory agency by the end of 2006. The United States Agency for International Development (USAID) is helping to prepare for the establishment of an independent electricity regulatory agency by this deadline, although the work plan is reportedly behind schedule. The Government has proposed that responsibilities for licensing and tariff determination functions be transferred to this regulator. If the plans outlined by the Government are realized, the agency will meet high standards for regulatory independence. In February 2005, a final draft of the bill setting up a regulatory agency was tabled in the Parliament. If the bill is passed, responsibility for regulation would be properly allocated.

Under the plans for the regulatory commission, commissioners will be proposed by the President and approved by the Parliament, and appointed for a fixed term. This method of appointment grants a degree of security of tenure and augments scope for a decision-making authority. It is not clear, however, how the plan to make the agency self-funding will be realized. It is also unclear whether the agency will be allowed to take final decisions or will merely make recommendations to the Prime Minister or the President. Delays in the implementation of these plans are not encouraging, and some sector officials have unofficially raised the possibility of other regulatory arrangements, which would not offer as much independence.

I. Regulatory Challenges

Issues. Government officials and industry personnel were asked to identify challenges that might be addressed through better regulation, and the following were raised as issues:

Table 8: Matrix of Regulatory Responsibilities

Organization	Behavioral (non-tariff)	Structural	Economic (tariffs)	Technical
Office of the President		Decision on overall sector direction	Final approval and enactment of Tariff Council recommendations	
Tariff Council			Recommendation on tariff levels	
Council of Ministers	Setting up the Tariff Council		Consensus on tariff increases	
Ministry of Industry and Energy	Policy issues	Policy issues	Participation in working parties	Supervision of State Energy Control Agency
Ministry of Economic Development	Energy forecasts	Oversight	Impact of energy policy on the rest of the economy	
Azerenergy	Compliance with rulings	Compliance with rulings		Technical expertise and policy advice

Source: Azeri government officials.

(i) Too many agencies are involved in regulation, which results in political considerations playing a strong role. Also, cost considerations are made subservient to affordability concerns. These factors contribute to tariffs being too low.

(ii) The collapse of the district heating system and the gas distribution scheme in rural areas mean that the electrical system is being called upon to supply power beyond its designed capability, resulting in outages and restricted hours of supply.

(iii) Incentives and mechanisms to ensure that the concessionaires improve service quality are weak.

(iv) Azerenergy still has transmission and generation bundled together and remains far from purely commercial in its approach. It is also still an important energy policy advisory body. This will make it difficult to attract private investment in generation.

Approaches. Based on the experience of other CAREC countries, it is possible to identify a number of potential solutions to these regulatory problems.

(i) The number of agencies involved in regulation should be reduced when the regulatory authority is set up in 2006. An amendment to the Constitution giving the regulator a level of independence similar to that enjoyed by the Central Bank will be very helpful. The examples of Kazakhstan and Mongolia suggest that the clarity introduced by vesting regulatory power in a single entity is significant.

(ii) To tackle power outages caused by distribution and transmission overloads, the regulator can work with DISCOs in creating suitable DSM schemes. These may include capacity charges, capacity limitations, or other load-saving and load-shifting incentives for consumers. PRC, Tajikistan, and Uzbekistan utilize capacity charges for large consumers.

(iii) The new electricity regulator can conduct public opinion surveys on the quality of service being offered. The results can serve as a regulatory measurement of the effectiveness and efficiency of service. Hungary has utilized a very effective system of tying a concessionaire's revenue caps to the quality of service provided. Implementing such schemes will, however, be measurement intensive, especially when system faults occur at all levels and not just in distribution. Realigning the tariff structure by raising residential tariffs will also provide incentives to improve service in residential areas to attract higher bill payment. To date, CAREC countries have all had significant difficulty addressing the problem of poor service quality to marginal consumers.

(iv) The unbundling of Azerenergy's transmission and generation functions and the removal of its policy functions should be a high priority. The PRC and Kazakhstan examples show that independent transmission companies help to assure private investors that they will be able to access the market. Guaranteeing that the state-owned generator is

not involved in policy formulation similarly evens the playing field necessary to promote investment in generation.

I. Conclusions

Azerbaijan began, as did all CAREC countries, with ministry control of electricity. Its sector is currently in transition from a ministry structure to a mixed system that has features of a regulated public sector monopoly (transmission and generation) and competition for the distribution market, although the 25-year concession may be too long to provide strong incentives to perform well.

The principal focus of the system at present is to put the distribution functions in order. Contracting out of DISCOs to the private sector has dramatically improved the incentives to collect bills. The process of competition for the market resulted in a regulated private monopoly. Although questions have been raised about the integrity of the process, in a short period of time, the new concessionaires appear to have made significant improvements in bill collections. The commercial incentives enjoyed by the concessionaires appear to be the strongest driver in the improvements that have occurred so far. However, a clear and resolute political response is required to address the problems of state-owned enterprises not paying power bills on time, and of Barmek not fulfilling its payment obligations to Azerenergy.

The noncompetitive transmission system is currently bundled with the potentially competitive generation system. Rigorous behavioral regulation will be required to achieve a level of transparency of operation to assure private investors in generation that they will have impartial access to potential customers. Such a degree of regulation is likely to prove costly. A degree of structural regulation to separate generation from transmission and distribution will improve transparency and confidence levels.[17] Transparency and risk minimization go hand in hand. If greater transparency and a nondiscriminatory approach to power dispatch could not be ensured, the government would be required to pay a risk premium to any private entrants into the system. For example, any investor considering entering into a power purchase agreement (PPA) will demand more concessions and guarantees to compensate for uncertainty and conflicts of interest at the transmission company. The Government and consumers will then absorb the risks on behalf of the investor. However, public assumption of commercial risks is one of the things that allowing private investment is designed to eliminate.

While significant progress has been made with vertical unbundling of Azerenergy by separating distribution and awarding concessions for its management, functional separation of policy, regulation, ownership, and business management remains incomplete. Little progress has been made in de-monopolizing generation. Completing this process would also significantly improve the transparency of the sector and provide confidence to future investors. If Azerbaijan intends to fund its new capacity requirements by spending public money, these improvements must help ensure that such expenditures reap large returns. More progress in upgrading generation and the gas sector are both essential to achieving improvements in the quality and quantity of electric power supplies.

There is a good prospect that the 25-year concessions will improve cash flows and the efficiency of investment at the distribution level. Significant investments are required in generation and transmission and these can only be financially justified if the system is running cash surpluses. Currently, the incentives faced by the decision makers remain highly distorted. The decade-long freeze on electricity prices is a clear example of regulatory failure. Utilization of the power sector to address social problems in Azerbaijan has carried a high price that resulted in the deterioration of power infrastructure, which is expensive to remedy. Several right steps have already been taken and the Government appears to be grappling seriously with the competing challenges of improving the institutional framework, increasing transparency, ensuring much needed investment, rationalizing prices in a phased fashion, and providing adequate and affordable services to the poor. The distribution concessions could be successful if tariffs are rationalized and the Government adopts a real zero-tolerance approach to nonpayment whether the offending party is public or private.

17 Requiring transmission to be an autonomous subsidiary of Azerenergy will be a useful first step, although this will still be inadequate to significantly improve confidence among potential investors.

V. PEOPLE'S REPUBLIC OF CHINA

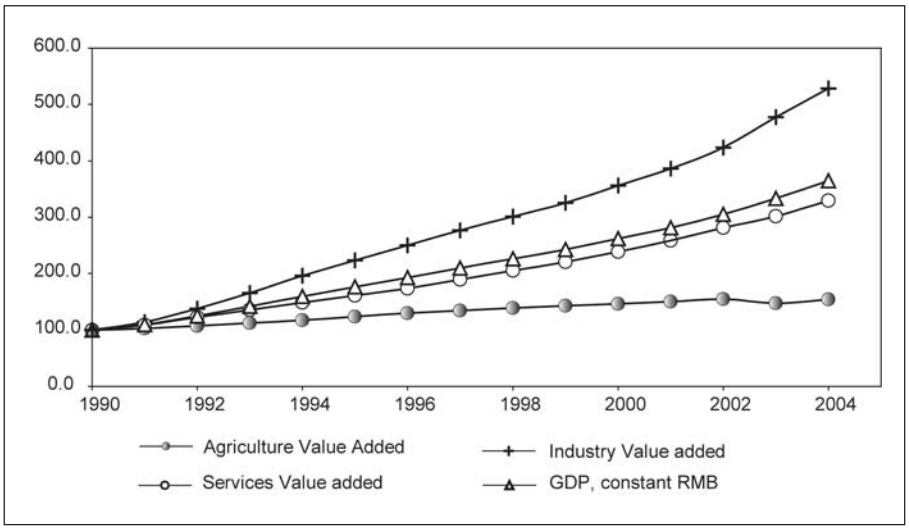
A. Overview

The estimated population of the PRC is 1.3 billion, about 40% of whom live in urban areas compared with only 26.4% in 1990. The population is largely concentrated in the Eastern Seaboard and the developed hinterland now stretches hundreds of kilometers inland. The country has a land area of 9.6 million km^2.

The most dramatic feature of the PRC's modern history has been its spectacular economic growth over the last 2 decades. Figure 6 shows indices of aggregate output between 1990 and 2004 by sector. Agricultural value added has grown by an average of 3.1% annually while the growth rate in services has averaged 8.9%. Industry has grown at an unprecedented 12.6% per annum, resulting in GDP growth rates of around 9.7%. Electricity consumption has increased, almost in lockstep, growing at 8.4% annually between 1990 and 2002.[1] According to the State Electricity Regulatory Commission (SERC), 1,741 terawatt-hours (TWh) of electricity were consumed in the PRC in 2004 and actual demand was even higher. Investment requirements in the power sector have therefore been extraordinary. Government finance, as well as huge amounts of private investment channeled through state-controlled banks, has permitted the PRC to meet much of this massive increase in electricity demand for air-conditioning and industrial use. However, problems with the timing of capacity expansions—probably resulting from investors reacting to current rather than expected price information—have resulted in a cycle of power shortages and gluts over time.[2] The system is therefore currently experiencing a power shortage.

The PRC's power system was run as a vertically integrated state-owned monopoly under the State Power Company (SPC) until 1985, at which time the establishment of independent power providers (IPPs) was permitted. Since 2002, the Government has commenced a long-term restructuring of the power sector. The State Council accepted the National Power Industry Framework Reform Plan in April that year, which has provided for several reforms. SPC was split up. Its generators were separated from the wires businesses and placed in five separate companies, while responsibility for power transmission and distribution was given to two newly formed state-owned grid companies. SERC was established to oversee the development of power markets and some

Figure 6: Aggregate Output Indices, 1990–2004
(1990 = 100)



GDP = gross domestic product, RMB = renminbi; the local currency of the People's Republic of China.
Source: WB. [Accessed October 2005]. *World Development Indicators*. Washington, DC.

1 WB. [Accessed October 2005]. *World Development Indicators*. Washington, DC.

2 For more on this, see: Lin, Bo Qiang. 2004. Power Shortage, Short-Run Response, and Long-Run Strategy. *Journal of Economic Research*, 3. (In Chinese).

experimentation with the design of such markets has been undertaken. However, launching of power wholesale markets is widely regarded as unwise until the current power shortage is resolved.

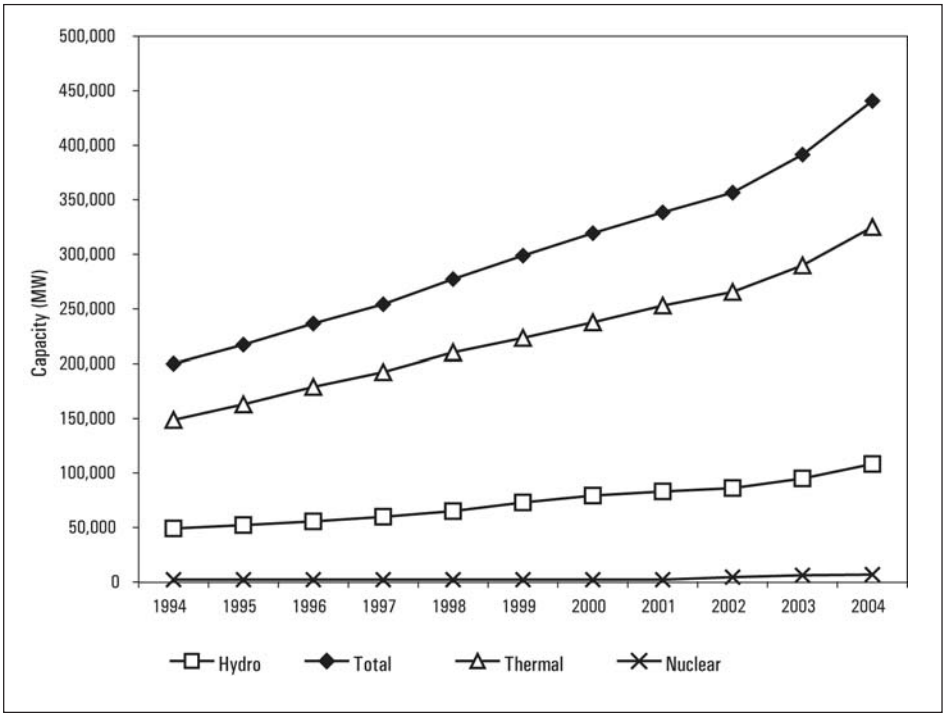
B. Generation

Figure 7 shows the rapid growth of installed generation capacity in the PRC from 200 GW in 1994 to 391 GW in 2003. Recent figures from SERC show that the installed generation capacity at the end of 2004 was 440,000 MW. Notwithstanding the publicity given to some of the PRC's large hydroelectric projects, the data show that thermal power stations (mostly coal-fired) comprise the bulk of new power generation. In 2004, out of 2,187 TWh of power generated, 1,807 TWh was thermal power while only 328 TWh was hydropower. Nuclear power accounted for 50 TWh, although its importance in the fuel mix is expected to increase as coal supplies become scarcer and concern regarding pollution from coal plants mounts. Gas-fired plants are also likely to become increasingly important for environmental reasons.

The PRC is currently building a great deal of new hydropower capacity. The largest generation project under construction, by far, is the Three Gorges Dam. When fully operational in 2009, it will include 26 separate 700 MW (18,200 MW) generators. The reservoir created by the dam began to fill in June 2003 and its first turbines began operating in July 2003. Despite its size, the Three Gorges Dam will increase the PRC's total generation capacity by only 4.1% relative to 2004 levels. The second largest hydropower project under construction will involve 25 generating stations on the upper Yellow River with a combined installed capacity of 15,800 MW (or 3.5% of 2004 capacity). These figures illustrate the enormous size of the PRC electricity sector, particularly in thermal generation.

Capacity growth shows no signs of slowing down. Officials informed the study team that a further 60 GW capacity was due to be released in 2005 and various media sources estimate that up to 300 GW of new capacity is currently under construction. There are discrepancies between these official and unofficial figures because a significant amount of generation capacity is reportedly being built without the permission of the Government.

Figure 7: Installed Generation Capacity, 1994–2003



MW = megawatt.
Source: PRC Electricity Council. 2004. *Electric Power in China* and 2004 figures from SERC.

As mentioned earlier, the PRC has suffered a cycle of oversupply and undersupply of power. There was a serious oversupply problem in the late 1990s due largely to the closing of poorly performing state-owned enterprises, which were large and inefficient consumers of electricity. The Government responded to the short-term oversupply in part by placing restrictions on the construction of new power plants, which in turn, reduced the growth rate of capacity excessively, resulting in a power shortage by 2002. This shortage is likely to be eliminated by the new capacity currently under construction. In fact, some industry observers expect to see surplus capacity by 2007.

Despite permission for IPPs to enter the market in 1985, over 90% of the PRC's generating capacity is still publicly owned. Under the power reform program in December 2002, SPC's generation assets, which accounted for 55% of total installed capacity at the time (roughly 500 power plants), were split up into five state-owned generation corporations. Many companies, which appear to be privately owned, are in fact owned by large public banks or local governments. Financing of new plants is also dominated by state banks.

In addition to increased capacity, demand growth is being met through higher load factors. SERC data show that the average plant load factor has grown from 55% to 62% between 2002 and 2004.[3]

C. Transmission

Prior to its breakup, SPC owned all transmission and distribution wires, as well as a substantial share of generation capacity. The SPC wires assets were split up between two grid corporations: (i) the Southern China Power Grid Company (SCGC), which handles Guangdong, Guanxi, Guiahou, Hainan, and Yunnan Provinces; and (ii) the State Grid Company (SGC), which serves the rest of the country. SGC controls five grid companies corresponding to the North, Northeast, Northwest, East, and Central grids. These regional grid companies are responsible for the development and operation of the regional grids and dispatch, and for the development of power markets under the regulatory supervision of SERC.

The PRC's stated intention is to eventually create a unified national power grid and have a modern power market in which plants sell power to the grid at market-determined rates. This entails an enormous program of transmission construction. In 2004 alone, the PRC built 25,841 km of 220 kV transmission lines—a 13% increase on the line length in 2003.

Apart from simply expanding the transmission network to cope with the increased demand for power, the Government has put in place a program of "transmission from west to east". The purpose of this policy is to provide power for the rapidly expanding eastern seaboard from generation sources inland and to reduce the levels of pollution from thermal plants close to the regions where the economy is expanding rapidly. There is a complementary program to connect the north and the south. Two new circuits connecting Fujian to the East China Power Grid completed in 2002 are part of this program. Construction commenced on two circuits connecting the Northeast and the North China grids in 2003. In addition, the North China Power Grid constructed a west-to-east transmission line. This brought to four the total number of circuits for sending power from west to east.

D. Distribution

Local power distribution networks are subsidiaries of the two state-owned grid companies and are themselves composed of several subsidiaries. The organizational structure is developed in line with the economic responsibility system for state-owned enterprises in the PRC, which is designed to provide incentives for ensuring high performance efficiencies.

For example, the Beijing Electric Power Corporation (BESP) is a subsidiary of SGC. BESP in turn manages 16 different power supply companies (PSCs), each of which serves an area under BESP's jurisdiction. Each PSC oversees multiple subsidiary electricity supply stations (ESSs). The ESSs are responsible for the distribution of power and maintenance of the distribution network at 110 kV and below, as well as for metering, billing, bill collection, and related customer service. They are also responsible for ensuring that customers are only connected to the system legally. Each station covers a geographical area that may be the size of a street, village, or town. The PSCs set marketing and efficiency targets for each of the ESSs in their jurisdiction. Each

3 The load factor is the average number of hours of operation in a year divided by 8,760 hours.

PSC is responsible for ensuring that ESSs perform well enough to ensure that it meets its own performance targets set by BESP. Parent companies provide incentives to their daughter companies to meet performance target levels by tying the payroll allocation of each daughter company to its performance.

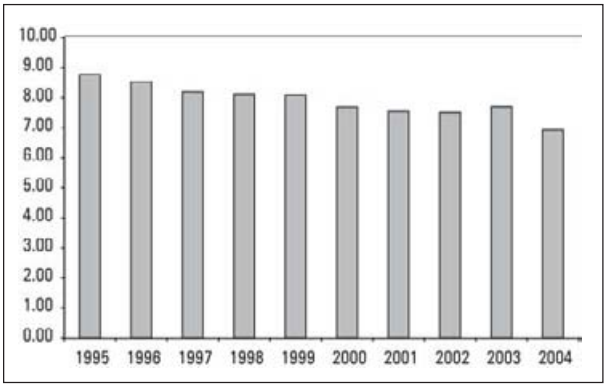
Power metering is delegated at two levels. First, each ESS is responsible for managing the electricity meters below the 110 kV level. Second, a provincial department is responsible for overseeing metering standards across all local power companies. This has the advantage of separating responsibility for meter reading and verification, reducing the possibility of corruption. Provincial control of metering requirements serves as a management audit of each of the companies required to meet performance targets.

Prepaid meters are used extensively. For example, as of May 2005, 86% of BESP's 3.1 million customers use prepaid meters. Prepayment is reputed to be highly effective in ensuring collections and reducing ESS costs in the PRC.

E. Power Losses and Cash Flow

No published information on billing and collection efficiencies in the PRC was obtained for this study. However, government officials state that the problem is not serious. Total transmission and distribution losses in the PRC are remarkably low at 6.93%. Figure 8 depicts the trend in line losses, which indicates that the PRC has among the lowest losses in the CAREC region. These figures imply that commercial losses are practically non-existent as reducing technical losses below 5% is extremely challenging. It seems likely that the tight incentive structures in effect at the DISCOs are the primary reason for the PRC's success in maintaining low commercial losses.

Figure 8: Percentage Line Losses, 1995–2004



Source: PRC Electricity Council. 2004. *Electric Power in China*.

Similarly, it was not possible to access information on the state of sector cash flow. While generation tariffs approximate cost recovery levels, it is not clear to the study team whether the grid company is able to collect sufficient money to finance its operations and necessary system expansions.

F. Tariffs

Catalogue retail power tariffs are established at the provincial level by the provincial pricing bureaus. These bureaus report to the local government and must conform to the directives of the National Development and Reform Commission (NDRC). Local pricing bureaus, which report to the local governments, may add small surcharges and fees to arrive at the final local electricity prices. They are also responsible for consulting with utilities and bringing the latter's requests for tariff increases to the provincial pricing bureaus. However, NDRC is the final arbiter on the question of tariff increases and consults extensively with the provincial pricing bureaus.

At present, the PRC has a uniform classification system of retail electricity tariffs across the country. The classifications have not changed since 1976. Retail tariffs are set for the following consumer classes:

(i) large industry,
(ii) non-general industry,
(iii) residential lighting,
(iv) non-residential lighting,
(v) commercial,
(vi) agriculture, and
(vii) irrigation and drainage in poor regions.

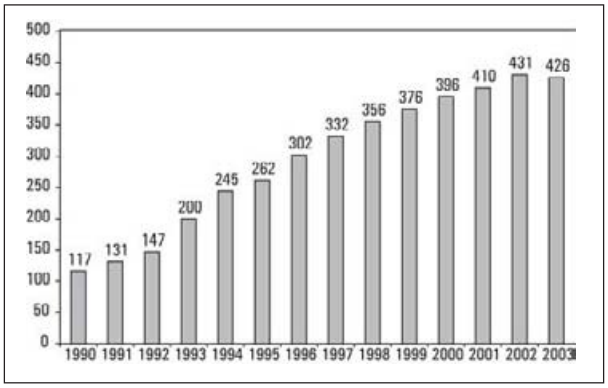
There are currently no separate transmission or distribution tariffs. Networks are simply paid the difference between retail and generation tariffs. Wheeling charges are, however, set for a few specific inter-regional long distance transmission lines.

Over the past 20 years, generation tariffs have become progressively more uniform. Between 1985 and 1996, two types of generation tariffs were used. The Government regulated power plants received tariffs set by NDRC while all other plants earned tariffs based on local reference tariffs determined by provincial pricing bureaus in consultation with NDRC. In 1996, the Government required all reference generation tariff applications to be submitted to NDRC for review and approval. In 1997, it began to consolidate the local reference and centrally regulated generation tariffs to develop uniform generation tariffs for each provincial power grid. In 1998, the Government issued new guidelines, requiring tariffs to be based upon the approved rather than actual power plant capital and operation costs leveled across the economic life of the plants. It also set a 3-year timetable for achieving uniform retail electricity tariffs for urban and rural areas and uniform generation tariff setting methods for each grid. More recent generation pricing guidelines from NDRC aim to set a uniform generation tariff for all power plants of the same type (e.g., hydropower or coal-fired power plants) within a power grid based on the standardized costs and returns for power plants for each type.

It may seem anomalous that NDRC is involved in tariff setting while SERC is not. NDRC has been established longer and has traditionally been responsible for tariff setting. By contrast, SERC is responsible for overseeing the creation of regional electricity markets. Once regional and national markets are functioning at the wholesale and retail levels, there will no longer be a need for centralized retail tariff setting. As the emphasis moves from administered to competitive markets, the role will likewise move from one organization to another.

Figure 9 depicts the growth of average tariff levels in the PRC. Significant tariff increases occurred during the 1990s, but they have slowed recently. ADB analyses suggest that tariff levels now suffice to achieve financial cost recovery, although they do not yet reflect marginal economic costs. Specifically, tariffs do not cover the costs of environmental damages and the true shadow costs of utilizing domestic fuel reserves.

Figure 9: Average Retail Tariff Levels
(yuan/megawatt-hour)



Source: ADB. 2004. *Technical Assistance to the PRC on Power Pricing Strategy*. Manila.

For example, an ADB study finds that the LRMC inclusive of only financial costs in Liaoning was approximately $0.057 per kWh while retail tariffs (Table 9) are roughly in the same range. Because the above estimate excludes environmental damages and values fuel costs at transacted rather than economic prices, Table 9 shows that residential and agricultural tariffs are below economic LRMC. Higher voltage customers may be paying prices more in line with actual economic LRMC. Thus, residential and

Table 9: Electricity Pricing of Liaoning Power Grid
($/kWh)

Item	400 V and below	10 kV	35 kV	Below 220 kV	220 kV and above	Capacity Charge (kVA/ month	Capacity Charge (kVA/ month
Residential	0.0544	0.0532	0.0532				
Non-residential lighting	0.0845	0.0832	0.0832				
Commercial		0.096	0.0912	0.0936			
Non-general industry	0.0799	0.0787	0.0774				
Ordinary industry	0.0677	0.0664	0.0652				
Agriculture and processing	0.0483	0.0471	0.0459				
Large industry		0.0522	0.0506	0.0491	0.0478	2.658	1.812
Ferroalloy, calcium carbide, etc.		0.051	0.0494	0.0478	0.0466	2.658	1.812
Fertilizer	0.0414	0.0399	0.0383		2.658	1.812	

kV = kilovolt, kVA = kilovolt-ampere, kWh = kilowatt-hour, V = volt.
Source: PRC Electricity Council. 2004. *Electric Power in China*.

agricultural customers receive cross-subsidies. Further, the same assessment that estimated LRMC at $0.057 per kWh also finds that transmission and distribution systems receive a particularly low tariff margin. It finds that unless tariffs for the wires system are raised, the grid will have to continue to be upgraded using government funds or raise private equity rather than rely on the revenues of the grid companies.

While tariff levels do not quite account for full economic costs, the PRC has been quite active in promoting tariff structures well suited to saving for new capacity requirements. Large industrial consumers pay a two-part tariff: energy charge (fen per kWh) and capacity charge (fen per kWh or fen per kVA), which provides incentives to minimize capacity requirements. Over 20 provinces charge large consumers peak and off-peak tariffs, so that more than 50% of total electricity consumption is subject to these kinds of tariffs. The average ratio of peak to off-peak tariffs is about 3:1, with 4.57:1 being the highest ratio. These substantial variations provide incentives for consumers to shift load from peak to off-peak hours, thereby saving capacity.

Innovative schemes to save on energy are also being tried. Currently, there are 11 provinces that apply wet and dry seasonal tariffs, including six provinces with high proportions of hydroelectricity (Hubei, Hunan, Jiangxi, Sichuan, Guangxi, and Yunnan) and five with energy supply and demand imbalances (Beijing, Tianjin and the South area of Hebei Province, Shanghai, and Chongqing).

It is alleged that some provincial power companies have misinterpreted power sector reform as a new freedom to change power purchase and selling prices unilaterally. A survey conducted by SERC in 2002 indicated that some provincial power companies have set their purchase prices of on-grid power below the official on-grid power prices established by the Government. Some have also unilaterally established their own procedures to modify electricity tariffs, or have unilaterally given discounts to increase market share or attract certain consumers. As a result, power producers did not receive adequate revenue to cover their costs of power production and new cross-subsidies resulted from the discounts. These diverse figures may indicate that the power sector in the PRC is more diverse and fragmented than it is supposed to be under the law.

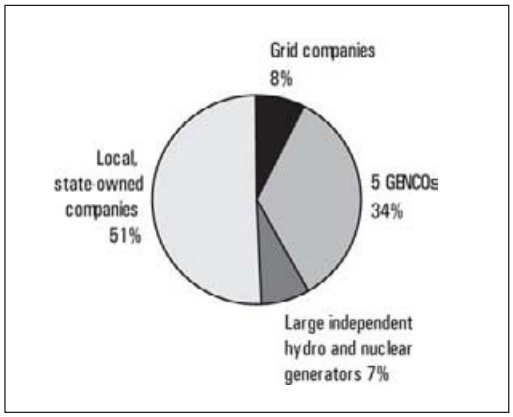
G. Industry Structure

As detailed above, great care has been taken during the unbundling of the PRC power markets to ensure that the eventual market structures are suitable for the introduction of competition. Figure 10 shows the ownership composition of generation capacity. The share of generation capacity owned by any given corporation formed out of SPC was capped at 20% of the total market. This restriction on industry concentration was applied in each region as well. In fact, the actual concentrations are even smaller than those allowed as the combined generation capacity owned by these firms is only 51%.

Figure 10 shows that the power grids own 8% of generation capacity. These tend to be local generators established close to load centers, which have been built by the grid companies to ensure proper system balance. It remains to be seen what will be done regarding ownership of these plants. It will be important to regulate their use carefully under a market system. Other IPPs would need assurances that the grid companies would not favor these plants.

Several regions are currently experimenting with power markets. The Northeast and East regional grids are already doing power market simulations. The Southern grid is due to begin experimentation in late 2005. The Central, North, and Northwestern grids are also planning simulation exercises. Due to the current

Figure 10: Ownership Structure of Generation Capacity



GENCOs = generation companies.
Source: SERC presentation to the Annual Meeting of CAREC Members Electricity Regulators Forum, Beijing, 4–6 July 2005.

power shortages in the eastern and southern PRC, markets are not yet permitted to determine prices as it is widely presumed that a shift to markets would cause prices to spike unless the shortages are addressed first. This concern is well-founded in economic theory and experience with power markets. Such price spikes in a market context are justified because it is precisely these spikes that provide signals for expensive peaking plants with low potential load factors to be built. Given the current investment boom in power generation, no such price signal seems to be required.

H. Regulatory Challenges

The study team was unable to meet with a full complement of sector officials in the PRC. As such, a proper discussion of regulatory approaches, objectives, and challenges identified by the regulatory bodies (SERC and NDRC) is not possible. However, a number of regulatory challenges and issues have been highlighted by this brief review of electricity regulation in the PRC.

(i) The Electricity Law of 1995 established general pricing principles, and following that, NDRC has issued general pricing guidelines that are more market-oriented. Despite this, tariff setting-procedures remain publicly unobservable and application of these principles is difficult to scrutinize.

(ii) The process by which responsibility for electricity regulation is being transferred from NDRC to SERC, and from regulator to market-determined tariffs, is not publicly known or predictable. Presumably, as the power shortage eases and markets can be implemented, SERC will obtain greater control in overseeing the markets that determine wholesale tariffs. However, opposition to power reforms is gathering momentum.

(iii) It is difficult to tell the extent to which the sector is self-funding and how the massive expansion of the electricity system of the PRC is funded. Much of the capital fueling this expansion comes from domestic banks whose lending decisions are not fully transparent, but appear to display faith in the capacity of power sector investments to earn reasonable returns.

(iv) Some tariffs, particularly on residential consumers, are below the LRMC.

(v) Private investors sometimes complain that power plants with government connections are sometimes given a higher priority by system operators than independent private plants. Whether or not there is truth in this allegation, SERC will need to ensure that the decisions of system operators are publicly well understood and regarded as impartial.

(vi) Over the past decade, the PRC has conducted several pilot studies, all of which found massive potential economic and environmental benefits to improving energy efficiency. One of the main features of market-based pricing of electricity is its ability to put alternative energy sources and conservation at par with new construction. Given the high cost of new capacity, pollution, and fuel currently borne by the PRC, the benefits of this move could be substantial. In the meantime, regulatory support for DSM will be extremely important.

(vii) Expensive long-term PPAs might complicate the transition to markets if market prices would fall below the agreed prices.

(viii) Given the high level of atmospheric pollution in the cities, pricing environmental costs into electricity tariffs will pose an economic and regulatory challenge in the years to come. Command-and-control policies to clean up production practices are reported to be impacting dust and sulfur dioxide emissions. However, price signals are also required in order for consumers to consider properly the environmental costs. Until generation tariffs become market-determined, the tariffs set for different classes of generators greatly influence the fuel mix and must include measures of this environmental damage.

I. Conclusions

Apart from Kazakhstan, the PRC is the CAREC country, which has made the most progress toward market regulation of its electricity sector. To this end, it has resolved to functionally separate policy, regulation, and business management. Ownership is partly unbundled with the introduction of private sector participation in the sector, but the ownership and control of sector assets must be made more transparent and simple.

The PRC has begun the vertical unbundling of its electricity sector by separating generation from transmission. The distribution and retail functions remain bundled as do retail, distribution, and transmission tariffs. While there is a clear policy indication that they will be separated in the future, announcements are awaited on how this will proceed. The principal problems in the PRC electricity sector are common in many economies. For example, transparency in operation has vastly improved, but many issues such as tariff methodologies cause confusion because the principles underlying regulatory decisions are not clear. The issue of transparency in ownership is important. Unless it is resolved, it will hinder the development of a market. As long as companies, investors, IPPs, and even regulatory authorities are controlled by state authorities, there will be fears of discrimination, unfounded though they may be.

However, none of the above points undermines the very real achievement of the PRC in ensuring that its vast electric power system is keeping pace with the world's most rapidly developing economy.

VI. Kazakhstan

Map 2: Kazakhstan

A. Overview

Kazakhstan is a sparsely populated country with abundant mineral resources, particularly oil. With a land area of 2.7 million km^2, its estimated population is only 15.2 million. Approximately 8.4 million people live in urban areas and the majority of the population have access to electricity. A large proportion of the rural population is also connected to the power grid, especially in the more densely settled southeast and northern parts of the country. Reliability of electricity supply in rural areas is poor.

Being the Central Asian economy most closely tied to Russia, Kazakhstan suffered dramatic contractions following the collapse of the Soviet Union—estimated at about 43% of the economy between 1990 and 1997. The post-independence recession wiped out a number of industrial subsectors (particularly, those dependent upon the formerly captive Soviet Union market), but with foreign investments in oil, industry's share of GDP has increased from 21% in 1996 to more than 38% in 2003. This share could be even higher according to some estimates.[1] In contrast, agriculture's share in GDP has shrunk from 35% to 8% in the same period. These large macroeconomic swings led to surplus power capacity in the late 1990s, followed by tightening power supplies in some areas by 2005. Sound economic and financial policies have helped sustain Kazakhstan's growth rates, particularly since 2000.

Kazakhstan has unbundled its generation, transmission, and distribution functions. Generation tariffs are mostly market-determined and ownership

1 EIU. 2004. *Country Profile: Kazakhstan*. Available: http://db.eiu.com/report.

of most GENCOs and DISCOs has been privatized. The Ministry of Energy and Mineral Resources (MEMR) is the policy-making body, but it is also responsible for the technical aspects of regulation. The Agency for the Regulation of Natural Monopolies (AREM) deals with economic regulation and sets transmission tariffs. The Competition Protection Committee (CPC) under the Ministry of Industry and Trade (MIT) regulates electricity distribution and supervises the unbundling of DISCOs into monopoly wires companies and competitive retail companies.

B. Generation

About 97% of Kazakhstan's power plants are now privately owned. AES Corporation is the largest foreign investor in Kazakhstan's power generation sector, having invested more than $60 million in Kazakhstan since 1998. In August 1996, the company purchased the former Ekibastuz GRES-1 coal-fired power plant in northern Kazakhstan. The plant is the largest power plant in the country with a total production capacity of 4,000 MW, equivalent to about 20% of the country's generating capacity. AES Corporation also holds a 20-year concession on two hydroelectric stations (AES Ust-Kamenogorsk and AES Shulbinsk) and four CHP stations in the eastern part of the country.[2]

Other significant international interests have also been attracted. In October 2000, Kazakhstan and Russia announced that they had reached an agreement in which Russia's UES would receive a 50% share of the Ekibastuz State Regional Power Station 2, a 1,000 MW coal-fired plant in Pavlodar to cancel out Kazakhstan's $300 million debt to UES for electricity supplies.[3]

Kazakhstan has 71 power stations, including five hydroelectric plants. This represents an installed capacity of approximately 18,500 MW, 80% of which is coal-fired and 12% is hydroelectric.[4] The coal-fired plants are located in the northern coal producing regions. Kazakhstan's hydroelectric facilities are located primarily along the Irtysh River, which flows from the PRC across northeast Kazakhstan. More than 70% of installed capacity is concentrated in the north. Given its sparse population relative to the south, this region possesses excess capacity.

The production and consumption of electricity fell significantly following independence. Although the country technically generates enough electricity to meet demand, it has suffered from frequent power shortages since 1992 due to the sector's deteriorating infrastructure. A decade-long decline in electricity consumption resulted in a decrease in generation from thermal power stations while generation at hydroelectric facilities remain constant due to their lower variable costs. The Irtysh River is an important source of hydropower. The PRC and Kazakhstan have held negotiations on its management since 1999.[5]

Economic growth since 2000 has helped boost generation to 63.7 TWh in 2003 and consumption to 62 TWh. This marked the first time since independence that Kazakhstan's domestic electricity generation exceeded its consumption.

The northern networks serviced by the coal-fired power plants that make up most of the country's installed capacity have recently begun exporting electricity to Russia. For instance, in January 2003, the Ekibastuz Power Plant No. 2 located in the northern Pavlodar region began exporting electricity northward to the Russian Federation.[6] The southern regions often import electricity from the Kyrgyz Republic and Uzbekistan through the CAPS because they have insufficient installed generating capacity.

C. Transmission

Kazakhstan is the first country in Central Asia to have a truly independent transmission company. The Kazakhstan Electricity Grid Operating Company (KEGOC)—a 100% government-owned transmission company established in 1997—operates the HV transmission lines, substations, and the central dispatching apparatus. Its assets include the HV transmission system of 110–150 kV and 73 substations.[7] Under Order No. 198 issued by the MEMR minister on 27 August 2004, the functions of the system operator were delegated to KEGOC.[8] KEGOC was made

2 Public Finance Monitoring Center. 2004. *Assistance in the Liberalization of Energy Tariffs and its Impact on Poverty Reduction.* Also on http://www.eia.doe.gov/emeu/cabs/kazapriv.html.
3 Energy Information Administration (EIA). 2004. *Kazakhstan Country Analysis Brief.* Available: http://www.eia.doe.gov/cabs/kazak.html.
4 See footnote 3.
5 See footnote 3.
6 *Kazakhstan News*. Available: http://www.kazakhstaninvestment.com/kz-news-03-23-04.html
7 See http://www.kegoc.kz/index.php3?parent_id=1026301632&lang=eng
8 Dispatch is concerned with real-time matching of demand and supply. System operator functions include forward planning and identification of system security problems that need to be addressed in the medium to long term.

responsible for the overall management and stable operation of the whole Kazakhstan power system.

Kazakhstan's electricity transmission and distribution system is divided into three networks: north, south, and west. The power plants in Kazakhstan have enough capacity to satisfy auxiliary power and capacity demand, but due to mismatches between the historical configuration of the transmission networks and the location of demand, southern and western regions experience power shortages. The power shortage in the western part of the country is due to historical positioning when its electric power demands were partially supplied from the adjacent regions of Russia. The west and north power grids are connected to each other by the power grids from Russia and do not have a grid connection exclusively on the territory of Kazakhstan.

The southern grid was designed to be fed with hydropower from the Kyrgyz Republic and Tajikistan through the CAPS. It is connected to the northern grid by two 220 kV and one 500 kV power transmission lines. Southern Kazakhstan, which does not have sufficient primary energy resources and therefore suffers power shortages, is supplied by transmissions from the north grid and imports from the CAPS.

KEGOC is planning a second north-south power line to make it possible to fully supply the southern grid with energy generated domestically. The line will cost an estimated $300 million to build. In 2003, KEGOC began investing approximately $73 million to upgrade the country's HV transmission lines, upgrade automated substations, and purchase new distribution equipment. These investments are part of a bigger $258.4 million upgrading project being planned with financial assistance from EBRD and WB.[9]

D. Distribution

Regional electricity DISCOs serve areas approximately defined by the borders of *oblasts* (regional administrative divisions). Kazakhstan has privatized most of its electricity distribution system. Currently, there are 14 oblasts and 18 DISCOs. The first two electricity distribution networks to be run privately serve Almaty and Karaghandy. In July 1999, AES Corporation was awarded management rights for the Ust-Kamenogorsk and Semipalatinsk DISCOs that were close to three power plants also operated by the company under a 15-year agreement with the Government signed in November 2000.[10]

Not all privatizations have gone smoothly. A foreign investor, which bought the Almaty DISCO, decided to leave Kazakhstan in 2000 over a dispute with the regulator regarding tariff levels.[11] It is now managed by a local consortium known as Almatyenergo or Almaty Power Consolidated (APC).[12] Currently, three DISCOs are publicly owned—Mangistau, Zhezkazgan, and West-Kazakhstan.

While the Kazakhstan power sector is almost entirely vertically unbundled, APC is vertically integrated—providing service in the generation, transmission, and distribution of electricity and heat. The reasons provided for this integrated utility are that CHP plants are difficult to separate from the rest of the delivery system and that long distances from other generators mean that a generation market in Almaty would be too poorly contested to function well.

Following the adoption of the policy objective in early 2004 of further developing market relations in the electricity sector and the revised Law on Electricity, DISCOs have started separating their wires businesses from their retail functions. This is being done with the aim of creating retail business and shifting to competitive retail price determination. Both AREM and CPC take an interest in this endeavor.

E. Power Losses and Cash Flow

Kazakhstan incurs large energy loss in transmission and distribution over its 285,000-mile distribution lines. According to the Minister of Energy and Natural Resources, Vladimir Shkolnik,[13] about 15% of generated electricity is lost before it reaches consumers due to the widespread deterioration of power infrastructure.

Table 10 presents data on overall losses. Noncash payments are high but the collection as a percent of billing is a respectable 92%. As in all CAREC countries except for the PRC, the role and extent of noncash

9 Information supplied by KEGOC.

10 See http://www.eia.doe.gov/emeu/cabs/kazapriv.html.
11 See footnote 3.
12 See http://www.eia.doe.gov/emeu/cabs/kazak.html.
13 EIU. *Kazakhstan Country Analysis Brief* and http://www.eia.doe.gov/emeu/cabs/kazak.html.

payments is unclear and sector officials did not acknowledge this as a problem during meetings with the study team.

Table 10: Losses, Billing, and Collections, 2002

Item	Percentage
Total Power Consumption (TWh)	59.9[a]
System Losses (as a % of net supply)	15[b]
Billing (as a % of sales)	95[b]
Collection (as a % of billing)	92[b]
Noncash Payment	45[c]

TWh = terawatt-hour.
Sources:
[a] Globalis – A World Map (Available at: http://globalis.gvu.unu.edu/), accessed 18 September 2005.
[b] WB. 2005. Presentation to the CAREC Senior Officials Meeting.
[c] WB. 2004. *Regional Electricity Export Potential Study*. Washington, DC.

Power brokers play a crucial role, financing long-term power purchases for enterprises that are unable to pay cash up front. It is clear from this table then that Kazakhstan is on the way to a balanced situation in which cash flow suffices to pay for the power consumed.

At the retail level, APC's collection rate of close to 90% is reported to be typical of the situation in Kazakhstan.[14] In 2001, KEGOC officials reported that as soon as generation was privatized, payment problems were resolved because both public and private DISCOs were compelled to pay for the electricity they sold. Appropriate incentives and improved management at the local level have induced a large improvement in collections to the point where it is no longer considered to be a serious problem. Figure 11 depicts how cash flows within the sector. From the consumers, payment goes to DISCOs and then to GENCOs. When needed, especially for long-term purchases, brokers mediate to finance contracts between DISCOs and GENCOs.

14 Based on discussion with several parties including APC officials.

F. Tariffs

Under the former Soviet Union, Kazakhstan utilized a system of fixed electricity tariffs unrelated to production costs and investment needs. Table 11 shows the main features of how tariffs are now determined in Kazakhstan. AREM regulates companies deemed to be natural monopolies. Generation tariffs are determined by the open market. Distribution and retail is supervised by CPC, which is currently overseeing the separation of the retail functions of DISCOs so that competition can be introduced.

Wholesale prices are market-determined through long-term contracts with the Kazakhstan Wholesale Electricity Market (KOREM), providing a space in which these may be traded and price discovery may occur. In a competitive electricity market, the price is given by the SRMC when the system has excess capacity. (This is the cost of the last unit of power generated, taking the capacity of the system as a given.) In Kazakhstan, the reduction in power demand following independence has left the country with excess capacity (except in the south). The SRMC is less than the average production cost and power companies report that market tariffs have fallen below profitable levels.

The problem of tariffs being below production costs is likely to be resolved in the next few years. With

Figure 11: Cash Flow in the Power Sector

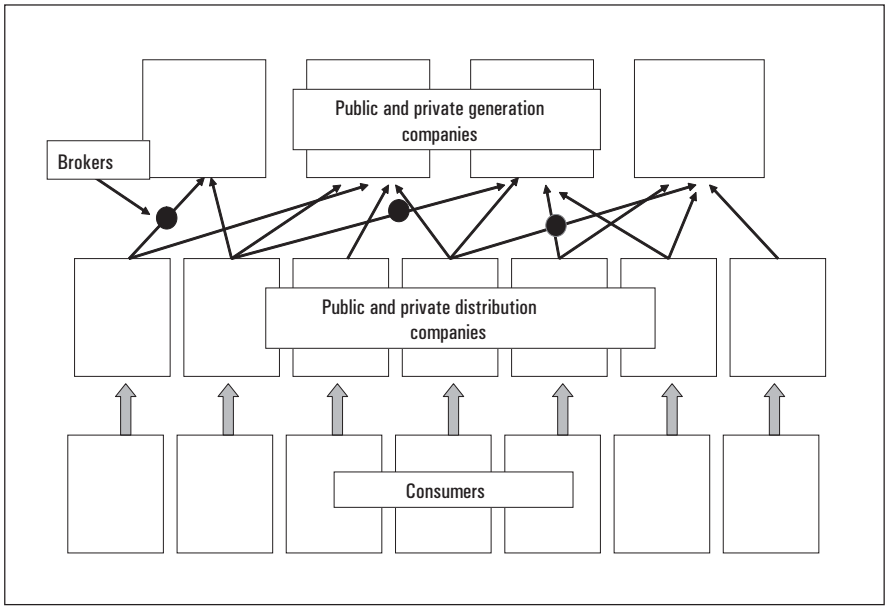


Table 11: Analysis of Tariffs

Item	Potentially Competitive		Noncompetitive	
	Generation	Retail	Transmission	Distribution
Regulatory Authority	Wholesale market (KOREM)	CPC	AREM	Not separately identified
Period of Adjustment	Under contract	Throughout the year	Twice a year	Not separately identified
Basis of Adjustment	Reasonable profit, based on asset value	Based on reasonable justification	Reasonable profit, based on asset value	Not separately identified
Seasonal Tariffs	Market-driven	None	None	Not separately identified
Lifeline	None	Local social assistance	None	Not separately identified
Capacity Charges		None	None	Not separately identified

AREM = Agency for the Regulation of Natural Monopolies, CPC = Competition Protection Committee, KEGOC = Kazakhstan Energy Grid Operating Company, KOREM = Kazakhstan Wholesale Electricity Market.
Source: Kazakh sector officials.

growth in economy and power demand, the system is likely to become capacity constrained again and prices will rise to reflect the cost of this constraint. This price increase will in turn induce investment in new plants. If such growth in demand does not occur, some power plants would go out of business, creating enough scarcity to raise market prices to levels profitable for the remaining plants.

Transmission tariffs are proposed by KEGOC and approved by AREM when the former provides a written request. Under the law, any natural monopoly is entitled to review tariffs twice a year i.e., in 1 April and 1 October. Sixty (60) days before 1 February or 1 August, the regulated firm submits the application with all supporting documents for review by a working group of AREM. This group considers cost items and approves estimates for each activity. AREM sets tariffs based on its estimates of allowable costs.

Currently, transmission tariffs depend on transportation distances for distance of less than 600 km, and are independent of distance for transmission requiring 600 km and longer. AREM, KEGOC, and MEMR are now discussing a proposal to restructure KEGOC's transmission tariffs. Under this proposal, tariffs will not depend on distance and will instead use zonal pricing. Zones correspond to oblasts.

Retail tariffs for companies that retain monopoly positions are regulated by CPC. Table 12 shows the pattern of tariffs in 2004 and compares these with previous years'. Rates have continued to increase during 2003 and 2004. Industrial tariffs have risen by more than 35% during the period while household tariffs have increased by 18%. It should be noted that rates are higher in the main centers than in the regions. To offset the effect of these price increases, particularly to the low-income consumers, local governments (municipalities) provide social assistance calculated based on the costs of utility services.

The effect of market reforms in Kazakhstan has been to realign tariffs with costs for different consumer groups. Despite the large increases in the listed tariffs, HV industrial and large consumers can get lower effective tariffs by making medium- to long-term supply contracts with generators, usually with a validity of about 2 years. In accordance with the usual practice in market-oriented systems, the regulatory focus is shifting to transmission and distribution as the market develops because generators could otherwise use constraints in the wires system to manipulate market prices.

Table 12: Selected Regional Electricity Tariffs, 2002–2004

Item	Ind1[a] $/kWh	Ind2[b] $/kWh	Ind3[c] Trans[d] $/kWh	City $/kWh	Agriculture $/kWh	Non-industrial[e] $/kWh	Budget $/kWh	Residential Ex-VAT $/kWh	Residential Inc-VAT $/kWh
Almaty									
01/01/2002	19.6378	0.0213	0.0255	0.0207	0.0259	0.0291	0.0291	0.0259	0.0300
01/01/2003	21.0512	0.0229	0.0284	0.0222	0.0254	0.0312	0.0312	0.0277	0.0322
01/01/2004	23.3538	0.0254	0.0315	0.0246	0.0282	0.0346	0.0346	0.0308	0.0354
Astana									
01/01/2002	13.9715	0.0197	0.0213	0.0213	0.0213	0.0213	0.0213	0.0213	0.0248
01/01/2003	16.1975	0.0228	0.0239	0.0239	0.0239	0.0239	0.0239	0.0239	0.0277
01/01/2004	19.2308	0.0271	0.0284	0.0284	0.0284	0.0284	0.0284	0.0284	0.0326
Vostochno-Kazakstanskaya									
01/01/2002	0	0.0157	0.0157	0.0151	0.0151	0.0151	0.0151	0.0151	0.0175
01/01/2003	0	0.0181	0.0181	0.0170	0.0170	0.0170	0.0170	0.0162	0.0187
01/01/2004	0	0.0207	0.0207	0.0204	0.0207	0.0207	0.0207	0.0193	0.0222
Semipalatinsk									
01/01/2002	0	0.0226	0.0226	0	0.0217	0.0217	0.0217	0.0151	0.0175
01/01/2003	0	0.0242	0.0242	0	0.0232	0.0232	0.0232	0.0162	0.0187
01/01/2004	0	0.0268	0.0268	0	0.0258	0.0258	0.0258	0.0179	0.0206

kWh = kilowatt-hour, VAT = value-added tax.

Notes:

[a] Industrial and other consumers with N>=750 ÌVÀ, per 1 kW of maximum load in year.

[b] Industrial and other consumers with N>=750 ÌVÀ, per 1 kW consumed electricity.

[c] Industrial and other consumers with N<750 kVÀ.

[d] City Transport.

[e] Can be described as commercial.

G. Industry Structure

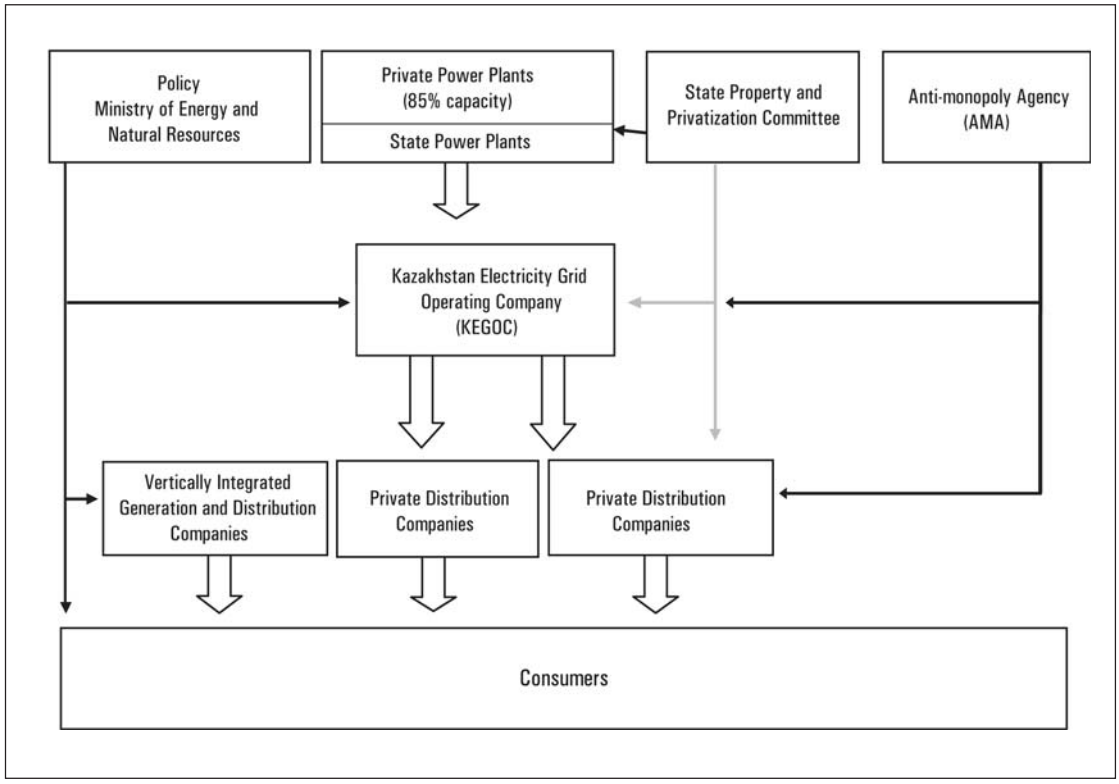
Kazakhstan has functionally separated policy, regulation, and business management of its electricity sector. Generation was separated from transmission and distribution. Tariffs for generation and retail have been unbundled and those of transmission and distribution are expected to be separated as well. The institutional structure of the Kazakhstan power sector is illustrated in Figure 12.

At present, wholesale tariffs are largely set by the market for electricity contracts. About 90% of electricity is traded in bilateral contracts. The balance of generation—about 10%—is sold under regulated arrangements in areas (such as APC) where generation is bundled with transmission and distribution, and competition is not currently effective. Contractual relations provided a more efficient framework for governing operations. However, there was a problem with trading surplus generation and purchase of additional supplies. In 2000, a legal framework formalized relations among the various market participants and established an electricity exchange. KOREM—an electricity market operating entity—was set up under a government decree.[15] KOREM offers a market in which about 6% of Kazakhstan's electricity production is traded.

For the majority of contracts, KOREM plays no part aside from standardizing them and seeking to reduce transaction costs. For the 4–6% of power that contracting parties seek to dispose of or purchase, it uses two trading systems that operate on a-day-ahead basis in two sessions: (i) a process of bilateral bidding for new contracts, followed by (ii) running counter-trading with automatic determination of prices and selection.

15 Government Decree No. 606. *On additional measures on increasing the effectiveness of the wholesale market of electricity and its volume*. 20 April 2000.

Figure 12: Institutional Structure of the Power Sector



Source: Adapted from: ADB. 2002. *Technical Assistance on the Regional Power Transmission Modernization Project in the Central Asian Republics*. Manila.

KOREM is responsible for supporting centralized trading.[16] This includes maintaining uninterrupted availability for centralized trading, verifying compliance with the centralized trading requirements, providing market participants with the information on prevailing market prices and other market-related information, and training and support to potential electricity wholesale market participants. KOREM also arranges the underwriting and settlement of spot trades, monitors enforcement of transactions and compliance with rules, and drafts daily supply and consumption schedules for the market based on trading outcomes. Likewise, KOREM is responsible for developing a market for purchases and sales on a spot market basis. The spot market is not in operation yet.

Wholesale competition is facilitated by the presence of KEGOC as an independent carrier of electricity not involved in trading. AREM also wishes to facilitate trading at the retail level and is beginning to move toward this model by vertically unbundling retail energy sales from distribution wires services.

H. Regulatory Objectives and Approaches

The objective of electricity regulation in Kazakhstan is to increase competition. Generation tariffs are market-determined. Transmission, distribution, and retail tariffs were regulated until competition was introduced. Kazakhstan is considering ways to unbundle distribution into the distribution wires business and the potentially competitive retail energy business. After this, it hopes to introduce full competition in the retail business while continuing to regulate the transmission and distribution wires businesses.

Table 13 shows that responsibilities in electricity regulation are mostly clearly allocated and the mandate of the regulator is unequivocal. This clarity isreflected in the simplicity of the arrangements and the clear policy that has emerged. One recent complication is that CPC has been given the responsibility for determining retail

16 Information on KOREM's role and operating procedures was provided by KOREM during a meeting with the study team on 10 January 2005.

Table 13: Matrix of Regulatory Responsibilities

Organization	Behavioral (non-tariff)	Structural	Economic (tariffs)
COM/Parliament		Policy unbundling of retail and distribution wires services	Formation and appointment of AREM
MEMR		Development of policy on trading and market	Development of the regulatory approach
AREM	Quality of supply and competition issues	Ensuring open access and non-discrimination in transmission	Transmission tariff setting
CPC			Retail tariff setting

AREM = Agency for the Regulation of Natural Monopolies, COM = Council of Ministers, CPC = Competition Protection Committee, KEGOC = Kazakhstan Energy Grid Operating System, MEMR = Ministry of Energy and Mineral Resources.
Source: Kazakh government officials and representatives.

tariffs—a task used to be handled by AREM. The institutional reasons for this change are unclear, and there have been reported difficulties in establishing who will have which responsibilities and why.

MEMR is the policy-making body responsible for crafting market-oriented policy direction and setting up the electricity contract trading system and KOREM. It is also responsible for the technical aspects of regulation. AREM, on the other hand, is concerned with economic regulation and tariffs for transmission, while distribution tariffs are set by CPC.

AREM requires that KEGOC have separate accounts for every type of service it provides. It then allows tariff increases based on the calculation of LRMC faced by KEGOC. Tariffs are legally required to cover all the justifiable costs of the natural monopoly and allow for a reasonable profit. Justifiable costs are defined to include incremental cost of capital as well as variable costs. AREM determines the extent to which assets are genuinely employed to generate service and their eligibility to be included in the rate base. If costs reflect poor commercial decisions or "gold plating", they may be disallowed. Currently, the guidelines require AREM to

(i) ensure transparency by requiring the natural monopoly to allocate costs by type of activity; and

(ii) ensure that the utility can make future investments by considering the cash flow, including the profit for next year and the accumulated profits from the previous years.

There has been some discussion about switching to a more flexible costing scheme for tariff determination purposes. This is because the current practice of considering tariff applications line-by-line makes regulatory submissions, deliberations, and rulings unnecessarily arduous.

I. Regulatory Challenges

Issues. Kazakhstan has gone much further in reforming its electricity sector than any other CAREC country. However, a number of challenges remain to be addressed. The following challenges were raised by the regulator, utilities, and the Government.

(i) Ensuring that access is granted to competing generators is an ongoing regulatory problem in Kazakhstan. The country's geography (with widely separated markets at opposite ends of the steppe) only allows small local markets. Local distribution is still largely organized as a monopoly, and in some cases, integrated with generation. This is the case even in areas such as Almaty where there are neighboring generators that can compete. It is alleged that some local vertically integrated monopolies do not permit open access to their grids despite having excess generation capacity.

(ii) With the current excess capacity, there is little scope for manipulating KOREM. However, as demand picks up over the next few years and capacity becomes constrained, there will be greater possibility of gaming the market by creating artificial capacity shortages. Therefore, KOREM will need more sellers and careful monitoring of

bottlenecks in the network. The building of the north-south transmission line will help increase the number of generators competing in the southern market. Cross-border trading is essential at present, but in the future, it can also be a useful regulatory tool to ensure that competition operates and that the scope for gaming is limited.

(iii) It is conceptually challenging to regulate tariffs for a CHP plant when the electricity is priced using market mechanisms and heat prices are regulated. It is important to ensure that the concept is widely understood and to employ a consistent nationwide approach.

(iv) Retail tariff regulation is carried out locally. Power companies have alleged that some methodologies and decisions on similar issues are inconsistent and that local interests come to dominate the process. For example, the social protection system that operates in Kazakhstan is tied to the prices of utility services. If the prices rise beyond the defined percentage of income of the poor consumers, local government agencies have to provide additional social transfers. One allegation is that some local government officials can influence the regulator to reduce tariffs, thereby saving the local government budget at the expense of the privately owned utility. Price controls effectively pass the cost of social protection onto the utilities.

There are no compelling parallels to these problems in other CAREC countries, except perhaps for the problem of pricing the output of CHPs. Government officials identified this as an area which has caused significant conceptual difficulty. In this regard, the theoretical clarification provided in the Appendix should provide food for thought.

J. Conclusions

When Kazakhstan became an independent country, Kazakenergo was a ministry running the electricity utility. Building on a solid base of relatively young local talent with support from the Government of the United States, Kazakhstan embarked on a significant power sector reform program in 1997. Policy, regulation, business management, and ownership were functionally separated. Competition became the principal arbiter of sector activity and the objective of the regulator is to ensure fair competition. Competition based on trading of medium- to long-term contracts is now being enhanced by KOREM. Generation has been made competitive and the transition to retail competition is underway. The relatively noncompetitive transmission company (KEGOC) is subjected by AREM to a separate form of regulation.

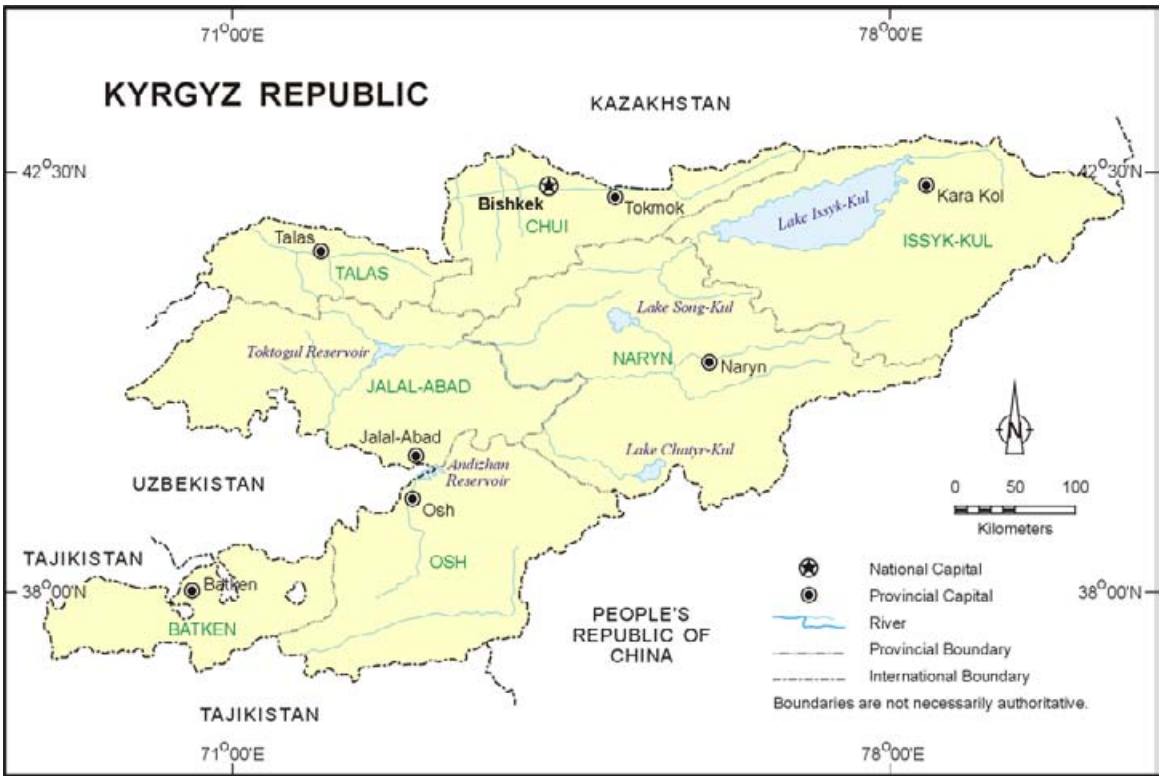
This Kazakh model is in line with modern thinking on power markets. It employs a mixture of behavioral regulation where competition is difficult to obtain or has not yet fully developed, and uses structural regulation or mandatory unbundling elsewhere.

With the unbundling and privatization of generation as well as distribution and retail in many parts of the country, Kazakhstan has gone much further than any other CAREC country in de-monopolizing its sector, although in some areas, transmission constraints and distance mean that local vertically integrated monopolies still exist. Currently, overcapacity means that there has not been large-scale investment in generation and tariffs are below the level required to cover the LRMC. The situation is evolving and as demand for power rises, tariff increases are inevitable. Tightening electricity supplies will also pose a significant test for the Kazakh market as they will make gaming of the power markets economically possible. Regulators will therefore have to be on their toes.

Kazakhstan has recognized the value of aligning electricity prices to costs. The ongoing vertical unbundling of its sector has increased the information available for regulatory purposes. In addition, Kazakhstan's electricity regulator has a clear mission and operates within a framework focused on bringing competition to the sector. The main regulatory challenge then in Kazakhstan is not financial sustainability or any other similar malaise, but how to keep an existing successful market functioning well, attract new necessary investment into the sector, and protect consumers as the market tightens.

VII. KYRGYZ REPUBLIC

Map 3: Kyrgyz Republic



A. Overview

The Kyrgyz Republic[1] has an estimated population of 5.12 million,[2] 35% of whom are urban dwellers.[3] The country is bordered by Kazakhstan to the north, Tajikistan to the south, Uzbekistan to the west, and the Xinjiang region of the PRC to the east. The Kyrgyz Republic is a landlocked country with a total land area of 198,500 km^2. About 94% of the country is over 1,000 meters above sea level with an average elevation of 2,750 meters. It is located north of the Tien Shan mountain system.

The Kyrgyz Republic has rich high-altitude steppe used for grazing. Irrigation is available to 80% of the cultivated area. Services and agriculture each comprises around 38% of GDP while industry—mainly gold mining—accounts for just below 15% of GDP. The economy contracted sharply after gaining political independence, but growth has resumed since 1996.[4] The Kyrgyz Republic's main trading partners are other Central Asian republics and the PRC. In 1998, it became the first former Soviet republic to join the World Trade Organization.

1 This report was drafted prior to the March 2005 political changes in the Kyrgyz Republic and may not fully reflect the positions and actions of the current government.

2 ADB. 2005. *Basic Statistics 2005: Developing Member Countries: Population Estimates for 2004*. Manila.

3 ADB. 2004. Kyrgyz *Republic: Country Strategy Program Update (2005-2006)*. Manila.

4 WB. 2005. *World Development Indicators*. Washington, DC.

The State Property Committee (SPC) owns 87% of the shares of power utilities, with the remaining shares held by private individuals and investment companies. The State Energy Authority (SEA) is responsible for regulating the sector.

B. Generation

The Kyrgyz Republic has a very large hydroelectric potential estimated at more than 163 TWh annually, less than 10% of which is currently exploited. It has an installed power capacity of 3,742 MW: about 85% or 3,181 MW were estimated to be available in 2002.[5] Electricity production from hydropower accounts for more than 80% of the total primary energy production. Following the vertical unbundling of Kyrgyzenergo in 2001, JSC Electric Power Stations is now in charge of all major electricity generation (i.e., those stations with a capacity of over 30 MW). Most of this power is generated from the cascade of Naryn River, which flows into the Syr Darya and proceeds through Uzbekistan.

The partially complete power stations—Kambarata No. 1 (1,900 MW) and Kambarata No. 2 (360 MW)—are the next candidates for generation development. A recent WB study finds that power from Kambarata 1 will be too expensive to be competitive in any of its potential export markets.[6] However, this finding is unlikely to reduce the priority that has been accorded to its development because UES—the leading Russian power company—has already expressed interest in completing work on the two dams. Should these dams be completed, the electricity available for export from the Kyrgyz Republic would increase significantly. The main constraint on power exports is the limitation on winter hydropower generation, which causes flooding in the Syr Darya basin.

There are only three thermal power stations of significant size in the Kyrgyz Republic. The largest of these is a CHP facility that provides district heating in the capital city of Bishkek. These power stations are multi-fuel, running largely on gas from Uzbekistan, but are also the primary users of fuel oil in the country. They have been producing below their designed capacities mainly because of the Government's inability to fund the purchase of fuel.

5 ADB. 2002. *Technical Assistance on the Regional Power Transmission Modernization Project in the Central Asian Republics*. Manila.
6 WB. 2004. *Regional Electricity Export Potential Study*. Washington, DC.

C. Transmission

The Joint Stock Company National Grid (JSCNG) is responsible for transmission operating in parallel with the CAPS. The transmission system in the north is connected to that in the south by the 500 kV Toktogul–Frunzskaya line crossing the mountain ranges at an altitude of 3,500 meters, and through a second 500 kV line at lower altitude running through Kazakhstan and Uzbekistan. The northern grid is interconnected with the southern Kazakhstan system by two 500 kV lines and four 220 kV lines. The southern part is connected by seven 220 kV lines to the Uzbekistan system and to some of the larger stations of the Naryn cascade. Construction of a direct link with Tajikistan is underway. JSCNG is also the system operator.

According to JSCNG officials, transmission losses have been reduced from 10.2% in 2001 to 6.3% in 2004. The power grid is in need of urgent improvement as the equipment employed is more than 30 years old and in poor condition. Maintenance and development budgets are low. JSCNG officials reported in March 2005 that the DISCOs owed their company approximately $44 million.

D. Distribution

In 2001, the DISCOs were separated from Kyrgyzenergo and became independent entities. The Government has made reform of the distribution sector a high priority. The final stage of restructuring scheduled since 2001 was the auction of concessions to run the DISCOs. Sever Electro North, which serves the Bishkek area, was to be the pilot. However, due to strong political opposition to privatization, a concession arrangement is still awaited. Sever Electro personnel have publicly voiced support for privatization because they are not optimistic about the possibility of management becoming independent of political interference while the company remains publicly held.

Households comprise about 60% of Sever Electro's market. Illegal connections, nonpayment, and arbitrary metering and billing are common. Almost all of Sever Electro's customers have meters, but most of these meters are old and require replacement. Sever Electro is trying to replace the meters from its own resources, although some consumers reported being

forced to buy their own meters. This has led to the development of a market for stolen meters. As a consequence, some residential consumers keep their meters inside their homes, making it difficult for meter readers to access. As an unsatisfactory compromise, the meter for an entire housing unit is often read and the power bill is averaged across all the households. This eliminates any real incentive for households to conserve electricity. There are also reported problems with the security of the computerized customer databases and billing systems, which allow some consumers to avoid paying their bills.[7] Furthermore, service reliability remains poor. More remote areas often receive only 4 hours of electricity daily.

E. Power Losses and Cash Flow

Years of inadequate maintenance and rehabilitation coupled with weak commercial incentives have led to substantial electricity losses through the grid. Table 14 reports that in 2004, 93.7% of net power supply from generators was delivered, 83.4% of that power (or 78.1% of net supply) was delivered to customers, 74.3% of the delivered power (or 58% of net supply) was billed, 86.6% of the billed amount (or 50.2% of net supply) was collected, and only 62.7% of the collected amount (or 31% of the value of net supply) was in cash. This is causing a severe cash flow crisis in the sector and bitter disputes among the generating, transmission, and distribution companies.

Table 14: Losses, Billing, and Collections, 2004

Item	Percentage
Transmission Losses (as % of net supply)	6.3[a]
Undelivered Power (as % of transmitted power)	16.6[b]
Unbilled Power (as % of delivered power)	25.7[b]
Non-collection (as % of total billing)	13.4[b]
Noncash Collection (as % of total collections)	37.3[b]

Sources: [a] JSC National Grid;
[b] DFID. 2005. *Tariff Policy and Utility Reform Project on Kyrgyz Republic.* Bishkek.

Vertical unbundling has been accompanied by greater diligence in the reading of meters at the intersection of the transmission and distribution network. This improvement has been vital in revealing the role of DISCOs and locating and minimizing losses. Metering at substations within the distribution system, however, remains weak. The prevalence of high levels of noncash payments (37.3%) also means that measurements of payments are open to interpretation and manipulation. Estimates of the extent of losses are therefore difficult to come by.

DISCOs have concentrated on improving billings and collections with limited success. Table 15 provides the billing details for each DISCO for 2002–2004. The following trends are evident: (i) billing performance is consistently weak at 74.3% of electricity delivered, (ii) billing for some DISCOs (especially Vostock) deteriorated significantly between 2002 and 2004, and (iii) billing efficiencies vary significantly across DISCOs.

The DISCOs, therefore, continued to obtain payment for only 53.7% of the electricity they purchased in 2004—almost exactly the same situation in 2002. Clearly, these figures suggest that improvements in billing arrangements are required. Experience in other CAREC countries (e.g., Azerbaijan and Tajikistan) suggests that in addition to requiring investments of time and money, new billing systems must be accompanied by commercial incentives for the system to work.

Due to a combination of low tariffs and high levels of commercial losses, the DISCOs have insufficient funding to undertake anything except emergency repairs, and therefore, none of the needed capital expenditure has taken place. This is leading to a steady decline in the integrity and reliability of the network together with a corresponding increase in technical losses. Table 16 shows that technical losses of DISCOs rose from 15.1% in 2003 to 16.6% in 2004.

In trying to reduce commercial losses, both the Government and the DISCOs have focused on improving collections. They have reduced this component of commercial losses from 17.2% of the amount billed in 2002 to 13.4% in 2004. However, given that billings account for only 74.3% of electricity distributed and 62.0% of the electricity received by the DISCOs, these impro-vements in collections can have little impact on overall commercial losses.

7 UK Department for International Development (DFID). 2005. *Tariff Policy and Utility Reform Project on Kyrgyz Republic* and interviews confirmed by USAID in *Electricity Loss Reduction Demonstration Models: Initial Performance Monitoring Results for Severelectro and Oshelectro Pilot Areas*, 2004.

Table 15: Amount of Electricity Distributed that is Billed

Distribution Company	Distributed Electricity (GWh) (electricity supplied to DISCOs less distribution technical losses)			Billed Electricity (GWh)			% of Billed, Distributed Electricity		
	2002	2003	2004	2002	2003	2004	2002	2003	2004
Sever	4052.3	4372.3	4161.2	2601.5	3031.9	2939.8	64.2	69.3	70.6
Vostock	1201.3	1301.4	1232.4	1091.8	1020.8	908.6	90.9	78.4	73.7
Osh	1830.6	1922.9	1739.3	1335.3	1512.1	1333.1	72.9	78.6	76.6
Jalalabad	855.3	1017.1	1030.5	776.5	916.9	886.7	90.8	90.2	86.0
TOTAL	**7939.5**	**8613.7**	**8163.4**	**5805.1**	**6481.7**	**6068.2**	**73.1**	**75.3**	**74.3**

DISCO = distribution company, GWh = gigawatt-hour.
Source: DFID. 2005. *Tariff Policy and Utility Reform Project on Kyrgyz Republic.* Bishkek.

Table 16: Distribution System Technical Losses

	International Standards	2002	2003	2004
Electricity Received By DISCOs (GWh)		9355.2	10,232.2	9,790.1
Technical Losses (% of electricity received)	5–10	15.1	15.8	16.6

DISCOs = distribution companies, GWh = gigawatt-hour.
Source: DFID. 2005. *Tariff Policy and Utility Reform Project on Kyrgyz Republic.* Bishkek.

DISCOs are unable to pay the GENCOs and transmission companies in full because they collect payment for only 53.7% of the purchased electricity. Coupled with uneconomic tariffs, the situation undermines the viability of the sector as a whole. A USAID assessment[8] estimates that electricity losses in 2003 were worth $50 million.

To overcome the losses, a management contract system has been proposed for the small DISCOs and a concession for Sever Electro (Bishkek, Chuj, and Talas oblasts). Discussions have centered on separating the selling functions from the management of the technical systems. It has been agreed by most players in the power system that if the selling functions would be privatized, it would improve the commercial incentives faced by the management. The biggest management problem is that DISCOs are not permitted to cut off supplies of power to customers that do not pay, and even if they were granted this latitude by politicians, they lack the incentives to do so.

The current state of sector finances implies that generators find it difficult to pay for imported gas. Due to the political friction with Uzbekistan and the dilapidated condition of the cross-border gas transmission pipes, the Kyrgyz Republic only receives inadequate winter gas supply. It relies excessively on winter hydropower that causes flooding downstream.

F. Tariffs

The amendment of the anti-monopoly law in 2004 caused the transfer of responsibility for tariff control from the Anti-monopoly Committee to SEA. SEA makes tariff recommendations based on the cost structure provided by MOF, JSC Generation, and JSCNG; and the retail margins provided by the DISCOs because the Law on Energy and Electric Power does not provide adequate guidance on tariff setting. These tariff recommendations are subject to the approval of the Office of the President. Apparently, some former Anit-monopoly Committe staff absorbed by MIT also provides inputs into the tariff setting process.

Legally, all customers in the same tariff classification should be charged the same tariff rate irrespective of location. Due to the tariff composition and absence of a modern billing system, however, the DISCOs appear to vary the amount charged without regard to the tariffs mandated by regulators. A DFID

8 USAID. 2004. *Electricity Loss Reduction Demonstration Models*. Washington, DC.

report[9] shows that the effective average tariffs charged to households by various DISCOs (calculated as the total revenues divided by the number of units of power sold) are too low to be consistent with the tariffs determined by regulators.

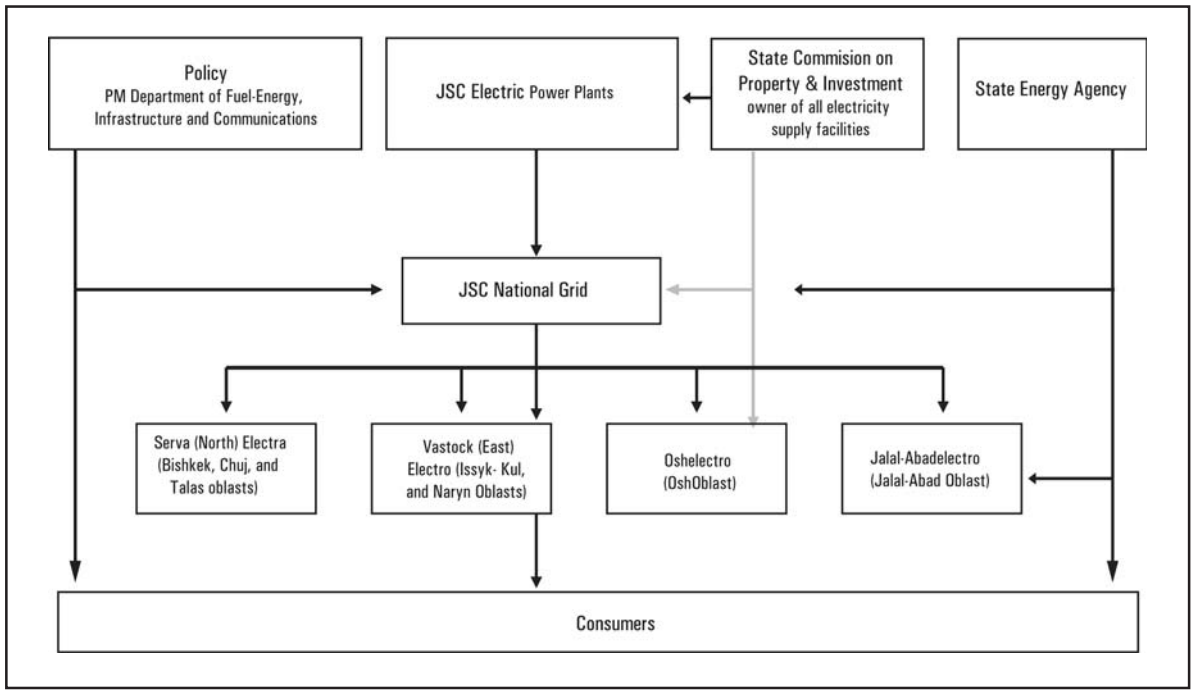
SEA believes that there must be collusion between collection staff and customers and it wants to address the problem by introducing a flat rate household tariff. Given that even single-part commercial tariffs are not properly applied, it is not clear to the study team if eliminating the lifeline tariff would greatly improve the accuracy of residential billing.

Experts from the Technical Assistance for the Commonwealth of Independent States determined that by 2006, DISCOs would require a total retail tariff of $0.023 per kWh. Based on this, SEA laid out a tariff policy through to 2006 to gradually abolish cross-subsidies from industrial and commercial users to domestic consumers, and to increase tariffs every 6 months. However, SEA could not fully implement this policy because the 2005 elections had reduced the Government's willingness to pursue tariff reform. The Government found it difficult to justify increases unless accompanied by tangible improvements in service quality, which are difficult to accomplish given the current financial circumstances.

G. Industry Structure

Kyrgyzenergo was established in 1997 and made responsible for the generation and distribution of electricity. With the sector restructuring at the beginning of 2001, it was split into several smaller companies as shown in Figure 13. Policy input comes from the Prime Minister's Department while SEA is responsible for price regulation. The main subsidiaries are JSC Power Plants, JSCNG, and the four state-owned DISCOs. Two repair companies and small hydroelectric stations were transformed into small private enterprises. Sever Electro is slated to be the first DISCO to be turned over to private management.

Figure 13: Institutional Structure of the Power Sector



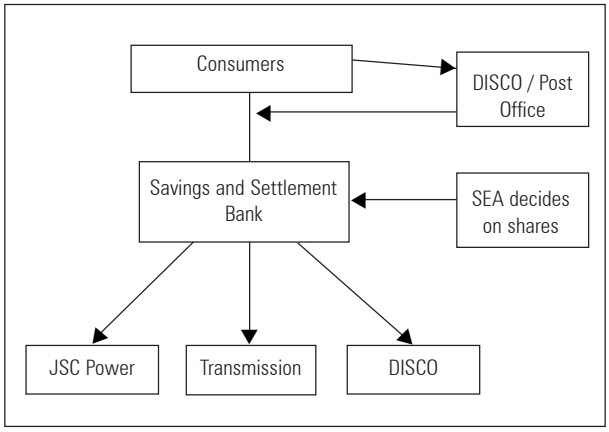
JSC = joint stock company, PM = Prime Minister.
Source: ADB. 2002. *Technical Assistance Final Report on Regional Power Transmission Modernization Project in the Central Asian Republics.* Manila.

9 DFID. 2005. *Tariff Policy and Utility Reform Project on Kyrgyz Republic*. Bishkek.

The vertical unbundling of the sector has revealed what people knew, but could not previously quantify—the DISCOs are virtually bankrupt, very poorly organized, and unable to provide quality service. The vertically integrated utility survived largely on the strength of profits on overseas sales by the generator and transmission companies. Now that unbundling has taken place and performance can be measured, each company's fragility has become more apparent.

Various measures have been undertaken in an attempt to improve collections and billing system. For instance, customers may now pay either directly to their local DISCO or to the savings bank, post office, or other authorized agencies (Figure 14). This is designed to make it more convenient for consumers to pay their bills.

Figure 14: Cash Flow in the Power Sector



DISCO = distribution company, JSC = joint stock company, SEA = State Energy Agency.
Source: SEA officials.

This payment arrangement also permits SEA to adjudicate on how the cash actually collected in the sector is allocated. As indicated in Figure 14, all collected money is turned over to the Savings and Settlements Bank (SSB). Then, SEA determines the commission to be retained by SSB and the distribution of the remaining cash among the utilities. This split actually determines the earnings of each company and is not proportional to the tariffs each company receives. Therefore, tariffs do not provide incentives to the companies to modify their behavior.

Table 17 shows no systematic pattern in the division of available cash. Sever Electro, which collects nearly 44.8% of its billings in cash, only receives 29% of the total cash available. Osh, which only collects 20% in cash, receives 38 % of the available funds. While some allowance for variations in local conditions is required, the data clearly indicate the need for a formula that provides incentives to collect more cash. The current distribution system is negotiated in private.

A publicly available formula that allows the DISCOs to predict what percentage of increase in collections they will be allowed to retain will clearly provide a much stronger incentive to collect more cash. This marginal percentage that the DISCO may keep must be large enough if it were to become a strong incentive to improve commercial performance. SEA reported that such system was tried, but it collapsed after a while amidst feuding among cash-strapped companies. Nevertheless, collections improved dramatically during its implementation. The lesson learned from this experience is that such a formula will be an integral part of any solution. This formula needs to specify tighter DISCO performance as years go by. Furthermore, it will certainly require infusion of

Table 17: Collection and Allocation of Cash, 2004

	Collections	Allocation (in %)		
	(% of billed amount paid in cash)	Distribution	Transmission	Generation
Sever	44.8	29	22	49
Vostock	28.8	34	23	43
Osh	31.5	38	32	30
Jalalabad	19.1	30	47	23

Source: DFID. 2005. *Tariff Policy and Utility Reform Project on Kyrgyz Republic.* Bishkek.

government money in the first few years to meet the basic cash requirements of the companies. Without such input, the system cannot be sustained long enough to reap results.

Potentially even more damaging to the system's long-term cash flow situation is the role of the so-called power resellers. While some SEA personnel are clear that several licenses had been issued for the reselling of power, many players in the industry denied knowledge of their existence and operations. Sever Electro believes that there are 10 resellers active in Bishkek alone. The Government and WB have agreed under the Structural Adjustment Credit negotiations to ban reselling, but it is widely reported that reselling still takes place.

Reselling happens when private interests gain control of particular substations, purchase electricity from generators informally at a substantial discount, and make a large markup on sales to large customers. This process lacks transparency and has few benefits for the cash-strapped public sector enterprises. The clients of the resellers have no opportunity to seek alternative suppliers, and therefore, do not gain the benefits of the wholesale discount. The principal effects of this system are monopoly profits to the resellers and erosion of the financial base of DISCOs. This is simply a small-scale privatization of a monopoly.

H. Regulatory Objectives and Approaches

Table 18 shows the distribution of regulatory responsibilities among various agencies. Five organizations are involved, with SEA taking the lead role. The objectives of each agency are not clear, although there is a consensus that higher bill collection and recovery of variable costs, at the least, are high priorities. While SEA and other parties wish to promote competition, a clear consensus on the requirements for competition is lacking.

There is no clear institutional mechanism to resolve regulatory or cross-agency issues. SPC owns the shares of JSCs. SEA, by virtue of Resolution 183[10] issued by the President, is responsible for regulatory issues, but has only recently acquired this responsibility and is still developing its capacity to perform the role. SEA is a state-funded agency reporting to the President. There was, for a time, a Presidential representative to the power sector with special responsibilities for bill collection. However, this position is currently vacant. The role of the Ministry of Finance (MOF) in regulatory decision making is not clear. It has an interest in the impact of the sector on the national economy and fiscal position, but it does not interfere in regulatory decisions. MIT is now reportedly getting involved, too. As the system operator, JSC Networks provides technical oversight of the sector.

Table 18: Matrix of Regulatory Responsibilities

Organization	Behavioral	Structural	Economic	Technical
President's Representative	Assessment and management of the political impact of tariff increases	Resolution of structural issues in 2002	Concerned with the impact of sector finances on the wider economy	
State Property Committee			Chief shareholder, concerned with maintaining the value of the utilities	
Ministry of Finance	Social policy, assessment of any fiscal effects of the sector		Tariff setting (information)	
State Energy Agency	Licensing, policy advice, legal services		Tariff setting, advice on policymakers	Quality of supply
Ministry of Industry and Trade, including Anti-Monopoly Committee	Pro-competition functions	Sector oversight	Formerly responsible for tariff setting	

Source: Kygyz sector officials.

10 Resolution 183 is the legal instrument that initiated the restructuring of the sector.

Sector licensing does operate speedily. The legal reasons for licensing are clear. The 1996 Kyrgyz Energy Law accords SEA the authority to issue licenses because this law decrees all energy resources to be the property of the state. It follows that any entity utilizing such resources must seek permission from the owner. However, the economic criteria for issuing or denying licenses, and therefore, the practical purpose of licensing, do not appear to be clearly defined. Assessment of the efficacy of the licensing system is therefore difficult. To sell electricity, a company must first get a license. To obtain a license, a company is required to submit cost estimates, a bank guarantee, and a budget based on tariffs set by SEA. Electricity licenses have been issued to sellers, resellers, DISCOs (who also have reselling licenses), and GENCOs. Since 1998, SEA's license division has issued 372 licenses to 266 companies. .

I. Regulatory Challenges

Some sector officials have recommended a return to the pre-2001 vertically integrated industry structure, wherein profits from cross-border sales were used to offset losses and inefficiency in other parts of the system. The bundled utility of the past concealed Kyrgyzenergo's true financial position. A more forward-looking approach would be to use the information revealed by unbundling to pinpoint areas for action. It is clear that tariffs, which cover costs and improvements in the commercial management of DISCOs should be the two highest priorities.

Creating a regulatory framework for competition among generators will be difficult because most of the Kyrgyz Republic's power currently comes from a single cascade. However, there is immense potential for additional hydro development and the country can certainly participate in a larger regional market. A necessary condition for competitive pricing of power to work will be a tolerance of tariffs based on costs. Until local tariffs are cost reflective, new generation investments will have to cater extensively to export markets.

The Kyrgyz Republic has been energetic at reforming its power sector and has achieved a far greater degree of transparency than was available before. It is now apparent that its power sector is in dire financial position and in critical need of new investment. This poses a number of challenges to the Government. Several of the most important challenges for regulators are discussed below with reference, where possible, to corresponding experiences of other CAREC countries.

(i) The strategy to avoid the need for tariff increases by reducing losses to increase the revenue available to the sector has failed. It does not address the underlying incentives and constraints driving high losses and poor collections.

As has been discovered in PRC, Mongolia, and Uzbekistan, tariff reforms are mostly a matter of political will. The relatively strong performance of the PRC in this area suggests that tariff reforms must be accompanied by a zero-tolerance approach in dealing with nonpaying customers, and by service quality improvements. Outside of the PRC, such a zero-tolerance approach to improve the performance of DISCOs does not appear to have worked particularly well with publicly held DISCOs, although Tajikistan does claim some success in this regard.

(ii) There is a lack of proper metering and/or meter reading and commercial management in the distribution system, which results in low revenue collections and large losses among DISCOs.

The examples of Azerbaijan and Kazakhstan indicate that profit motives can encourage private DISCOs to perform these tasks better. However, they also show that private DISCO management is not a panacea for their poor performance, unless it is accompanied by significant government commitment to support the DISCOs' right to disconnect non-paying customers. Moreover, as the current situation in Azerbaijan highlights, it is not enough to make sure that the DISCOs collect money. It also requires significant efforts to ensure that they pay what they owe to the transmission and generation companies.

(iii) Low levels of investment mean extremely poor service, especially in winter and in rural areas.

The problems in this regard in the Kyrgyz Republic and Tajikistan are remarkably

similar. They raise the question of whether electricity is affordable to marginal customers in the absence of subsidies. Although there have been gaps in the implementation, Tajikistan has made significant progress toward resolving this issue conceptually, both through the use of income support to less able consumers of public services, and through the use of lifeline tariffs.

(iv) Consumers have incentive to destroy meters and requiring them to pay for their meters has created a black market for stolen meters.

(v) The regulatory system is somewhat muddled, unfocused, and poorly resourced. SEA urgently needs to develop its capacity. Regulatory roles are lodged with a number of agencies.

Comparison across CAREC countries reveals that Kazakhstan, which has only one body involved in regulation (the Anti-monopoly Agency) and pursues only one objective (competition), has the most efficient power sector. The PRC situation may be similar but its experience is not comparable. Tajikistan and Uzbekistan—with the biggest number of agencies involved in sector policy and regulation—are probably the least efficient.

(vi) The incentive structure for utilities has been replaced by arbitrary revenue shares determined by SEA. These shares do not provide incentives for DISCOs to improve their performance. Furthermore, because they introduce uncertainty into the future ROR on investment, they also confuse the investment environment.

The examples of Azerbaijan and Kazakhstan demonstrate the principles laid out in Chapter II for improving the incentives embodied in revenue shares. DISCOs should be rewarded with large revenue increments for collecting more cash, and should be penalized with large revenue penalties for collecting too little. If our interpretation of the Azerbaijan experience with respect to bill collection from consumers in different tariff classes were correct, it would be important to ensure that distribution tariff margins suffice to compensate the DISCOs for collecting money from the most difficult customers. As the experience of the Kyrgyz Republic has shown, it will be important to phase the shares carefully to maintain incentives and provide government support in the initial years to make the formula sustainable.

(vii) Ad hoc privatization of individual substations can create local monopolies, closing off future reform options and degrading still further the DISCO revenue base.

(viii) The lack of a single policy agency to drive further reforms is resulting in several sector management responsibilities falling to SEA. However, aside from not having the political mandate to discharge these responsibilities, SEA also gets distracted by them from its regulatory duties.

J. Conclusions

Control and management of the Kyrgyz Republic power sector has gone from a ministry to a collection of JSCs. The power system is dominated by a single cascade and a single GENCO. The regulatory system and policy environment are both weak. Some officials aspire to move sector management toward competitive market regulation with the regulatory objective being fair competition, but currently, there is no clear road map to get there.

While the decision taken in 2001 to vertically unbundle Kyrgyzenergo was bold and far-sighted, it has failed to achieve significant improvements due to insufficient attention to the incentives for the power companies. Transparency has been achieved in terms of DISCO performance, but the picture revealed is not a good one and efforts to resolve the problems revealed have thus far been ineffectual. Even simple functions like data processing have not been improved. The system cannot function without proper metering, data collection and processing, and a good cash flow. Therefore, improved metering and commercial management of DISCOs should be the highest priorities. This requires strong commitment on the part of the Government.

The introduction of unregulated power resellers is distorting the local retail market and creating a series

of unregulated local monopolies. The most promising area for the orderly introduction of competitive activity is in distribution, but implementation of proposals to create management contracts for DISCOs have been stalled for noneconomic reasons.

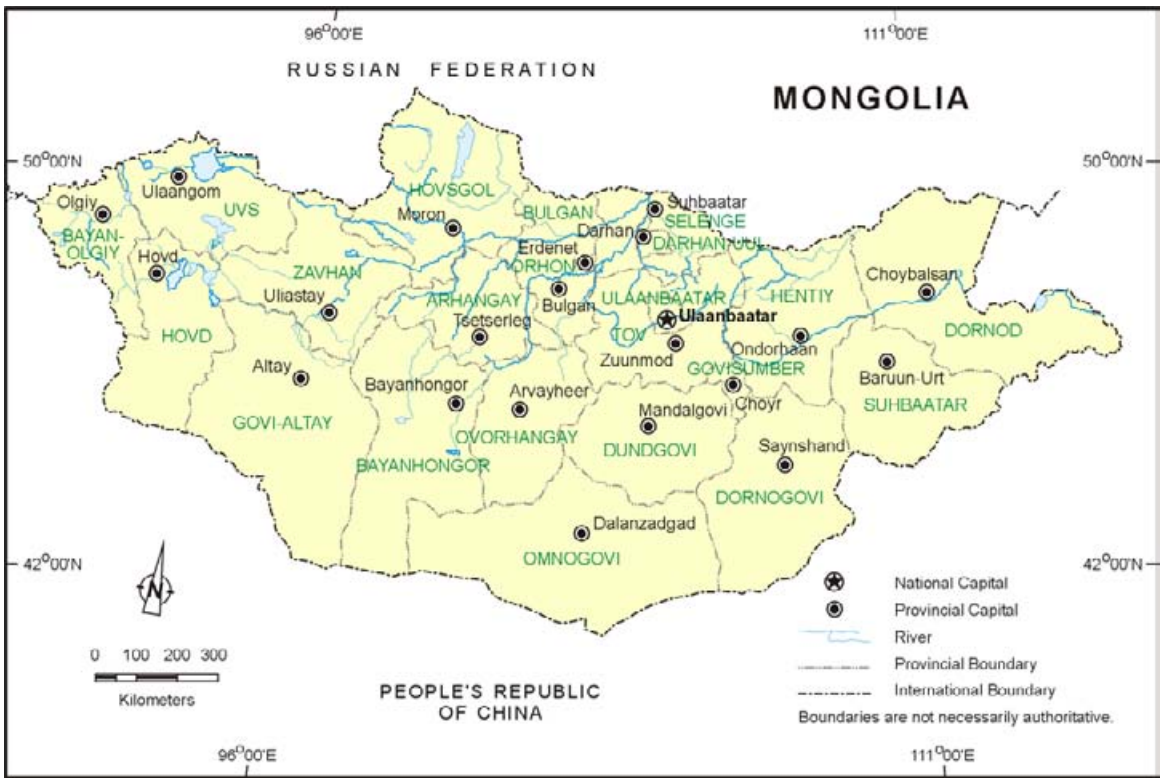
Part of the problem is that functional separation of policy, regulation, and business management is muddled and incomplete. This means that MIT, MOF, and the Office of the President, and are all becoming involved with overlapping and confused objectives. It is urgent that the responsibility for developing sector policy be clearly and unambiguously allocated to one agency. SEA is the regulatory body and it is essential that it be resourced adequately in human, financial, and economic terms to perform this task. MOF and SPC need to work out between themselves the best way to ensure that the solvency of the sector is safeguarded and that the possible impact on the national budget of a major economic and technical failure in the sector is mitigated.

Efficient investment in the sector will occur only when there is expectation for adequate ROR on investment. There have been expressions of interest from the Russian power company, UES, in investing in hydropower. However, even if such resources are developed for export, it remains to be seen whether they will contribute much to the domestic power supplies.

Regulations have kept tariffs from rising to levels that cover costs. Price controls have starved the sector of the cash flows it needs to fund future investment. Unless there are adequate cash flows entering the sector and flowing from distribution and transmission to generation, essential maintenance and refurbishment cannot be done. Without maintenance and refurbishment, the capacity of the sector to generate, transmit, and distribute energy will be impaired. Regulation cannot resolve all the sector's problems, but it can play an important part in addressing these problems and helping ensure that the sector has a better future.

VIII. Mongolia

Map 4: Mongolia



A. Overview

Mongolia is one of the most sparsely populated countries in the world. With a land area of 1.5 million km^2, it had an estimated population of 2.5 million only in 2003.[1] About 59% of the population live in the cities, particularly the capital city of Ulaanbaatar. Mongolia is a landlocked country bordered by Russia to the north and the PRC to the south.

The initial effect on Mongolia of the collapse of the Soviet Union and the loss of access to subsidized raw materials, industrial products, and consumer goods[2] was economic contraction, particularly in industry, and reverse urbanization. A modest growth rate was experienced between 1994 and 2001 until GDP growth peaked at 10.6% in 2004, due largely to the recovery of gold and copper prices, and increased production of gold.[3] This high economic growth resulted in a 7% increase in power demand as compared with a 2.9% growth rate anticipated between 2001 and 2020.[4]

Mongolia has undertaken several reforms designed to bring its electric power system closer to those of market economies. The enactment of the Energy Law in 2001 facilitated restructuring of its

1 ADB. 2004. *Regional Cooperation Strategy and Program for Central Asia Regional Economic Cooperation (CAREC) Member Countries*. Manila.

2 Widely believed to represent a loss of 30% of its GDP. In 1992 alone, GDP contracted by 9.5%.

3 ADB. 2005. *Mongolia: 2006–2008: Country Strategy Program*. Manila.

4 Energy Regulatory Authority (ERA). 2004. *Annual Report*. Ulaanbaatar.

energy sector. In the same year, the Energy Regulatory Authority (ERA) was established to serve as independent regulator in charge of licensing, tariff setting, and promotion of competition and dispute resolution among licensed energy utilities.[5]

Currently, ownership of the Mongolian power system remains with the Government. In each of the 18 government power companies, ownership is shared among the (i) State Property Committee (SPC) at 39%, (ii) Ministry of Fuel and Energy (MFE) at 41%, and (iii) MOF at 20%.

B. Generation

The electric power system of Mongolia comprises three unconnected networks. The largest and most significant is the central energy system that includes Ulaanbaatar and the industrial towns of Darkhan and Erdenet. The central system contains 710 MW of installed generating capacity (out of the country total of 806 MW) in five coal-fired CHP plants and one hydropower station. About 65% of this capacity is available any time. The most significant power plant is Power Plant No. 4, which has four generators with a total installed capacity of 540 MW. Available capacity has been increased incrementally through refurbishment of installed equipment financed through a mixture of loans from development partners and self-funding. With a peak demand of around 500 MW and a total available capacity of 464 MW[6], peak load, mostly during winter, is met by imports from Russia. Six provincial districts (*aimags*) are supplied by diesel generators, and in one case, by a hydro plant. The western energy system draws its power from Russia while the eastern network is exclusively diesel powered.

C. Transmission

The central energy system's connection to Russia is maintained by approximately 1,000 km of 220 kV transmission lines, which also connect the principal power plants to the main substations. Below these are approximately 700 km of lower voltage (110–35kV) lines to the PRC and the principal population centers in the central aimags.

The National Load Dispatch Center (NLDC) is an independent company responsible for managing the dispatch of power plants to synchronize demand for power with supply. NLDC officials report that the formation of 18 autonomous power companies has simplified the task of coordinating the system as the latter are now more accountable.

D. Distribution

About two thirds of the population have access to electricity and central heating. Distribution is handled by four electricity DISCOs: Ulaanbaatar, Darkhan-Selenge, Erdenet-Bulgan, and Baganur-South. Ulaanbaatar Distribution Company (UB DISCO)—the principal DISCO—serves the capital. It is the first government-owned DISCO targeted for full commercialization under a WB project.[7] UB DISCO handles power at 35 kV and below and serves about 145,000 customers. As can be seen from Table 19, UB DISCO delivers 1.1 million kWh of electricity annually. Its operations cover eight districts of Ulaanbaatar and 16 *soms* (a unit of local government lower than an aimag) of the central aimag. UB DISCO is licensed to undertake both distribution and retailing. It purchases power from the single buyer market (SBM) administered by the Central Regional Electricity Transmission Company (CRETC).

E. Power Losses and Cash Flow

ERA reports that the internal power use at power plants has been reduced from 22% to 19% between 2002 and 2004. It is somewhat difficult to reconcile the different estimates of losses in the wires system in Mongolia. ERA states that total losses in transmission and distribution have been reduced from 24% to 20% between 2001 and 2004. In contrast, CRETC reports transmission losses of 4%, while UB DISCO claims losing 30.6% of the power it receives. These discrepancies, notwithstanding the wide availability of disaggregated data to permit these comparisons, stand in stark contrast with the situation in Azerbaijan, Tajikistan, and Uzbekistan. Vertical unbundling can be credited with improving transparency. However,

5 See footnote 4.
6 WB estimates.

7 The project is described by Mongolian government officials as "everything but privatization".

Table 19: Electricity Sales of Ulaanbaatar Distribution Company, 1996–2004

Item	Measurement	1996	1997	1998	1999	2000	2001	2002	2003	2004
Purchased Electricity	million kWh	783.00	795.60	810.20	867.00	911.30	942.10	973.10	1022.00	1079.00
Sold Electricity	million kWh	530.90	558.80	570.10	569.20	603.90	616.50	649.10	686.00	748.40
	%	67.80	70.24	70.37	65.65	66.27	65.44	66.70	67.12	69.36
Total Loss	million kWh	252.10	236.80	240.10	297.80	307.40	325.60	323.90	336.00	330.60
	%	32.20	29.76	29.63	34.35	33.73	34.56	33.29	32.88	30.64
Technical Loss	million kWh	119.50	140.50	124.90	177.80	210.40	205.30	290.30	300.50	317.20
	%	15.26	17.66	15.42	20.51	23.09	21.79	29.83	29.40	29.40
Commercial Loss	million kWh	132.60	96.30	115.20	120.00	97.00	120.30	33.70	35.50	13.40
	%	16.93	12.10	14.22	13.84	10.64	12.77	3.46	3.47	1.24
Billing	million togrog	8203.60	17711.3	20146.3	21139.4	22734.80	27152.6	29687.70	31684.70	34565.70
Collection	million togrog	7859.80	16967.7	19089.4	20451.0	21812.80	25822.3	28458.40	30791.80	33698.00
Revenue	%	95.80	95.80	94.80	96.70	95.90	95.10	95.90	97.20	97.50
Receivables	million togrog	1578.70	2321.90	2609.90	3494.10	4637.30	5458.40	6441.40	7072.10	8011.80
	% of billing	19.20	13.10	13.00	16.50	20.40	20.10	21.70	22.30	23.20
	% of collections	20.10	13.70	13.70	17.10	21.30	21.10	22.60	23.00	23.80
Company Price	togrog	26.00	34.00	38.00	41.00	41.00	45.00	47.00	47.00	47.00
Domestic Price	togrog	16.00	28.00	32.00	35.00	35.00	45.00	47.00	47.00	47.00
Average Price	**togrog**	**15.45**	**31.69**	**35.34**	**37.63**	**37.65**	**44.04**	**45.73**	**46.19**	**46.19**

DISCO = distribution company, kWh = kilowatt-hour.
Note: Togrog is the legal currency of Mongolia.
Source: UB DISCO. 2004. *Annual Report*. Ulaanbaatar.

given that Mongolia has received significant donor support in system improvement, there remains a lot of work to be done to reduce losses.

The information on losses at UB DISCO is noteworthy (Table 19). The company reached a peak of sales relative to purchase (70.4%) in 1998, and after a period of slipping backward, it almost reached the same level again in 2004. Its best performance with respect to system losses was 29.8% in 1997, and after peaking at 34.6% in 2001, losses fell to 30.6% in 2004. Taking the numbers in Table 19 at face value, system losses appear to have been constrained mainly by the significant improvement in commercial losses, which fell from 16.9% in 1996 to 1.2% in 2004. A rather less liberal view is that commercial losses (which should result in limited goodwill toward DISCO management) are being hidden as technical losses to justify infusions of cash for investment to solve technical problems, unduly rewarding DISCO management.

According to these figures from UB DISCO, bill collection is not a significant problem as 97% of bills are collected. Overall, commercial entities pay almost 100% of the cost due for electricity, apartment users about 97%, but consumers in the ger areas pay only about 84%. The *ger*[8] areas are reportedly the most difficult places for revenue collection.

ERA also reports a reduction in the use of offsets from 40% to 15% between 2001 and 2004. This is important for ensuring that prices paid are real rather than notional. Notwithstanding any improvements in the position with respect to losses, offsets, and a healthy collection rate, receivables are still increasing as the cash collected by the system remains inadequate. Significant debt restructuring is required and some of these are being undertaken by the Government.

F. Tariffs

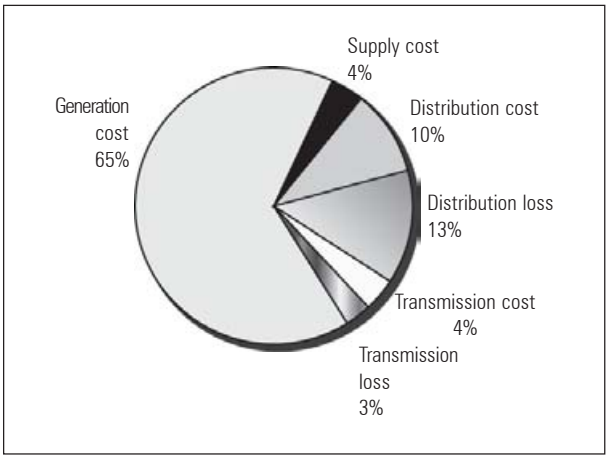
Electricity prices in Mongolia are unbundled between generation and retail tariffs as determined by ERA. Unlike other CAREC countries in which many agencies get involved in tariff determination, ERA was given full authority to set electricity and heat prices by the Law on Energy and Tariffs.

8 Traditional Mongolian tents that provide principal accommodation to many of the settlers in Ulaanbaatar.

There are two kinds of tariffs currently in place for residential and industrial/commercial customers: ordinary and time-of-use (TOU) rates (Table 20). Ordinary tariffs for residential customers range from Mongolian togrog (MNT)51–92 per kWh (or about $0.045–0.082 per kWh) depending on the region. Industrial/commercial entities and residential customers under TOU plans are charged the same rate of MNT51 per kWh for daytime consumption, but the rate for the former is higher by about MNT8 per kWh for night consumption. During peak hours, a much higher rate of MNT102 per kWh (roughly $0.091 per kWh) applies to industrial/commercial consumers.

ERA[9] shows how the MNT51 per kWh tariff charged for daytime consumption regardless of consumer type and applied to residential customers under the central energy system is determined (Figure 15). Permitted generation costs comprise about 65% of the total cost and the rest is composed of costs of transmission, distribution, supply, and losses. About 16% of this tariff structure accounts for losses in the system. It is noteworthy that allowable costs of distribution losses are almost equal to the actual cost of distribution and supply. In contrast, costs of transmission losses and cost shares are reasonable. Typical HV loss levels could easily account for 3% of costs given Mongolia's long line-lengths.

Figure 15: Electricity Tariff Structure



Source: ERA web site. Available at: http://era.energy.mn/english/?sid=5.

Table 20: Electricity Tariffs in Mongolia

A. Ordinary Rates

Region	Residential Customers		Price
	Apartment	Ger District	(MNT/kWh)
Central energy system	51	48.8	51.0
Western energy system	60	60	90.0
Eastern energy system	60	60	65.0
Dalanzadgad	60	60	90.0
Sukhbaatar aimakh	60	60	92.0

B. Time-of-Use Rates

Classification	Time Difference	Price (MNT/kWh)
Industrial and commercial entities		
Day consumption	06.00-17.00	51.0
Evening (peak) consumption	17.00-22.00	102.0
Night consumption	22.00-06.00	19.10
Residential customers		
Day consumption	06.00-21.00	51.0
Evening and night consumption	21.00-06.00	11.3

kWh = kilowatt-hour, MNT = Mongolian togrog.
Source: ERA web site. Available at: http://era.energy.mn/english/?sid=5.

9 See ERA web site. Available at: http://era.energy.mn/english/?sid=5&modules=2003_tariff_structure.

Mongolia has made significant progress in approaching cost-recovery tariff levels, although there is still room for improvement. ERA and WB[10] have proposed a tariff rationalization plan, which calls for bulk tariffs to be raised in a phased fashion to $0.036 per kWh by 2007. Currently, generation tariffs are $0.029 per kWh, exactly in line with the levels proposed by this plan.

Three groups of consumers are eligible for lifeline tariffs—pensioners' families, disabled people's families, and families with income under the poverty threshold line. The Government has been meticulous and precise in targeting assistance. Table 21 shows very lean allowances amounting to only between 30 and 75 kWh per month. This is a far more precise approach than those in the Kyrgyz Republic and Tajikistan. The lifeline tariff discounts in Mongolia are small, only about of $0.01 per kWh.

G. Industry Structure

In 2001, the Government—by virtue of the Law on Energy and Tariffs—divided the then Energy Agency into 18 autonomous companies, each with its own management, balance sheet, and an accounting system. Each company also has a board of directors drawn from the shareholders: SPC (39%), MFE (41%), and MOF (20%). In practice, membership in the board of these companies overlaps considerably.

The Mongolian SBM (Figure 16) was formed to coordinate commercial relations among the autonomous generation, transmission, and distribution companies established in 2001. Under the SBM model which became operational in 2002, CRETC—the single buyer transmission company—buys electricity from five GENCOs and sells it to four DISCOs for distribution and supply to end-users.[11] SBM is a market in name only because all prices are still dictated by ERA. Unlike most SBMs, there is also currently no scope for economic dispatch. Dispatch is based principally on availability, location, and demand for co-generated steam for heating and industrial use.

In practice, this system is probably better described as a financial management scheme rather than an SBM. Electricity is released by the dispatch center based within the transmission company. Cash from consumers are collected by DISCOs and sent directly to a zero-balance account. Everyday, revenue is transferred from the zero-balance to the general revenue account. Payments from the latter are made strictly in accordance with cash flow shares determined by ERA and approved by 70% of licensees in the market in the following order of priority: expenses, imports, generation, transmission, and distribution. These cash shares depend upon the amount owed to each company at regulated prices, inter-company arrears, and cash collections. ERA reports that since SBM was introduced, revenue to power plants as a percentage of power purchased has increased from 75% to 80%.

Table 21: Lifeline Tariffs for Low-Income People

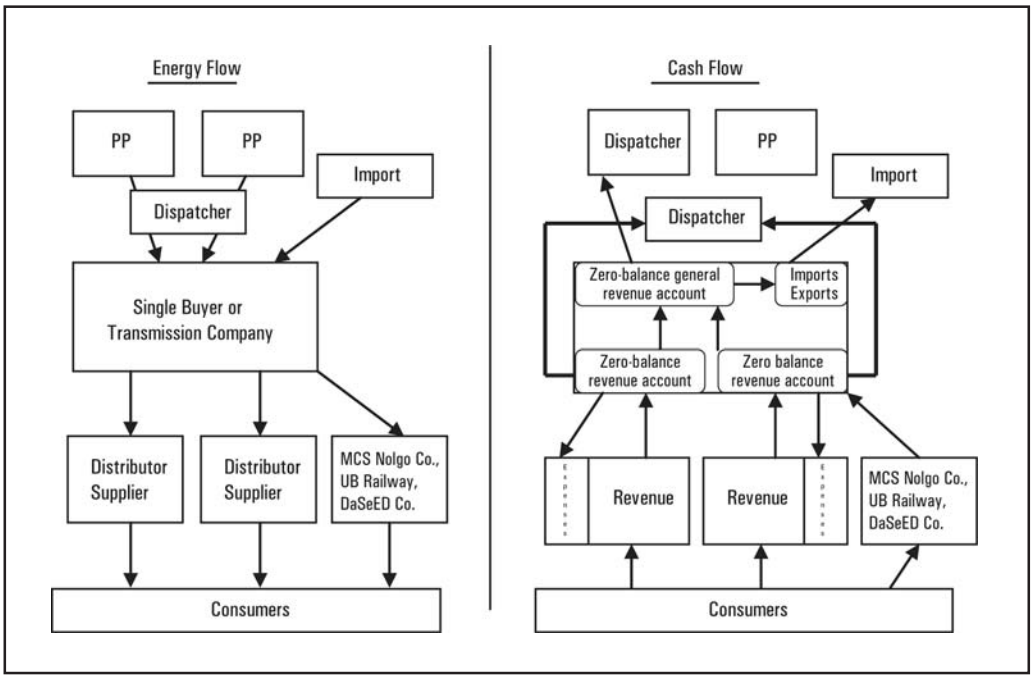
	Apartment		Ger District	
	Monthly Consumption (kWh)	Tariff without VAT (Togrog/kWh)	Monthly Consumption (kWh)	Tariff without VAT (Togrog/kWh)
Ulaanbaatar	up to 75	41	Up to 60	39.0
City	6 and up	51	61 and up	48.8
Darkhan	Up to 50	41	Up to 40	39.0
ErdenetBaganuur	51 and over	51	41 and up	48.8
Others	Up to 40	41	Up to 30	39.0
	41 and up	51	31 and up	48.8

kWh = kilowatt-hour, VAT = value added tax.
Source: ERA. 2004. *Annual Report.* Ulaanbaatar.

10 Presentation by ERA and WB. January 2004. *Mongolia – Taking Stock and Charting a Way Forward.* Ulaanbaatar.

11 See footnote 9.

Figure 16: Single Buyer Market of Mongolia



PP = power producer.
Source: ERA. 2003. *Annual Report.* Ulaanbaatar.

H. Regulatory Objectives and Approaches

ERA is probably the most independent regulator in the CAREC region, other than Kazakhstan's. It is governed by a regulatory board whose members are appointed by the Prime Minister, although it reports no government interference in its operations. ERA also enjoys some financial freedom because it is allowed by law to charge licensing and regulatory fees.

ERA's long-term regulatory objectives are to introduce competition in generation and develop a wholesale electricity market, promote energy efficiency through appropriate rules and incentives, and establish an environment that attracts private investment in new generation capacity and new transmission lines. The approach to achieving this involves raising tariffs to cost-recovery levels while attempting to solve the sector's cash flow problems. Social protection through lifeline tariffs is viewed as necessary to permit needed tariff increases.

An interim goal is for all DISCOs and GENCOs to be privatized, the latter being the first candidates for sale. It is also proposed to transform SBM to allow DISCOs and large consumers to purchase electricity from generators and pay the corresponding charge to the transmission company. The major concern about taking this step is that the benefits that have been gained from SBM might be lost.

I. Regulatory Challenges

Issues. In discussions with numerous sector regulators, officials, managers, and energy professionals, a number of issues were raised to which ERA must help develop responses.

(i) DISCOs lack sufficient incentive to reduce commercial losses due to the way cash is distributed.

(ii) Tariffs do not yet recover costs.

(iii) The sector is currently highly indebted. The debts are attributed to individual enterprises, although they do not necessarily appear on their books.

(iv) Dispatch is currently not based on any clear rules or principles. Estimated marginal costs for heat and electricity from CHPs are

currently based on a former Soviet rule of thumb rather than on economic conditions.

(v) The rules for licensing of private GENCOs are not clear. This inhibits the development of new generators located near the coal mines.

(vi) The independent transmission company is managing SBM and getting confused with its role. Some of its officials would like to bypass the DISCOs and sell power directly to large consumers. Its core business is transporting electricity and it should not be in the business of selling power, collecting bills, etc. Such mission creep could obstruct proper development of a power market later on.

(vii) The possibility of a spot market and unbundling the DISCO wires and energy sales are being explored, and in concept, are widely supported as the next steps to electricity market reform. However, it is not clear how a spot market can operate even with full unbundling given the current small market and dominance of the highly concentrated CHP system in Mongolia.

Approaches. A number of possible approaches have been suggested as possible solutions to many of the problems identified above. Mongolia has been getting extensive advice from various international development partners on how to fix these problems. What follows are some feedback on how to resolve the first three of these based on experiences in other CAREC countries.

(i) Under the SBM, DISCOS are currently at the end of the revenue chain with respect to revenue collections. This is correct in principle because DISCOs have the greatest scope to increase revenue through loss reduction. Nevertheless, the Mongolian system for determining cash shares appears to be blunting the DISCOs's incentives to collect cash as only a small percentage of any increase in revenues collected from consumers is likely to be given to the DISCOs. The contrasting experiences of Azerbaijan and the Kyrgyz Republic with respect to the distribution of cash shares highlights the importance of using a formula that permits companies to know with a high degree of certainty that performance improvement will result in actual increase in the amount of cash they receive.

If the high loss levels are due to problems with meter reading and billing system, the possibility of using prepaid metering now quite common in the PRC is worth considering. Prepaid metering consolidates the power company's costs of meter reading, billing, and collection, and replaces meter reading with less frequent audits. Since prepaid telephone cards are now well-established in Mongolia, the principle may easily be adapted to the power sector. However, there is no publicly available evidence on who actually receives this "lost" electricity. It is also vital that proper incentives to reduce losses be introduced. Privatization of at least some DISCO functions should help if it is accompanied by the right contractual conditions and government commitment.

(ii) Raising tariffs to cost-recovery levels is not easy, and Mongolia is making progress toward this goal. Experiences in the PRC and Kazakhstan show that political commitment to this goal is vital. They also can be contrasted with less successful experiences in Kyrgyz Republic, Tajikistan, and Uzbekistan to show that raising tariffs is not the only requirement for improving cash flow within the power sector. Loss reduction can also significantly reduce the costs of the sector.

(iii) The debts of power sector companies should form part of their financial reporting. It is necessary to have a comprehensive solution to resolving this indebtedness problem because debt service raises the average cost of production. As the figures presented in Section E demonstrate, loss reduction will be crucial to solving the financial problems of Mongolia's power sector. Regardless of which reported achievement in loss reduction one considers, overall progress in realizing this goal remains slow or by far anemic.

J. Conclusions

Functional unbundling of the Mongolian electricity sector began in the mid-1990s. From 1994, policy formulation was placed with the Ministry of Infrastructure, financial oversight was lodged with MOF, and ownership was with SPC. Regulation sat uneasily between the ministry and various anti-monopoly bodies for some time, until the creation of ERA in 2001.

Business management was initially handled by a ministry until it became a vertically integrated enterprise. From 1996, this electricity enterprise became a state agency reporting on business matters to MOF and SPC. Since 2001, it has been reshaped as a series of vertically unbundled companies. Sector policy leadership is now with MFE. In addition, SPC has played an active policy role in protecting and enhancing the Government's investment in the sector.

Probably more than in any other CAREC country, transparency is used effectively as a regulatory tool in Mongolia. Performance results of each company are published. Tariffs are likewise made public and ERA is now required to hold hearings prior to setting tariffs. UB DISCO has published a comprehensive report, setting out a large amount of statistical information relating to its financial and operational performance. In addition, the energy, payment, and revenue balances of the SBM are published monthly, so that each party can check whether it is getting its fair share in accordance with the agreed revenue shares. The simple act of making it clear to managers that the results of their work will be published is a great incentive for improvement. However, it needs to be accompanied by further incentives to leverage improvements in DISCO performance. In particular, ERA will need to clarify the issue of whether losses are technical or commercial and where they are coming from, which will require detailed technical studies.

Notwithstanding the fact that the directors of most of the power companies are government officials from MFE, MOF, and SPC who also sit on the board of other companies, they correct serve the best interests of the company when acting as its directors. This is far from a perfect system and there is always the danger of conflicts of interest altering commercial decisions.

Mongolia is increasingly becoming an open society. The transparency it has shown in publishing energy sector performance and the successes and failures of its utilities has reached a level worthy of consideration by other CAREC countries. Likewise, it is noteworthy that despite five changes of government since 1990, Mongolia has managed to pursue reforming its energy sector. This study acknowledges that some significant challenges remain to be addressed, but by any standard, Mongolia has made a good start in addressing the problems of its energy sector.

IX. Tajikistan

Map 5: Tajikistan

A. Overview

Tajikistan has an estimated population of 6.73 million. About 562,000 people or 8% of the population live in the capital city of Dushanbe.[1] The country's terrain is mostly mountainous, extending to the foothills of the Himalayas. Its landlocked area is bordered by the Kyrgyz Republic to the north, Uzbekistan to the west and north, Afghanistan to the south, and the PRC to the east.[2]

Tajikistan's economy is still recovering from post-Soviet economic collapse and civil wars in 1997. The Tursonzoda (TADAZ) aluminium smelter at the west of Dushanbe dominates Tajikistan's non-agricultural economy. It is one of the largest smelters in the world with a capacity exceeding 500,000 tons per year,[3] although by 2003, production climbed to only 320,000 tons per year from its low of 189,000 tons in 1997. Between 1991 and 2003, aluminium production's contribution to the country's industrial output rose from 8.5% to approximately 40% annually. This increase reflected the collapse of the rest of Tajikistan's industrial sector (particularly, manufacturing activities) following the loss of a captive market in the former Soviet Union. Aluminium exports account for 95% of aluminium production and 60% of export revenues despite the need to import aluminium oxide

1 EIU. 2005. *Country Profile: Tajikistan*. Available at: http://portal.eiu.com/index.

2 US Department of Energy. [n.d.]. *An Energy Overview of the Republic of Tajikistan*. Available at: http://www.fe.doe.gov/international Russia_and_Central_Asia.

3 See footnote 1.

(bauxite) from Russia. Aluminium smelting consumes over 40% of the country's annual power output. TADAZ is also a major strain in the electricity sector, placing massive demand on the system in winter when shortages are most acute, and displaying less than perfect discipline in paying its bills.

Tajikistan is highly dependent on hydroelectricity. Its major river system is the Amudarya watershed. Its major streams include the Panj River in the south, Gunt and Bartango rivers in the east, and Kafirnigan and Vakhsh rivers in the central and western part of the country. In terms of power production potential, the Vakhsh River is the most important.[4]

Tajikistan's electricity system is split into a northern grid in the Khudjand region and a southern grid focused on Dushanbe (both of which are linked to Uzbekistan), and an independent eastern grid in the Pamir region. Its transmission system forms part of the CAPS.

B. Generation

Tajikistan's power sector is managed by Barki Tojik—a vertically integrated utility owned by the Government. Generation capacity consists of just over 4,000 MW of hydro capacity, all but 126 MW of which forms part of the Vakhsh River cascade and a 300 MW CHP plant in Dushanbe. The Vakhsh River has a total installed capacity of about 3,800 MW, producing 4 million MWh annually. The output of the Dushanbe CHP plant is severely limited due to fuel shortages, with gas supplies from Uzbekistan being subject to frequent interruptions. Limited fuel supplies are leading consumers to turn increasingly to electricity, putting increased load on the system.

The Nurek Hydro Station is the largest power plant with an installed capacity of 3,000 MW. It is at the head of the Vakhsh cascade. Its reservoir is capable of seasonal regulation of the flow of water in the Vakhsh River. Tajikistan has the potential to produce more than 300 million MWh of electricity per year, but currently produces only 16.5 million MWh.[5] The main constraint on the Tajik generation system is the lack of stored water for generation during winter. Due to this constraint, load shedding is frequent. The complete list of existing hydroelectric generating plants in Tajikistan is found in Table 22.

Table 22: Hydroelectric Generating Plants

Generator	Location (River)	Capacity (MW)
Nurek	Vakhsh	3,015.0
Baipaza	Vakhsh	600.0
Golovnaya	Vakhsh	210.0
Kayrak-Kumskaya	(non-operational)	134.0
Kairakkum	Syrdarya	126.0
Varvarinskaya	(non-operational)	28.0
Perepadnaya	Vakhsh	24.0
Tsentralnaya Tajik	(non-operational)	18.0
Centralnayay	Vakhsh	15.0
Varzob 2	Varzob	14.4
Pamir I	Gunt	14.0
Khorog	Gunt	10.0
Varzob 1	Varzob	7.5
Varzob 3	Varzob	3.5

MW = megawatt.
Source: Barki Tajik and ADB records.

The north-south grid system in Tajikistan results in relatively significant amounts of electricity being both imported and exported. Traditionally, both imports and exports have been with Uzbekistan. Power trade with the Kyrgyz Republic is expected to increase following the building of the transmission line in the north. Imports fell by 50% between 1992 and 2000 and exports decreased by 33% between 1992 and 1997, although the latter increased subsequently. Recently, power exports to Russia via Kazakhstan took place for the first time in nearly 10 years.

A possible source of much needed investment in the Tajik system is the renewed interest by foreign investors both in power generation and aluminium smelting. Russia views Central Asia, particularly Tajikistan, as a potential source of inexpensive electricity to balance its own system and supply electricity exports to Europe. It also sees prospects for additional aluminium smelting in Tajikistan. Investors are considering to complete the construction of Sangtuda I and Rogun dams initiated during the Soviet era. Rogun is at the head of the Vakhsh cascade while Sangtuda I and II are downstream from Nurek.

Construction of Roghun and Sangtuda ceased following the collapse of the Soviet Union. The construction of Rogun[6] was suspended partly due to

4 See footnote 2.
5 See footnote 2.

6 At 335 meters high, it will be the tallest dam in the world

concerns about the relatively high seismic activity in the area, which creates engineering as well as safety issues. The Government is conducting talks with the governments of Russia and Iran, seeking finance to resume these projects. Sangtuda I and II would provide electricity exports and Rogun could supply electricity to a proposed new Russian owned aluminium smelter in Tajikistan. The Government considers Sangtuda 2 to be its first priority and is willing to commit state resources toward its completion. Table 23 contains a list of major proposed projects.

Table 23: Possible Sources of Additional Generation

Generator	Status	Location (River)	Capacity (MW)
Dashtijum	Planned	Panj	4,000
Rogun	Partly constructed	Vakhsh	3,600
Shurob	Planned	Vakhsh	750
Sangtuda I	Partly constructed	Vakhsh	670
Kaphtarguzar	Planned	Obikhingou	650
Sangtuda II	Partly constructed	Vakhsh	220
TOTAL			10,524

MW = megawatt.
Source: ADB records.

The size of these projects and the investments each requires are very large relative to the Tajikistan economy. Rogun at 3,600 MW, Sangtuda 1 at 670 MW, and Sangtuda 2 at 220 MW are all large dams. The estimated costs are $1.2 billion, $500 million, and $180 million, respectively. Furthermore, these projects will take several years to complete. And even if they all become commercially successful, there is no guarantee that the owners will be prepared to supply power to the Tajik domestic market unless prices rise to roughly the levels of countries that investors have targeted as markets for electricity exports.

C. Transmission

The Tajikistan transmission system is part of the CAPS and consists of two voltage levels: 500 kV and 220 kV. There are two 500 kV lines running from the Nurek Power Station to the 500/220 kV Regar Substation, and a connection from there to the 500 kV system in Uzbekistan. There are two 500 kV substations and about 300 km of 500 kV lines. The 220 kV system consists of 30 substations and 1,200 km of lines. In addition, there are approximately 2,800 km of 110 kV lines in operation. Tajikistan is also connected with Afghanistan via a 110 kV transmission line operated at 35 kV.

The country's northern and southern networks are not directly interconnected. Bulk transfer of energy between north and south is achieved by power exchange using a 500 kV transmission line through Uzbek territory. Given the Tajik view that Uzbekistan extracts economic rents from this situation, one of the major priorities of Barki Tojik has been to construct a 500 kV line to connect these. This proposal is widely regarded as prohibitively expensive given Tajikistan's economic position, although it might be economically justifiable as part of a wider regional investment program if Uzbekistan cooperation could not be secured.

Power stations and major 500 kV and 220 kV substations in Tajikistan have electricity meters on their outgoing (supplying) feeders. However, these electricity meters—having existed since the Soviet era—are old and inaccurate. Some of them are not even in working condition due to a lack of spare parts and funds for repair or rehabilitation. Substations between the transmission and distribution systems and within the distribution system do not have adequate electricity meters on their high- and medium-voltage supplying feeders. Projects being financed by international development partners may go some way to resolving the problem insofar as it is a technical and not a management problem (as so much of the metering troubles in the region appear to be).

D. Distribution

There are three DISCOs in Tajikistan, one for each existing grid: North, South, and Pamir (eastern region). The North and South DISCOs are managed by Barki Tojik. The sparsely populated Pamir region is supplied by an independent vertically integrated system run with assistance from the Government of Switzerland and the Aga Khan Foundation. Billing and collection responsibilities in each of the Barki Tojik subsidiaries have been turned over to several government-owned electricity sales companies (ESCs), each covering an exclusive area. There are about 1 million connections served—mostly by the North and South companies—and roughly 150,000 of them do not have meters. Service quality is very poor with many parts of the country on restricted and

interrupted service, particularly during winter. For the most part, this unreliability is due to winter load shedding because the largest single customer (TADAZ) operates on a must-run basis with no economic incentives to shift its energy demand from winter to summer, and there is inadequate water storage to meet total demand for power. Load shedding falls disproportionately on the poorest consumers.

Barki Tojik reports that it has started to suspend electricity supply to nonpaying private customers, which has somewhat contributed to the improvement in collections from 75% in 2002 to 86% to date. Nevertheless, the study team was informed by some customers that suspensions of service were still somewhat chaotic, with suspension often carried out on the wrong customers.

E. Power Losses and Cash Flow

Despite measures undertaken to minimize subsidies and collect payment arrears, the fiscal subsidy to the energy sector was estimated at 7% of GDP in 2002. According to the International Monetary Fund,[7] customers owed Barki Tojik about $43 million in arrears as of October 2003. Table 24 shows that in 2002, 22% of all electricity supplied by generators was not reflected in bills, 54% did not result in payment, and only 21% resulted in cash payment.[8] Recent attempts to improve collection through the establishment of ESCs appear to have improved the collection situation, but there is no evidence that nondelivery and non-billing have been reduced.

Tajikistan is undertaking an end-user metering drive. Rates for un-metered customers have been raised to provide incentives to switch to metered service. Unfortunately, some consumers have reported that they are being required to buy their own meters, creating the opportunity for a black market in second-hand meters and other opportunities for rent seeking.[9] For consumers who receive better service and use meters, particularly in Dushanbe, the billing and collection system still leaves a lot of room for improvement. At the core of the system are controlling officers whose job is to read the meters and record the electricity consumed. A computerized system was installed in the Dushanbe ESC with ADB assistance. Controlling officers were trained and each is given a small financial incentive to collect money—a bonus of Tajikistan *somoni* (TJS)40 or $13 per month—if collections exceeded a modest target.

Table 24: Losses, Billing, and Collections, 2002

System Losses (GWh)	3,028
Total Number of Consumers (million)	About 1.0
Undelivered Power (as % of net supply)	11.0
Unbilled Power (as a % of delivered power)	12.0
Non-collection (as a % of billings)	30.0[a]
Noncash Payment (%)	60.0

GWh = gigawatt-hour.
[a] Current non-collection rates provided by Barki Tojik are 14%.
Source: WB. 2004. *Regional Electricity Export Potential Study.* Washington, DC.

Although Dushanbe's new billing system has potential, it is still not fully functional and some consumers prefer to operate under the old system. The wages paid to controlling officers remain low. There are widespread reports that they supplement salaries by either collecting money from consumers and not passing it on, or by underreporting consumption for a bribe. Staff turnover is high and there are few incentives for everyone to keep the system running efficiently. Unlike the situation in Azerbaijan and Kazakhstan, there is no commercial incentive to motivate management to record consumption properly and account for the money collected.

F. Tariffs

Generation in Tajikistan is constrained during winter by lack of water. To make up for the cost of this constraint, residential and commercial consumers have been placed on a seasonal tariff, which is 50% lower from May to September. Compared with an LRMC of approximately $2.10,[10] winter power prices range from $1.66 per kWh for commercial and agricultural entities, $0.89 per kWh for industry, and $0.56 per kWh for subsidized municipal and pumping stations. However, TADAZ—the largest single user of electricity in the country—utilizes much of the winter

7 See footnote 1.
8 According to these figures 89% of generated power was sold, 88% of that was billed, 70% of billed was collected, and 40% of collection was cash. Therefore, there was 0.89*0.88*0.7*0.4 = 0.22 collected in cash.
9 Barki Tojik disputes this claim and this study could not resolve the discrepancy.
10 WB estimate.

load and has uninterruptible supply, but does not pay its bills regularly. If TADAZ will be made to pay its bills regularly and pay higher winter tariffs, it would have an economic incentive to adjust its seasonal production schedules. This would take considerable load off the grid during winter.

Tariffs are ostensibly calculated to permit an ROR on capital already invested. Because capital already invested is used in the calculation rather than the capital to be invested at the margin, the tariff captures an average cost and not a measure of LRMC. Thus, it will not price capacity constraints. This may partially explain the discrepancy between the tariff estimated by WB and the low tariffs currently being used.

Table 25 outlines the situation with respect to tariff setting. The lead regulatory agency is the Agency on Antimonopoly Policy and Entrepreneurship (AAMP). It acts according to the provisions of the Law on Natural Monopolies in reviewing tariff levels proposed by Barki Tojik. AAMP also operates based on an agreement between ADB and the Government that tariff levels and collections, especially from TADAZ, must rise to a level that enables repayment of loans. Rates were increased by 25–30 % in 2002 and by 60% in 2003. Only very recently was the large number of consumers exempted from paying for electricity drastically reduced. WB has recommended tariff increases of 6% each quarter over a 5-year period (or raising prices by 220% over 5 years). At the same time,

Table 25: Analysis of Tariffs

	Potentially Competitive		Noncompetitive	
	Generation	Retail	Transmission	Distribution
Regulatory Authority	Agency on Antimonopoly Policy and Entrepreneurship	Agency on Antimonopoly Policy and Entrepreneurship	—	—
Tariff Levels per kWh(2005)	–	Industry and similar consumers: $ 0.0089 Agriculture: $0.0166 Pumps: $0.0056 (May–September: $0.0028) Non-budget/financed consumers: $0.0166 Budget/financed: $0.0056 (May–September: $0.0028 Municipal: $0.0056 Municipal Transport: $0.0017	—	—
Customer Classes/ Voltage	—	Industrial, agricultural, budget, pumps, utilities hot water, households, etc.	—	—
Period of Adjustment	Irregular	Up to 6 times a year	Irregular	—
Basis of Adjustment	—	Aiming at full cost recovery	—	—
Regional	None	Pamir region operates separately	None	None
Seasonal	None	Households and commercial, but not TADAZ	None	None
Time of Day	None	None	None	None
Lifeline	None	Applicable to residential customers. Increased from 150 to 250 kWh Up to 250 kV/h: $0.0053 May–September: $0.0026 Over 250 kV/h: $0.009 May–September: $0.0045	None	None
CapacityCharges	None	None	None	None

TADAZ = Tursonzoda aluminium smelter.

it is planned to provide and install electric and gas meters in Dushanbe and expand the billing system to include gas. These conditions have been an important driver of recent tariff adjustments.

While AAMP is concerned with bill collections, only information on costs and expenditures, benchmark, acceptable losses (not actual losses), and the power generated is used during the decision-making process. Changes in actual system losses do not factor into tariff calculations. This is a good principle because passing the cost of excessive technical and commercial losses onto the paying customers, in effect, allows an inefficient bill collector off the hook and unjustly penalizes customers who are fulfilling their obligations.

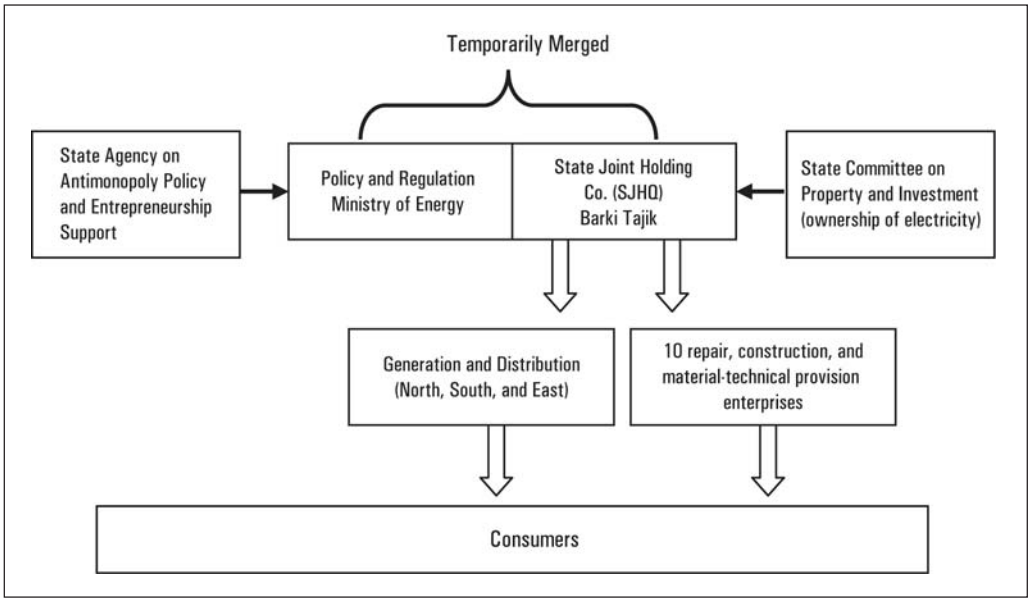
Un-metered customers are billed on the basis of the number of rooms in their homes. The rates used to be lower than the average amount billed to a comparable consumer with meter. As discussed in Section E, it is claimed that a recent regulatory decision to significantly raise the rates for un-metered customers has already succeeded in motivating many of them to shift to metered rates.

The Government provides budgetary support to poor households to help them cover their utility bills. Money is allocated to poor consumers through a *rayon* (district) committee. If a consumer meets the criteria, it receives cash equivalent to a maximum value of 150 kWh. The money can be paid in cash or directly to Barki Tojik. If the consumer gets the money but does not pay his bill within 6 months, the subsidy is cut off. Furthermore, if a household is in arrears for over 6 months, the money is transferred directly to the owed utility. The annual cost of this program is TJS27 million (or about $9 million). There are, however, some indications that this money is not being fully disbursed to the recipients.

G. Industry Structure

The Government owns Barki Tojik and the ESCs. Proposals to introduce both competition and private sector participation would have to address the unique challenges posed by the predominance of hydropower from a single cascade. Ownership and sector organization have taken a peculiar turn since January 2004 when Barki Tojik was effectively merged with the Ministry of Energy (MOE). These changes are depicted in Figure 17. The Government has explained that this is a temporary measure necessary to make the best use of available resources (e.g., the promotion of the general manager of Barki Tojik as minister of energy) and that it needs to take full control of Barki Tojik in order to restructure the company.

Figure 17: Institutional Structure of the Power Sector



Nevertheless, the move appears contrary to the regional trend toward functional separation of policy, regulation, business management, and ownership. It is a move away from transparency because it combines business management and policy, and reduces information flow. This, in turn, makes economic pricing, some investment decisions, and loss reduction more difficult. According to Tajik officials, a paper suggesting a return to separate institutions has been prepared and circulated.

The Strategic Plan for restructuring natural monopolies provides that restructuring must be completed by 2007. Restructuring to improve transparency and efficiency began as an initiative of MOE and had the support of Tajikistan's development partners. MOE will be the ongoing strategy development body. The Government and the WB are currently discussing a proposal to split Barki Tojik into one GENCO, one transmission company, and three DISCOs—North, South, and Central. Under this plan, DISCOs will be responsible for distribution and retail of both electricity and gas. The Northern DISCO will remain an integrated company dealing with generation, transmission, and distribution as there is no interconnection between the north grid and the rest of the country. Barki Tojik indicates that this restructuring will be accomplished before the end of 2005.

It is a common perception in Tajikistan that when resources are limited, functional separation of policy, regulation, business management, and ownership will simply place more demand on scarce human resources. This is true if every organization has to have its own legal, economic, accounting, and technical expertise. However, instead of being an obstacle to restructuring, outsourcing these tasks separately to independent contractors (maybe the former staff of the utility set up as an independent consulting firm) could actually ensure that the limited pool of talent can be used more widely. Nevertheless, vertical unbundling is widely regarded to result in some loss of scale economies, especially in small systems.

The only exception to the full state ownership of the system is the concession to run the autonomous Pamir Company located in the Pamir mountains in the southeast of Tajikistan. The concession was initiated by the commercial arm of Aga Khan Foundation and agreed at a high level because there was no other means to address the deterioration of service in the region. The tariff considerably reduces the exchange rate risk for the investors because it is stated in US dollar. As a further protection to the financial viability of the project, a budget account and an escrow account are maintained separately. The Government replenishes the account, and if government agencies do not pay their bills, the escrow account makes up the difference.

H. Regulatory Objectives and Approaches

The Law on Energy and the Law on Natural Monopolies are the principal legal instruments governing the economic regulation of the electricity sector in Tajikistan. Several agencies are interested in electricity regulation, but essentially, only three are of significance. Table 26 shows the respective responsibilities of different government agencies. Barki Tojik is responsible for preparing applications for tariff changes. These applications are submitted to AAMP, which uses information provided by MOF to make recommendations on appropriate tariff rates. The MOF recommendations are then submitted for approval by the President because tariff increases are highly politically sensitive.

Table 26 also shows that the sector remains a purely government-run enterprise. All the parties involved in the regulation and operation of the sector are government agencies. All are funded through the state budget and the only non-budget incomes are energy sales and inspection fees.

Tajik officials have recently studied the experience of Kazakhstan and the Kyrgyz Republic and the regulatory and structural reforms they have implemented. They clearly wish to proceed in a similar path, but in some instances, there is a lack of clear understanding of the practices in the neighboring countries. For example, some officials identified the need to pass retail price differentials through to generators as a barrier to vertical unbundling. However, as explained in Chapter III, there is a distinction between pricing in the wholesale market (with either market-determined or regulated tariffs) and the retail market (with tariffs that reflect customers' load characteristics or mandated cross-subsidies). Electricity retailers have to manage the tariffs they offer to customers to ensure collection of revenues sufficient to pay for power purchased in the wholesale market. Provided they can cover the cost of their purchases, there is no need to complicate the

Table 26: Matrix of Regulatory Objectives and Responsibilities

Organization	Objective	Behavioural (non-tariff)	Responsibilities		
			Structural	Economic (tariff)	Technical
Office of the President	Good functioning of the sector including financial solvency		Re-bundling of Barki Tojik	Consultative	
Ministry of Finance	Minimize the cost of the energy sector to the national budget, maximize economic development			Input to tariff setting overall regulation of the finance sector	
Agency on Antimonopoly Policy	Defend consumers, avoid expenditure by producers, ensure production is profitable	Analysis of applications for tariffs, power to make recommendation to the President		Economic analysis and information gathering	
EnergerNadzor (inspection agency)	Safe use of electricity, compliance with regulations				Technical supervision and enforcement of bill payment
Barki Tojik-Ministry of Energy	Efficient sector structure, self-sustaining organizations and development	Supervision of subsidiaries	Promoted the policy of splitting generation/ transmission (bundled) and distribution	Tariff applications for subsidiaries	Technical expertise to advise on and implement standards

Source: Tajik government officials and representatives.

wholesale market by passing the price variations found at the retail level back to generators.

I. Regulatory Challenges

Issues. Tajikistan faces a number of critical structural and regulatory issues in bringing its electricity sector into an effective operational framework. In most CAREC countries, government officials and regulators willingly identified regulatory issues that require resolution. In Tajikistan, no similar openness was shown, but the following issues on its electricity sector were identified in this study:

(i) The move to attach Barki Tojik to MOE has been explained as a response on the need to give effective support to the new minister of energy (formerly the chief executive of Barki Tojik) who, in turn, has the political support to ensure that reforms are carried out. This setup is likely to confuse commercial and policy objectives and result in neither being properly served unless the new arrangement is followed by quick reforms.

(ii) TADAZ—the aluminium smelting entity that consumes about 40% of the country's annual power output—does not pay its bills regularly; neither does it pay a sufficiently high winter tariff to encourage production in periods when the power supply is less constrained.[11]

(iii) MOE reports that GENCOs have meters, but effective meters are not installed in the DISCOs or in substations between high- and low-voltage lines. Poor metering of major electrical energy flows reduces the transparency of system operations. This lack of transparency is intimately tied to poor commercial performance.

(iv) Vertical integration coupled with poor metering and financial reporting diminishes managerial incentives to operate efficiently. The regulatory and other benefits of transparency are also foregone.

11 TADAZ now enjoys a summer discount. The amount is $0.05/kWh in summer and $0.094/kWh in winter. While the seasonal variation in tariffs does provide a useful signal for scheduling, the low tariff level in fact means that TADAZ still does not have adequate incentives to reduce winter load.

(v) There is a massive cash-flow shortfall in the electricity sector, which cripples current operations.

(vi) The sector's inability to invest in urgent rehabilitation and service extension leads to extremely poor service—especially in winter and in rural areas—with serious fiscal and nonfiscal consequences for economic development.

(vii) Currently, there are about 1 million consumers and roughly 150,000 of them do not have meters. Effective metering, billing, and collection are the key to improving revenue flows, but consumers have been reported to destroy and/or damage meters to reduce their payment liabilities. It is also reported that meters are stolen and are available in the black market.

(viii) The assistance (250 kWh) delivered monthly as a lifeline tariff is too large and extends to the majority of middle class consumers. Generalized tariff concessions obscure the marginal cost of power, distort behavior, and lead to wasted energy. Lifeline tariff concessions that provide a small amount of power sufficient to meet the needs of the very poor are appropriate. Tajikistan muddles these two approaches.

Approaches. There are practical examples of possible solutions to each of these problems that have been tried by other CAREC countries. Suggested approaches to the respective issues identified above include the following.

(i) A degree of separation between policy and commercial roles has been achieved in Azerbaijan, PRC, Kazakhstan, Kyrgyz Republic, and Mongolia. Although government interference in the operation of power companies continues in most of these countries—exacerbated by extensive state ownership—the importance of permitting operational autonomy has been recognized. As this study documents, the level of operational autonomy is generally reflected in the commercial performance of the utilities.

(ii) The lack of a higher winter tariff for TADAZ—reflective of its cost to the power system in winter—is a major regulatory failure that is simple to correct, at least in principle. TADAZ's nonpayment of bills is mainly the concern of the Government. As the primary shareholder of both TADAZ and Barki Tojik, the Government must take responsibility for the commercial behaviour of the former and the financial viability of the latter. Kazakhstan appears to have had a great deal of success in getting government agencies pay their bills, mostly by granting utilities the right to uncompromised action if they fail to pay. As withholding power supply to an aluminium smelter is not possible, the Government will simply have to intervene to restore financial discipline.

(iii) Bulk metering in Azerbaijan, PRC, Kazakhstan, and Mongolia appears to be doing well. The meters in the Kyrgyz Republic may be technically of lower quality than the ideal, but genuine functional unbundling means that they are read religiously. Unsurprisingly, these countries also present the clearest picture of where losses are occurring.

(iv) ADB and WB promote the idea of vertical unbundling in the southern network and leaving generation and transmission bundled in the smaller northern network. The argument for unbundling is that it increases transparency and consequently improves the ability to manage resources efficiently. Given the limited size of Tajikistan's power systems and the limited opportunities for competition in generation on the Vakhsh cascade, a legitimate debate on whether it is worthwhile to separate generation from transmission in the south has emerged. This separation may be helpful if Tajikistan hopes to offer cheaper international generators the opportunity to compete in serving Tajik consumers, especially in winter. Given the size of the northern network and the distant possibility of it being connected to the southern grid, the loss of transparency would be small if Barki Tojik remains vertically bundled in the north.

(v) Tajikistan shows progress in improving cash flow into the power sector. The experiences of Azerbaijan and Kazakhstan with private management of distribution, as well as Tajikistan's own experience in the Pamir region, suggest the importance of proper commercial incentives for improving billing and collection. Conversely, the ability of state-run DISCOs in the PRC to improve discipline indicates that proper cash flow can be ensured with the right political commitment. The PRC experience also shows that prepaid metering is a powerful tool for improving collections. Finally, casual observation of the Azeri experience with improving collections from different classes suggests that improvements in billing and collection are much more likely to occur if distribution margins are high relative to the billing and collection costs.

(vi) Improvement of service quality in the Tajik context would be difficult. The PRC presents some good examples of how to deal with energy constraints while minimizing their costs to the population and the economy. These involve DSM mandates and predictable, evenly distributed load shedding.

Economic solutions—some of which would require regulatory consideration and supervision—involve the allocation of scarce energy and wires capacity in an orderly fashion. These can include prearranged contracts that specify processes, prices, and priorities for the allocation of capacity and energy. Subject to social requirements, these contracts should involve pricing of supply constraints. For example, large consumers such as TADAZ may be required to bid for uninterruptible power contracts to cover the cost of load shedding when water levels are low. Residential contracts can involve capacity (kW) charges in addition to the usual usage (kWh) charge. This will provide incentives not to overload the distribution system.

Capacity constraints can also be enforced by the use of circuit breakers or fuses. If circuit breakers at the individual consumer level are difficult to monitor, circuit breakers could be utilized at a block level. In this way, peer pressure can be brought to bear on those attempting to beat the system. While this provides less direct incentives, it is the load placed on lines at the level of the distribution block that needs to be controlled.

Consumers who prefer to receive a lower quality of service (e.g., with frequent supply interruptions) should pay lower electricity prices.

(vii) AAMP's approach of raising rates on unmetered households to encourage them to use meters is sensible. However, charging consumers for their own meters works contrary to this strategy and promotes theft and a black market. The Kyrgyz and Uzbek experiences demonstrate this amply. Meters need to be considered a normal part of the asset base for calculating tariffs.

(viii) The electricity sector currently experiences a cash flow-shortage. Therefore, any subsidy provided must be well-targeted and must involve the smallest reduction in revenues to the sector as possible. Raising the lifeline allowance to 250 kWh may not be necessary for all consumers.

J. Conclusions

Tajikistan's electricity state enterprise, Barki Tojik, is still organized as a ministry rather than a commercial enterprise. It is subject to regulatory scrutiny by AAMP. However, with the prevalence of payment in kind and barter, as well as the reluctance to reveal information that should properly be disclosed by regulated enterprises, transparency remains a major problem in the electricity sector in Tajikistan. Unless there are dramatic changes very soon, the sector is unlikely to attain financial solvency or substantially upgrade service quality in the short term. Prices are so low that any talk of imminent private investment, unless it is targeted to the export market, is unrealistic.

At the distribution level, apart from the case of the Pamir region, there is no commitment to concessions or management contracts. The lesson from Azerbaijan and Kazakhstan is that when appropriate incentives are provided, privately managed DISCOs are capable of resolving the nonpayment problem faster than

has commonly been assumed. Given the apparent success of the Pamir Consortium in improving collections, it may serve as a home-grown example of the possibilities of concession arrangements.

Because MOE-Barki Tojik remains an essentially monolithic entity, the need to scrutinize behavior and apply regulations to tariffs and service quality persists, and has actually increased recently. AAMP needs both capacity building and a higher status in the government before it can effectively regulate an entity with the resources and political support enjoyed by Barki Tojik. The more creative approach to structural options outlined above could change the incentives for Barki Tojik and take some of the pressure off the regulatory system.

Tajikistan's prolonged civil war led to a focus on immediate security issues. The need to keep the existing power utility solvent and effective is not a priority. This is an extreme example of regulatory failure—dilapidated infrastructure and a bankrupt utility. Currently, with the merger of MOE and Barki Tojik, the danger of political and regulatory capture, in which the interest of the utility is put ahead of its customers, is a likely possibility. Regulation has a role to play in resolving the situation, but it cannot substitute for appropriate sector policies, commercial management, and shareholder oversight.

X. Uzbekistan

Map 6: Uzbekistan

A. Overview

Uzbekistan has an estimated population of 26.6 million, about 37% of whom are urban dwellers.[1] It is the only double landlocked country in the world with a total land area of 447,400 km^2. Uzbekistan is bordered by Kazakhstan to the north, Afghanistan and Tajikistan to the south, Turkmenistan to the west, and the Kyrgyz Republic and Tajikistan to the east. The western part of the country is mostly covered by inhospitable dessert.[2]

More than most Central Asian countries, Uzbekistan has followed a policy of state-led development and import substitution. Consequently, reform of the electricity sector has been extremely slow. Despite a decision in 2001 to restructure the sector, little tangible change has taken place. The slow pace of change may be attributed to the institutional design of the sector and the weak incentives it creates to attain the goals of reform.

Uzbekistan has some very large natural gas reserves currently estimated at 1.8 trillion KCM. Extraction rates typically hover around 56 billion KCM annually. In recent years, most of this has been used domestically, although export to Kazakhstan, Kyrgyz Republic, and Tajikistan is a trade potential. Recently signed gas deals mean that a large amount of natural gas will be exported to Russia and Ukraine, making extraction rates likely to increase unless domestic consumption is curbed. The prices for these exports—reportedly around $57 per KCM—are significantly

1 ADB. 2004. *Key Indicators 2004: Poverty in Asia Estimates and Prospects*. Manila.
2 ADB. [n.d.]. *Rebuilding the Silk Road*. Manila.

higher than the prices charged for domestic use. This provides a more realistic benchmark by which Uzbekistan should value its gas reserves. The Government's increased interest in energy conservation and willingness to raise tariffs for electricity, gas, and heat may in part reflect a duly increased valuation of Uzbek gas.

Almost all urban dwellers and the majority of rural population are connected to the power grid. The reliability of energy supply varies. It is generally much more reliable in the capital city of Tashkent than elsewhere in the country. The intensity of energy use in relation to GDP is among the highest in the world.[3]

Uzbekistan's electricity sector reflects a stalled transition from a centrally planned to a market-led economy. [4] The whole of the Uzbekistan electricity system is controlled by UzbekEnergo—a joint stock company—formed out of the previous Ministry of Energy (MOE) in 2001. It is part of the integrated CAPS whose Unified Dispatch Center is located in Tashkent and connects to the power grid of southern Kazakhstan, Kyrgyz Republic, and Tajikistan.

The Pricing Department of MOF is responsible for setting the prices of all forms of energy including electricity, and is therefore, the principal regulatory authority.

B. Generation

In 2003, Uzbekistan had 11,580 MW installed generating capacity supplied by 43 generating plants: 11 thermal (9,870 MW) and 31 hydroelectric (1,700 MW) power stations organized into 16 JSCs. Most of the thermal power plants are fueled by natural gas. The largest are Sydarya (3,000 MW), Tashkent (1,860 MW), and Navol (1,250 MW). The Talimardjan thermal power station with 800 MW turbines is currently being commissioned while Sydarya is being rehabilitated under an EBRD loan. The largest hydroelectric power plant is Charvak (620 MW). These power stations connect to the CAPS 500 kV system and to the domestic 220, 110, and 35 kV transmission systems.

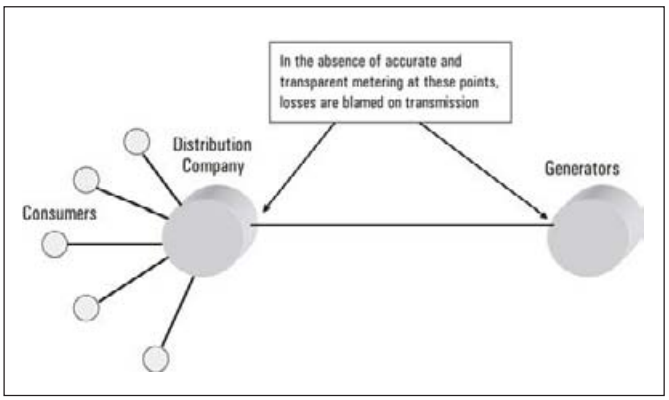
Net Uzbekistan imports of hydropower from the Kyrgyz Republic and Tajikistan run between 800 GWh during wet years and 1,800 GWh in dry years. This corresponds to using less imported hydropower when it is most abundant and potentially cheapest. This sourcing pattern reflects Uzbekistan's preference for energy self-sufficiency rather than using relative prices as an indicator for efficient resource utilization. Power imports are used as a last resort when domestic capacity is exhausted. These net export numbers belie a far larger reciprocal gross trade in electricity.

C. Transmission

Transmission is the task of UzelectroSet—a transmission subsidiary of UzbekEnergo. UzelectroSet's wires are crucial for linking the CAPS together. The unwillingness of the Government of Uzbekistan to sign an agreement granting neighboring countries open access to the Uzbek transmission grid has led to the cancellation of a loan from ADB and EBRD intended for the rehabilitation of this grid. Alongside the transmission system, UzEnergoSbyt—another subsidiary—operates as a buying and selling monopoly. This is a temporary institution slated for elimination once wholesale market competition is introduced.

Many government institutions report concerns that in the absence of adequate bulk metering, transmission data can be manipulated to cover up deficiencies elsewhere in the system (Figure 18). Officials recognize the need to replace wholesale meters, obtain accurate information, and hold UzelectroSet accountable for transmission losses. This is necessary to develop a clear picture of the performance of DISCOs. Currently, there is a concern

Figure 18: Problem with Data Transfer



3 International Energy Agency. 2005. *Key Energy Statistics*.
4 Kazakhstan is the obvious exception to this characterization.

that nontechnical distribution losses (which signal mismanagement and the potential for UzelectroSet to utilize less resources) are being written off as technical transmission losses. This practice would then require the Government to invest more resources in the company.

D. Distribution

Power distribution is managed by 15 DISCOs that operate in defined regional areas.[5] These DISCOs use a mixed billing system. Some customers are metered while others are not. Billing for the latter is based on estimates of consumption. In some cases, customers are billed based on the average group consumption of their apartment block.

Due to the current lack of commercial incentives to bill and collect money efficiently and the consequent shortage of capital for development, distribution reform is a high priority. As will be shown later, commercial losses, some of which require the complicity or negligence of DISCO employees, are estimated to be very high.

One of the problems in Uzbekistan has been the inadequacy of consumer metering. Consumers without meters pay a price of zero for each additional unit of electricity consumed, and have no conservation incentive. Recognizing this, the Government has implemented an aggressive metering campaign. Official statistics indicates that 89% of electricity metering has been achieved, but crude on-the-ground assessments suggest that this must represent a percentage of only a particular class of consumers because many consumers remain un-metered. Customers are asked to pay for their own meters. However, due to large recent tariff increases, this policy has promoted stiff resistance to the installation of new meters.

E. Power Losses and Cash Flows

Table 27 shows the WB estimates of losses, billing and collections in 2002. According to these figures, technical losses totaled 10%. Billing was estimated at 92% of sales and collection was 74% of billing. This means that only 61% of power produced was paid for during the year.[6] About 60% of these payments were noncash, which means that only 24% of power produced was paid for in cash. According to the MVV Report[7] and some government sources, majority of these losses were in distribution. Technical losses are anticipated to increase with load in the short term as the beneficial effects of the rehabilitation work already underway are only expected in 2007 onwards. Similarly, with real tariff increases taking place from 2003, commercial losses are likely to increase, although this can certainly be avoided through improvements in the management of DISCOs. The Government has indicated that commercial losses have gone down recently, but could not measure this change accurately. Neither did it provide an explanation of how the improvement came about.

Table 27: Losses, Billing, and Collections, 2002

System Losses (GWh)	11,162
Total Number of Consumers (million)	4.1
Undelivered Power (as a % of net supply)	10
Unbilled Power (as a % of delivered power)	8
Non-collection (as a % of billings)	26
Noncash Payment (%)	60

GWh = gigawatt-hour.
Source: WB. 2004. *Regional Electricity Export Potential Study.* Washington, DC.

To address the problem of lack of discipline in electricity payments, the first deputy prime minister has been made the minister of energy. A Presidential decree has also elevated nonpayment of electricity bills to an infraction equivalent to tax evasion. The Government is very concerned with improving metering and record keeping because the existing meters do not provide enough information to construct an energy balance on which to base remedial measures. However, the most important problem is with wholesale metering and data collection between generators and major buyers. Disaggregated data on the amount of power entering and leaving the transmission system is not publicly available, making misreporting and theft likely explanations for the high losses.

Many official sources, particularly UzbekEnergo, present an optimistic picture of their electricity billing

5 As the study team could not meet with DISCO officials and the accounts of these companies are not publicly available, further detailed information on the performance of DISCOs is not included in this study.

6 According to these figures in 2002, 82.8% (0.90*0.92 = 0.828) of power produced was billed and 61.3% (0.74*0.90*0.92 = 0.613) of power produced was paid for by consumers.

7 MVV. 2003. *Syrdarinskaya: Thermal Power Rehabilitation Project Electricity Tariff and Collection Mechanism.*

and collections. They claim that the recent price increases have not met much consumer opposition due to low inflation and higher levels of economic growth in recent years. However, other reports indicate that many consumers have had problems coping with the increases and that legal enforcement actions for unpaid utility bills have grown fast. Consumer meters can be as much as 30–40 years old and are therefore inaccurate. Modern meters in Uzbekistan may record a 2% variation between the actual and metered power flows. In the case of old electro-mechanical meters still in service, the variation can be above 5%. More importantly, most meters are easy to tamper with.

It is possible to pay one's power bill directly to UzbekEnergo or through a savings bank, but most consumers prefer the latter. Many mini-banks have been set up in rural areas to facilitate payments. Their establishment is in line with the objective of MOF to improve collections, and ultimately, the flow of cash into the sector.

F. Tariffs

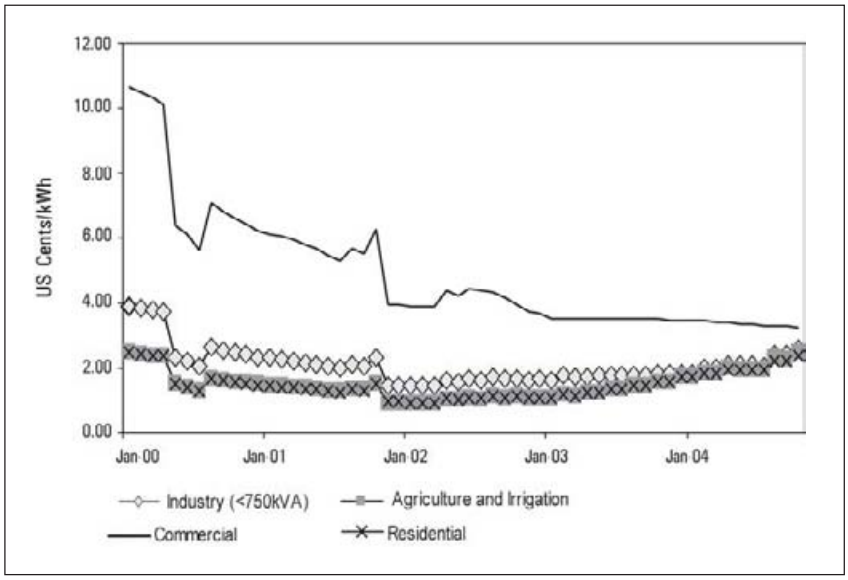
The Pricing Department of MOF is responsible for setting the prices of all energy forms, including electricity.

Each quarter, UzbekEnergo (on behalf of the entire group) submits a tariff petition to MOF, which assesses the need for price increases given the information supplied. The COM Secretariat has an oversight role in the sector and advises the Council on accepting, rejecting, or modifying the recommendations of MOF.

MOF considers the following when establishing tariffs: (i) actual operational costs for the generation, transmission, and distribution of electricity; (ii) forecasted capital expenditures in accordance with the mid-term sector development program and rehabilitation of existing and construction of new power projects; (iii) forecast of macroeconomic parameters in the next 2 years; and (iv) forecast of the effects of tariff increases on other sectors of the economy.

Inflation and devaluation of the Uzbek *sum* cancelled out the impact in dollar terms of price increases made between 1997 and 2002. Prices decreased by an average of 10.1% annually, reaching only $0.0109 per kWh in 2002.[8] In Uzbek sum, the change represented an increase of 2.8%. As can be seen in Figure 19, there were six tariff increases between 2002 and 2003, with the 60% increase in tariff taking place in 2003 alone.

Figure 19: Selected Electricity Tariffs



kWh = kilowatt-hour.
Source: ADB records.

8 See footnote 7.

Tariff reform has been the most significant achievement in the electricity sector reforms in Uzbekistan. There has been significant progress in reducing cross-subsidies.[9] A one-part retail tariff policy used to apply with special tariffs and subsidies for war veterans, rural teachers, and rural doctors. As Figure 19 indicates, residential and agricultural consumers were cross-subsidized by commercial consumers. The demand-share weighted coefficient of variation of tariffs across consumer groups used to amount to 22%. Policymakers acknowledged the perverse incentives caused by these variations and progressively reduced these variations to 2.6%.[10] As a result, there are now only five tariff groups. The most significant change has been the closing of the gap between commercial tariffs on one hand, and industrial, agriculture and residential tariffs on the other. While those residential customers without access to district heating enjoy lower electricity tariffs, there is no explicit lifeline policy and responsibility for developing such policy is not clear. Currently, only large industrial consumers pay a capacity charge, which is $45.1 per kW annually.

Further rapid tariff increases are not anticipated, reflecting the MOF's view that UzbekEnergo should first derive greater benefit from current tariff levels by reducing commercial losses, improving billing and increasing collections, as well as enhancing overall financial management.

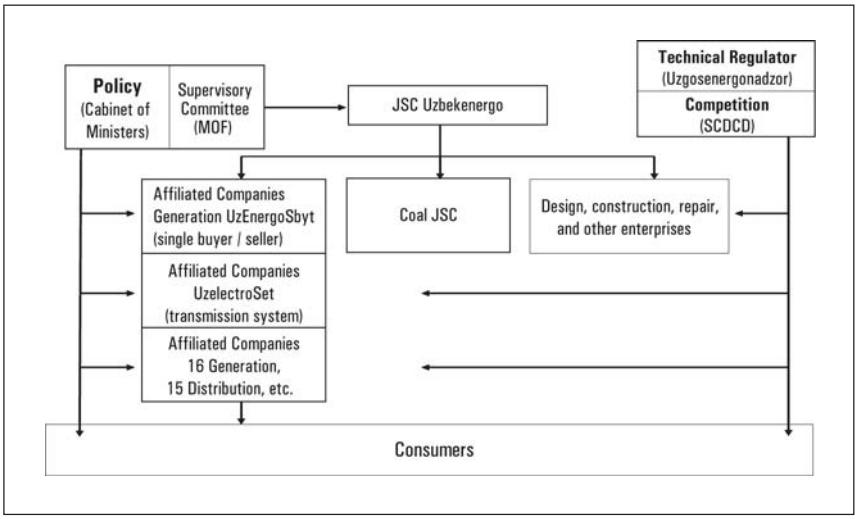
G. Industry Structure

Figure 20 shows the institutional relationships that have evolved in the electricity sector of Uzbekistan. It is clear that Uzbekistan authorities are aware of the international trend towards functional separation of policy, regulation, business management, and ownership of natural monopolies. However, the incomplete adoption of these principles means that control by UzbekEnergo continues without the competitive commercial relationships among subsidiaries necessary to achieve transparency and efficiency improvements.

While all the subsidiary companies in the electricity sector are, in theory separate JSCs, all financial and regulatory reporting is done through the senior management of UzbekEnergo. Similarly, some reports claim that the Sydarya Thermal Power Rehabilitation Project has been privatized. However, so far, the station has only been corporatized (i.e., turned into a commercial company with nongovernment members on the board of directors). UzbekEnergo's ownership and control remains. Consequently, independent information on the performance of subsidiaries or on the settlements of accounts among them is not widely available. The company council operates in much the same way that it did as the management team of the ministry. This represents little change in the situation that existed before the unbundling policy began.

Under the reform initiated in 2001, one of the main objectives was to allow the private sector to buy up to 49% of DISCOs and GENCOs.[11] However, even

Figure 20: Institutional Structure of the Power Sector



JSC = joint stock company, MOF = Ministry of Finance, SCDCD = State Committee on De-monopolization and Competition Development.
Source: Adopted from: ADB. 2005. *Technical Assistance on Regional Power Transmission Modernization Project in the Central Asian Republics.* Manila.

9 This study uses the term "cross-subsidy" loosely. A cross-subsidy actually exists when one consumer group pays more than its cost of service so that another group may pay less. In Uzbekistan, everybody pays less than the cost of service. The basic subsidy to the system comes from undervaluation of gas reserves, rapid depreciation of infrastructure, and at least, until recently, some fiscal support. Hence, "cross-subsidy" as used here simply means that some consumers pay more than others and that the difference is not justified by differences in the cost of serving them.

10 Figures from MOF.

11 Decree # UP-2812. 22 February 2001.

when the reorganization is complete, UzbekEnergo's role as the group company will create conflicts. Under the structure, illustrated in Figure 20, private investors in DISCOs will be required to cooperate with UzbekEnergo (which would remain joint shareholder) in distribution, compete with it in the wholesale market (as it will be the owner of GENCOs and part owner of some DISCOs), and expect impartial treatment in transmission (as UzelectroSet will allocate transmission capacity to the DISCOs and GENCOs).

In addition, until a wholesale market is set up, a private owner of generation capacity will only have one customer, the buying and selling agency—UzEenergoSbyt. For a distribution investor, the same organization will be its only source of energy. If a wholesale market is organized, a private generator would have to trust that Uzelectroset would grant open access to the transmission network despite UzbekEnergo's commercial incentives to favor its own power plants. This suggests a high degree of commercial risk, and to date, private interest in these companies has been conspicuously absent.

UzbekEnergo's financial performance has been poor with insufficient funds to carry out regular maintenance. Recent price increases have permitted improvements in the group financial performance. However, these financial improvements have also been driven by the substitution of locally produced thermal power (generated from seriously undervalued gas) for unsubsidized imported hydropower.

H. Regulatory Objectives and Approaches

UzbekEnergo remains a state-owned, vertically integrated monopoly despite a policy pronouncement in 2001 to unbundle it, privatize distribution, and encourage private investment in generation. A large number of institutions have regulatory responsibilities in the energy sector, which clouds the transparency and rationalization of prices sought through functional separation and vertical unbundling.

Several agencies are interested in economic regulation, but their objectives differ in important ways (Table 28). MOF approves the tariff rates. However, the Ministry of Economy (MOEC) and COM become involved due to the economic development implications of power prices. MOF is interested in the financial solvency of the sector while MOEC is concerned with ensuring that tariff proceeds suffice to allow the energy sector to function well, and

Table 28: Matrix of Regulatory Objectives and Responsibilities

Organization	Objective	Behavioural (non-tariff)	Responsibilities		
			Structural	Economic (tariff)	Technical
Council of Ministers	Policy advice, good functioning of the sector	Overall monitoring	Functional separation and vertical unbundling policy	Consultative	
Ministry of Finance	Reaching equilibrium with neighboring countries, financial cost recovery, energy saving			Tariff regulation and supervision of finances	
Ministry of Economy	Self-sufficiency, development of the economy	Oversight	Oversight	Impact of energy policy on the rest of the economy	
SCDCD	Creating a competitive environment for business	Analysis of competition and effects of proposed changes	Advice on functional separation and unbundling policy		
UzGosEnergoNadzor	Technical inspection				Technical supervision and enforcement of bill payment
UzbekEnergo	Officially a joint stock company with a mission to run a successful business	Supervision of subsidiaries	Promoted the policy of functional separation and vertical unbundling	Coordination of tariff applications for subsidiaries	Technical expertise to advise on and implement standards

SCDCD = State Committee on De-monopolization and Competition Development.

contribute to the energy policy of self-sufficiency. The State Committee on De-monopolization and Competition Development (SCDCD), on the other hand, is responsible for ensuring that there is a competitive environment whenever possible. It assesses the justification for various monopolies and ensures that anti-monopoly laws and tariff limits set by MOF are observed. UzbekEnergo is responsible for the management of JSCs, and would be the agency most able to influence the quality of supply. UzGosEnergoNadzor is both an inspection agency concerned with compliance with rules and a supervisory authority in power delivery. It deals with technical regulation such as observation of safety standards, building rules, and power reliability standards.

The sheer number and variety of oversight roles and groups in different aspects of administration and the effectively monolithic structure of state-owned UzbekEnergo make it clear that the electricity sector in Uzbekistan is still entirely owned by the Government. This explains why there is virtually no outside participation. The need for wide availability of information on power losses and company finances and stronger incentives and accountability for improving efficiency and customer service remains unanswered.

I. Regulatory Challenges

Uzbekistan's power sector remains a single-owner system and has barely moved from the position it was in as a sector controlled by a post-Soviet ministry under UzbekEnergo. A number of factors severely distort decision making such as underpricing of natural gas resources, emphasis on keeping power prices artificially low, and aversion for competition from imported energy supplies. There have been significant achievements in the area of tariff reform, but these would be more effective if accompanied by measures to increase transparency. When various government agencies were asked what regulatory challenges need to be tackled, the following were identified.

(i) **Transparency.** There is a lack of transparency regarding who is supplying how much electricity to whom and where the losses are occurring.

(ii) **Industry Structure.** The policy of the Government is to encourage private investment in distribution and generation, but the structure of the sector is unfavorable to private investment due to (a) continued monopoly power of UzbekEnergo in generation; (b) unnecessary buyer-seller agency that is a monopolist; (c) lack of transparency in accounts and accountability; (d) dominance of the company council (board of directors); (e) poor metering among enterprises in the electricity supply chain; and (f) cross-ownership by UzbekEnergo of generation, transmission, and distribution. The reasons why each of these are not conducive to investment or competition are explained in Chapters I and II.

(iii) **Regulatory Approach.** The current regulatory approach is not clear. Aspects of policy and regulation are distributed among various organizations with differing objectives, making clear and consistent regulation difficult to achieve.

(iv) **Affordability.** There is no policy for ensuring the affordability of utility services, and apparently, there is no agency responsible for considering the issue. Therefore, necessary social protection is handled through highly distortionary implicit subsidies on marginal electricity tariffs.

While these issues constitute a serious impediment to progress, most of the problems can be addressed at relatively low cost and well within the capabilities of the sector's human resources. The significant achievements in tariff reform demonstrate the Government's commitment to improve the performance of the sector. Similar progress on transparency and accountability will complement the work that has been done so far.

(i) **Transparency**. The issue of transparency in the operations of UzbekEnergo may be addressed by removing obstacles to information flows and providing incentives to subsidiaries to reveal accurate information on their successes and failures. Proper unbundling is crucial for achieving transparency. The

experiences of other CAREC countries serve as useful examples of how to proceed and how not to proceed. The Kyrgyz Republic and Mongolia show how instituting real tensions among the subsidiaries through genuine vertical unbundling allows easy location of losses. Their experiences suggest the following improvements to create a real separation of subsidiaries' commercial incentives.

(a) Ensure metering improvements at generation, transmission, and distribution junction points and automatic reporting of meter readings to all companies and the regulator.

(b) Using these readings, construct an energy balance for the sector and update it regularly. This will create a readily available guide to where energy is used, where losses are occurring, and may even provide clues as to why the losses occur.

(c) Calculate and publish separate tariffs for generation, transmission, distribution, and retail services and compensate respective companies accordingly.

(d) Publish separate, accurate, and meaningful annual reports for each subsidiary company. These reports must be audited according to international standards and reconciled with the published energy balances and fuel inputs as a requirement of their license to operate.

(e) Institute separate and direct reporting and tariff applications by each subsidiary company of UzbekEnergo to the tariff regulator to ensure that MOF (or its successor in this role) has a clear picture of the financial status of each entity.

As a result of the Kyrgyz Republic and Mongolia undertaking the above reforms, locations of system losses and nonperforming organizations have been clearly identified. This enables targeting of interventions to gain the maximum efficiency improvement for a given investment.

The practice of publicly providing financial rewards to management for improvements achieved in loss reduction, service quality, and financial health is common around the world. CAREC countries may do the same. Nonetheless, it is important to note that while the regulator can issue regulations requiring the publication of such records, determining the amount of reward is a commercial responsibility normally shouldered by stockholders.

The numbers in Table 27 clearly indicate that implementing the above unbundling measures will reveal a cash flow problem currently obscured by the lack of public accounting for transfers within UzbekEnergo. A proper set of rules for allocating cash will be required in anticipation of this, which will provide incentives to improve the cash flow position. The most difficult aspect of establishing such rules is ensuring that subsidiaries are paid in accordance with the unbundled tariff structures. The experience of the Kyrgyz Republic suggests that some public financing will be required to make up for the cash flow shortfall in the initial stages of unbundling.

(ii) **Industry Structure.** Promoting private investment and competition requires that proper unbundling and transparency improvements take place as described above. Investors do not invest in a sector whose performance they cannot assess. However, transparency on its own is insufficient. When transparency is increased to a necessary level, most, if not all of the following will be needed to attract private investment.

(a) The single-buyer seller agency is only regarded as an interim body and can be abolished to allow contractual relationships to develop between generators and distributors. Mongolia has an SBM that has been effective in promoting efficiency improvement and boosting cash flows. However, the single buyer operates in an environment of tariffs, charges, and cash allocations that are transparent at generation, transmission, and distribution.

(b) UzelectroSet can be taken out of UzbekEnergo and be set up as a financially independent organization funded by charges for the transmission of energy from GENCOs to DISCOs and large consumers. This has been done in Kazakhstan and the Kyrgyz Republic. For the former, the change has

helped reveal system losses, and for the latter, it has facilitated the dramatic increase in competition at the generation level. As argued in Chapters I and II, an independent transmission company is required to reassure investors in generation and distribution that they will have access to the market.

(c) The role of the company council could be reduced and its policy advisory functions removed and placed under the COM, MOEC or some other appropriate body with an unequivocal mandate to offer advice on energy policy and with less conflict of interest.

(d) DISCOs, or at least their retail services, can be privatized or awarded to concessionaires. The lesson from Azerbaijan and Kazakhstan experience is that this can result in large and rapid improvements in the sector's cash flow. However, contract terms must be very carefully and transparently designed to ensure that these improvements are shared with consumers and that the private operators, in turn, pay their bills to the transmission companies.

(iii) **Improving the Regulatory Framework.** There is much to be learned from the Kazakhstan's and Mongolia's examples on this point.

(a) The COM can designate one lead agency for economic regulation. The benefits of taking this step would be greatest if such agency is autonoumous with either decision-making authority or clear responsibility to make open and transparent recommendations to the Government. If an autonomous agency is not deemed feasible, delegating total regulatory responsibility clearly to a semi-autonomous regulatory agency such as a division under MOEC or MOF would be an improvement over the current system. Whichever way it is set up, the regulator will require a clear mandate and proper authority to discharge its responsibilities.

(b) The regulator will collect and manage regulatory knowledge and skills for the sector. It will also provide training and public information on the positive role that regulation can play in improving transparency, investment, competition, and performance.

(c) The regulator will have the right to raise revenues to increase its degree of financial independence and balance the legal and financial power of the private players.

(d) The regulator will have the right to publish information.

(iv) **Low-Income Consumers.** One government agency may be given the responsibility for improving the welfare of the lowest-income members of the community. If electricity subsidies are to be part of this scheme, it is vital that they be provided on a lump sum or lifeline basis, and that these subsidies must not lower the price of the marginal units of electricity consumed.[12] It is also vital that the funding of such subsidy be transparent. Azerbaijan and Tajikistan are moving in this direction with a view to smoothing the political path for tariff rationalization.

J. Conclusions

It is difficult to find important differences between UzbekEnergo and the MOE that it replaced. The company remains vertically integrated, although initial steps have been taken toward creating autonomous subsidiaries for generation, transmission, and distribution. Similarly, functional separation of policy, regulation, business management, and ownership has occurred more on paper than in reality. UzbekEnergo remains a regulated public sector monopoly. Its regulatory framework requires clarification because responsibility remains distributed among several agencies with too many different objectives. MOF, by default, has been performing roles in an area that should be JSC management's responsibility i.e., improving the company's financial performance. The main requirement for reform in

12 See Chapter II.A.

Uzbekistan is to clarify roles and make individuals and agencies accountable.

In the last few years, there has been an energetic program to remove many of the distortions inherent in electricity tariffs. The program has been led by MOF. Reasonable tariff levels are essential if the policy of encouraging private investment is to be carried out. Tariffs that reflect the cost of operations and the full value of the natural resources being consumed will bring substantial long-term benefits to Uzbekistan, permitting it to rationalize the utilization of its gas resources over time and undertake vital maintenance of the power infrastructure.

Consideration of the requirements of future competitive market regulation has barely begun and the agency that could be responsible for economic regulation, SCDCD, does not yet have a good track record for introducing competition into sectors with firmly established monopolies. Uzbekistan has been one of the more cautious reformers among CAREC countries, prioritizing import substitution and self-sufficiency over economic efficiency. It may therefore be appropriate to consider other approaches to the introduction of the private sector rather than the partial sale of company shares. For example, competitive bidding for concessions or management contracts may receive more interest from investors than selling 49% of shares in a DISCO, without requiring the Government to relinquish ownership of national assets.

It is clear that the designers of UzbekEnergo's reforms were aware of the need to treat potentially competitive generation and distribution differently from the noncompetitive transmission and distribution wires. They appreciated the complementary nature of energy sales and infrastructure management. The reforms were designed to achieve some degree of vertical unbundling and structural regulation. These approaches are acknowledged in the model, but are only partially carried out in practice. The regulatory implication is that if the authorities seriously want a transparent and competitive system, some degree of intrusive regulation and a considerable rethinking of the design of the sector are required. This cannot be delivered by the current patchwork of agencies with a part-time interest in some aspects of regulation. Nor can a utility whose subsidiaries have each other's interests at heart be properly regulated. Thus, Uzbekistan needs a clear, expanded policy for structural reform and an agency with the mandate to deliver the benefits that can be obtained by introducing commercial incentives, transparency, and competition into the electricity sector.

Therefore, to solve the transparency problem and reduce losses, the first policy objective should be proper sector unbundling. This would permit the regulator (or subsequently, a market) to provide an incentive structure that truly pushes the sector to deliver high-quality service at low cost. The Kyrgyz Republic and Mongolian examples demonstrate how restructuring can provide the regulator with the information it needs to design such incentives. However, as these examples also demonstrate, having a clear plan for using this information to motivate efficiency improvements is vital.

In the high-inflation environment that Uzbekistan has experienced for much of the last decade—partly caused by distorted relative prices and cost increases due to import substitution—efficient investment decisions have been difficult to make. Regulatory failure that caused near bankruptcy arose from a system focused on keeping tariffs at low levels and the very real constraints on regulation imposed by the industry structure. The Uzbekistan experience has clearly shown the limitations of distorting electricity regulation and policy as a way to ameliorate wider economic problems.

XI. IMPLICATIONS FOR REGIONAL TRADE IN CENTRAL ASIA

This study was undertaken as part of an effort by ADB, with support from PPIAF and other development partners to establish a forum of regional electricity regulators.[1] This forum should serve two purposes. First, it will allow member regulators to learn from each other's experiences in designing domestic reforms. Second, it should permit them to work together to create an environment conducive to regional trade in electricity. The preceding chapters of this report document a wide array of economic and financial problems, industry structures, regulatory arrangements, and solutions attempted in CAREC countries' power sectors. It is hoped that this knowledge base would facilitate achievement of the first objective. The second objective, however, has only been touched upon, and it is necessary to elaborate on the linkages between these two objectives.

In the view of this study, the most important lesson regarding regional power trade is that domestic reforms are crucial for trade to develop organically along economic lines. There is already a large volume of electricity trade underway in Central Asia. However, this trade is not economically optimized. The differences between bulk power supply costs in Kazakhstan, Kyrgyz Republic, Tajikistan and Uzbekistan, and their fluctuations by season, have been well-documented by ADB[2] and WB.[3] (Indeed, it was precisely these opportunities for gains through trade, which prompted the Soviet Union to build the CAPS that connects the grids of each republic.) These cost differentials indicate that it is much cheaper during some seasons for a country to import electricity than run its own generators. Economic principles therefore dictate that at particular times, some generators should be left idle while a country imports power. In contrast to this efficient economic outcome, power in Central Asia is usually traded only when an importing nation lacks the generation capacity to meet power demand.

The costs of this lost opportunity are substantial. Hydropower exported from the Kyrgyz Republic and Tajikistan during summer months is cheap relative to thermal power generated in Kazakhstan and Uzbekistan. In contrast, the economic costs of hydropower generation in the Kyrgyz Republic and Tajikistan during winter are substantial. Water released in winter overflows riverbanks, which causes flooding and reduces flows of the Syr Darya and Amu Darya rivers into the Aral Sea. The Aral Sea is drying up, causing desertification in its surroundings and destroying local livelihoods. The Kyrgyz Republic and Tajikistan could meet their energy needs far more efficiently using coal and gas imported from Kazakhstan and Uzbekistan. The inability of Kyrgyz and Tajik consumers to access these fuels is causing them to turn to electric heating, placing unmanageable loads on the power systems and causing frequent system failures. Unfortunately, each of these possibilities for regional trade is underutilized.

Given the immense benefits that can be realized by returning to a more economically rational pattern of energy trade, the countries of the region, together with various multilateral and bilateral development agencies, have attempted to resolve these problems. These attempts are yet to achieve much success. This is usually described to four factors. The first is the desire of some governments (most notably, Uzbekistan[4]) to achieve energy self-sufficiency. The second factor is the relationship between energy and water in the region. Because international mechanisms for implementing proper water use rights are not available and energy trade discussions inevitably involve hydropower, these discussions become extremely contentious. Third, high levels of poverty mean that raising energy tariffs sufficiently to maintain the financial health of firms is ethically and politically challenging. Financially strapped utilities make for bad creditors, so power sales are difficult to execute. And finally, the undervaluation of fossil fuel reserves implies that thermal power is judged to be more competitive against summer hydropower than it really is.

1 For more on this effort, please see the Foreword or http://adb.org/CAREC/default.asp.

2 For example, see: ADB. 2002. *Technical Assistance Final Report on Regional Power Transmission Modernization Project in the Central Asian Republics*. Manila.

3 WB. 2004. *Regional Electricity Export Potential Study*. Washington, DC.

4 A Presidential quotation on the importance of energy self-sufficiency opens the 2003 annual report of UzbekEnergo, the national power utility of Uzbekistan.

Viewed from this perspective, talks to build better international relations, water management agreements, phased end-user tariff increases (accompanied by social support schemes), and increases in feedstock prices would be suitable policy instruments for promoting energy trade. It was to assist in the achievement of the latter two of these improvements that the establishment of a regional regulators' forum was first proposed.

This study highlights two more possible reasons why energy trade is not growing. One is that significant rents being generated by weak sector management establish reasons for a wide array of interest groups to either oppose power trade, or at least, to refuse to support it. The second reason is that inappropriate industry structures create incentives to oppose power trade. These problems are closely related, as the following discussion shows.

The country chapters document extraordinarily high levels of electricity "losses", non-billing, and nonpayment. They also show that large portions of technical losses may in fact be disguised commercial losses. Furthermore, there are hints that even when electricity is paid for, the use of barters and offsets renders the tariffs paid by many consumers quite arbitrary. In most countries in the region, only 30–60% of electricity generated results in cash payments to the utilities, and not even all of this is at regulated prices. Even the extreme economic hardship of consumers in the region could not possibly explain such large losses. Indeed, while commercial losses tend to be blamed on poor consumers with illegal connections, this is an unverifiable claim by construction. Commercial losses are power that has vanished without a trace. Rate payers simply will never know whether this power was taken by a slum dweller with an illegal connection, used by a middle or upper class citizen who bribed a meter reader to falsify a reading, or was sold discreetly by a company manager to an industrial user for a side payment. The magnitude of the commercial losses in Central Asian power sectors is a sure sign of serious mismanagement. Unsurprisingly, most observers conclude that the high loss levels imply corruption.

The analysis in the country chapters, particularly the experiences of the Kyrgyz Republic before and after unbundling, highlights the remarkable role that vertical integration can play in obscuring such mismanagement. Absent significant regulatory and shareholder interventions, transfer prices and cash flows among the departments of vertically integrated utilities are unobservable. This provides a degree of immunity to weak managers. As mismanagement generates rents, vertical integration can therefore be lucrative for bad managers and provide disincentives for good managers to perform their job well.

Regional energy trade has stiff informational requirements. Power flows must be properly metered as they cross borders and financial flows must be reported. A competent independent body must have access to this information to adjudicate on disputes. This kind of public scrutiny can reduce the rents that can be extracted from a power sector, and is sure to be unappealing to any sector player currently benefiting from lost power. The concerns of these players would be deeper if trade developed further, leading to the formation of a regional market that permits trade between entities below the level of national governments. This is because the informational requirements for decentralized trading are even more stringent, requiring not just cross-border flows of power and cash, but also domestic flows, to be publicly scrutinized.

Even in the absence of corruption and management failures, vertical integration creates barriers to power trade. When the power grid is vertically integrated, alternative power sources may not be able to compete fairly for access to the grid. This is convenient for the owners of noncompetitive generators because it reduces the possibility of consumers discovering cheaper alternatives. Thus, vertically integrated industry structures are inherently anticompetitive. Put simply, it is difficult to see why a vertically integrated monopoly would import electricity while its own assets sit idle. An independent transmission company, on the other hand, which makes higher profits if it moves more power, has a clear incentive to source power from the cheapest generators regardless of their location in order to stimulate demand. Descriptions given to the study team of how decisions to import power were made confirmed the impression that these decisions were based more on economic considerations in sectors whose transmission companies' interests were more distinct from those of generators.[5]

Thus, more suitable industry structures, involving fiercely independent transmission companies, increased

5 In this regard, it must be noted that vertical unbundling needs to be quite deep indeed before the dispatcher prefers imported over domestic power based on the economics alone, especially given the shortage of foreign exchange in most CAREC countries.

transparency, and shareholder commitment to electricity loss reduction are likely to be crucial for catalyzing regional trade. As this study has taken pains to point out, responsibility for these structural reforms lies with governments, not with the regulators. However, as guardians of the public interest, regulators need to be aware of the possibilities and publicize them to promote a less one-sided debate on the role of such reforms.

None of these arguments diminishes the relevance of previous analyses, which conclude that the resolution of international political disputes and problems in the pricing of water, feedstocks, and final energy consumption will play a critical role in catalyzing trade. This analysis simply argues that without careful attention to domestic reforms, fixing international relative prices and international relations are unlikely to be sufficient, or even feasible.

APPENDIX

Regulating the Price of Heat from Combined Heat and Power Plants When Power Prices are Competitively Determined

Like other Central Asia Regional Cooperation member (CAREC) countries, Kazakhstan is wrestling with the issue of how to price the outputs of combined heat and power (CHP) plants. Its problem, however, is unique because the price of electricity is market-driven. The following theoretical solution to this problem applies, provided that in addition to the CHP plant, there are dedicated electricity generation plants in the market and the CHP is a base load generator (which would certainly be the case during winter months when reliable heat output is required).

In this case, the unit market price for electricity is determined by other generators in the market. All the electricity generated by the CHP plant can be sold at that market price, which is the marginal cost of the highest variable cost non-CHP generator in service. The revenue earned by the CHP plant from the electricity output sold can be considered as a subsidy on the fuel cost for producing the heat. The ratios of heat and power outputs to fuel inputs can be used to spread this subsidy over the number of units of heat generated. Heat can then be regulated using the usual natural monopoly methods, using estimates of "post-subsidy" fuel costs to approve heating tariffs.

When setting heating tariffs in communities where heating fuel is purchased in an open market and subject to fuel price risk, regulators handle risks of this kind all the time. In that situation, increases in fuel prices have to be passed onto the final consumers. Whether the effective heating fuel price changes for a CHP because of actual fuel price fluctuations or fluctuations in the subsidy level determined by the electricity market, should not matter.

One potential complication is that if market prices for power were sufficiently high, the required post-subsidy heat price could be negative. How to deal with this problem depends on how heat demand is met.

First, consider the case where the CHP output is adequate to meet total heat demand if heat were given away for free. In this case, it is reasonable to provide heat for free because it is in excess supply and indeed economically free. It is the marginal units of power demanded, not heat, that cause additional energy resources to be utilized. Therefore, it is power, not heat, that is costly.

Next, suppose that at a price of zero, more heat is demanded than the CHP plant produces at full capacity. Logically, there must be a positive price for heat at which the demand for heat would equal its supply from the CHP plant. If this price is below the long-run marginal cost (LRMC) of the cheapest dedicated heat plant, then this is the price that should be charged for heat. If the price is above the LRMC of the cheapest dedicated heat plant, then such dedicated heat plants should be built and the heating tariff should be set equal to the price at which the LRMC of the most expensive heating plant equals the consumers' willingness to pay for the last units of heat consumed. In any of these cases, the CHP plant will earn supernormal profits which can fund lifeline tariffs on heat or power. The plant can also be taxed and the money returned to consumers through other fiscal instruments such as income support, higher public spending, or lower income or other taxes.