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KAZAKHSTAN NATIONAL PROGRAM FOR ENERGY SAVINGS

FINAL REPORT

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Prepared by:

Burns and Roe Enterprises, Inc.

In Collaboration with:

International Resources Group Ltd.
Foster Wheeler

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IRG INTERNATIONAL RESOURCES GROUP LTD.

memorandum

TO. Mr. Charles Bliss, Mr. Sam Gerges, Mr Edvard Markeset
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FROM: Richard E. Browning

DATE: 31 July 1995

SUBJECT: Status of National Program for Energy Savings, Task 1, DO#9 Kazakhstan

Attached is a copy of the English version of the Final Report. Russian copies of the Final Report were distributed last week in Almaty to the following organizations: Ministry of Energy and Coal; Ministry of Economy; Ministry of Industry and Trade; Ministry of Housing and Construction; Ministry of Finance; Ministry of Oil and Gas; Ministry of Transportation; Antimonopoly Committee; and Cabinet of Ministers. Also, copies were distributed to Mr. Barry Primm and Mr. Rolf Manfred last week in Almaty. The distribution of the Final Report completes the originally contracted scope of work.

However, I have been requested to return to Almaty the week of either September 4th or August 28th to make a presentation to the Cabinet Ministers and to answer questions raised by the Cabinet Ministers Mr. Primm has indicated to me that he supports my returning to Almaty to be involved in these Cabinet Ministers meetings.

Please call me if you have questions regarding the Final Report.

My best regards.

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The principal authors of this report were Dr Richard Browning (Chapters 1, 2, 3 and 5), Mr John P Banks (Chapters 4 and 5), and Mr James Francis (Chapter 10) of IRG, Dr Gerald Decker (Chapter 6) and Mr Sal Scardigno (Chapters 7 and 8) of Burns and Roe, and Mr Vladimir Peer (Chapter 9) of Foster Wheeler

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LIST OF ACRONYMS

ACE	American Council for an Energy Efficient Economy
ADB	Asian Development Bank
AFB	Atmospheric Fluidized-bed Boiler
AGTKE	Almaty Municipal Authority
AHSE	Almaty District Heating System Enterprise
ASHRAE	American Society of Heating, Refrigerating & Air Conditioning Engineers
BEST	Biomass Energy Systems and Technology
BTU	British Thermal Unit
CABO	Council of American Building Officials
CAFE	Corporate Average Fuel Economy
CDC	Commonwealth Development Corporation
CEPF	Central Environmental Protection Fund
CGCC	Coal-gasification Combined Cycle
CHP	Combined Heat Power
CIS	Commonwealth of Independent States
D	Destructive
DEA	Detailed Energy Audit
DOE	Department of Energy
DSM	Demand Side Management
EBRD	European Bank for Reconstruction & Development
ECA	Energy Conservation Agency
ECC	Energy Conservation Company
ECCB	Energy Conservation Coordination Board
ECD	Energy Conservation Department
ESCO	Energy Service Company
ESP	Electrostatic Precipitator
FGD	Fluegas Desulfurization
FSU	Former Soviet Union
Gcal	Giga Calorie
GDP	Gross Domestic Product
GEF	Global Environment Facility
GOK	Government of Kazakhstan
HEPP	Heat and Electric Power Plants
HHV	High Heating Value
HRSG	Heat Recovery Steam Generators
HUF	Hungarian Foviente
HVAC	Heating, Ventilation & Air Conditioning
IBRD	International Bank for Reconstruction & Development
ID	Induced Draft
IEA	International Energy Agency
IFC	International Finance Corporation
IFI	International Financial Institution
IFREE	International Fund for Renewable Energy & Renewable Energy & Efficiency
IRG	International Resources Group, Ltd
JICA	Japan Industrial Cooperation Agency
Kcal	Kilocalorie
KEMCO	Korean Energy Management Company

KW	Kilowatts
kWh	Kilowatts per Hour
LHV	Low Heating Value
LME	London Metals Exchange
MCM	Million Cubic Meters
MIGA	Multilateral Investment Guarantee
MOEC	Ministry of Energy & Coal
MOE	Ministry of Economy
MOIT	Ministry of Industry & Trade
MPG	Miles per Gallon
MT	Million Metric Tons
MTFE	Million Tons of Fuel Equivalent
MW	Megawatt
ND	Non-destructive
NIS	Newly Independent States
NODFOS	Vladimir Peer (Consult Chapter 9)
OECD	Organization for Economic Cooperation & Development
OPIC	Overseas Private Investment Corporation
PEA	Preliminary Energy Audit
PEFCO	Private Export Funding Corporation
PFBCC	Pressurized Fluidized-bed Combined Cycle
PRE	Private Enterprise
PSED	Private Sector Energy Development Program
RESF	Russian Energy Savings Fund
RGDREEP	Russian Gas Distribution Rehabilitation & Energy Efficiency Project
R&D	Research & Development
SBA	Small Business Administration
SPO	State Planning Office
SPPC	Special Purpose Project Company
TES	Thermal Energy Station
UN/ECE	United Nations/Economic Commission for Europe
USAID	United States Agency for International Development

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EXECUTIVE SUMMARY AND RECOMMENDATIONS

The Council of Ministers of the Republic of Kazakhstan decided in 1994 to establish a comprehensive National Program for Energy Savings, covering each sector of the economy Responsibility for developing the program was allocated jointly to the Ministry of Energy and Coal and the Ministry of Economy At the request of the Government of Kazakhstan, the US Agency for International Development's (USAID) Office of Energy Infrastructure for the Newly Independent States agreed to assist in the development of the program through the provision of technical assistance in jointly selected areas

IMPORTANCE AND POTENTIAL OF ENERGY SAVINGS

Importance of Energy Savings

Energy savings is important to the Republic of Kazakhstan because it can generate the following benefits

- Energy and capital savings and reduction in the rate of energy demand growth
- Improved environmental conditions
- Increased technology transfers
- Greater foreign exchange earnings or savings
- Enhanced competitiveness
- Job creation and enhanced workers' skills
- Potentially lower inflation
- Lower production costs and higher profits for large energy consuming enterprises
- Enhanced capability for enterprises to withstand future energy cost increases or curtailments

Kazakhstan is richly endowed in raw materials, including large deposits of oil, natural gas, coal, copper and other nonferrous metals Energy and raw materials were traditionally exported to the other republics of the former Soviet Union Energy and metals are two of the most important sectors in the Republic Today, these two sectors remain the most important to the economy in generating foreign exchange, attracting foreign investment, restoring traditional trade patterns, integrating Kazakhstan into the global economy via the development of new trading and transport routes, and providing a competitive advantage to existing or new energy- or mineral-intensive industries

Kazakhstan's energy intensity in 1992 measured as energy per capita was about 1 7 and 3 9 times greater than that of Poland and Turkey, respectively, while its electricity intensity was about 1 3 and 3 6 times greater than that of the same two countries Over time, with the successful implementation of the National Program for Energy Savings, Kazakhstan's intensity levels will decline towards the levels experienced in other countries at a similar stage of economic growth

Potential of Energy Savings

The rapidity of economic change ocurring in Kazakhstan, combined with the lack of reliable detailed data, make it difficult to perform the analysis normally undertaken in OECD countries to project long-term economic growth and energy demand Historical data provide limited information about Kazakhstan's future as the country makes the transition to a market-based economy There is great uncertainty surrounding macroeconomic and sectoral developments in both the short and longer term As a result, any projection of energy demand and potential energy savings at this time is difficult and potentially dangerous A simple macromodel has been formulated to project energy demand and potential energy savings The basic framework is at top-down spreadsheet model which focuses on the overall rate of

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growth of Gross Domestic Product, the changes in the individual sector shares of GDP, and the changes in energy intensity of the individual sectors Different scenarios can be developed by assuming different values for each of these three elements

Energy savings is the difference between energy consumed with and without the implementation of energy savings measures or policies Energy demand is a function of economic growth and changes in energy intensity Energy intensity is usually measured as the ratio of energy to economic output However, changes in energy intensity reflect the combined effects of structural changes in economies, real energy prices and changes in energy efficiency Energy intensity varies across countries depending on economic structures, historical price developments, the indigenous resource base, end-use patterns, climate and geography Reductions in energy intensity can be used as an indicator of the success of an energy savings program

The potential for energy savings is immense in Kazakhstan, as has been demonstrated in countries with similar command economies For example, Poland's energy intensity, measured as tons of oil equivalent per capita, was reduced from 2 21 in 1988 to 1 65 in 1992, a 25 percent reduction over four years Based on research and on the assumption that the energy systems in Kazakhstan can be characterized as similar to the energy systems of the former USSR, manufacturing fuel intensity can be reduced by 25 percent and manufacturing electricity intensity by 10 percent over the short to medium term and 40 percent and 20 percent, respectively, over the longer term These short to medium term reductions in intensity are achievable through a focused energy management effort, increasing energy prices to world equivalent levels, and the introduction of Western practices and technologies Based on the evidence obtained on selected industrial plants in Kazakhstan and on prior research work done on the former Soviet Union energy systems, implementing the short- to medium-term measures presented in this study will result in energy savings between 15 to 25 percent of the energy consumed in Kazakhstan in 1994 This energy savings, assuming 1994 values, will be about 20 to 34 billion Tenge (US $588 million to $1 billion), which is estimated as about 32 to 54 percent of Kazakhstan's energy trade deficit in 1995 To achieve the longer term reductions will require the adoption of more advanced Western technologies and time for many of the government programs and price increases to have their full impact

RECOMMENDED ENERGY SAVINGS MEASURES

There are many types of energy savings policies and programs available to governments, however, not all of the mechanisms discussed are appropriate for every country Selecting the most suitable energy conservation policies depends on the unique context of a particular country The energy sector in Kazakhstan is characterized by the following fundamental problems, which the national energy savings program implemented by the Government must address

- Low, subsidized energy prices
- Weak institutional structure and legislative framework
- Weak energy conservation "ethic," owing to low prices and the historical perception of energy as a free good
- Inefficient practices, equipment, and technology
- Inadequate access to capital

Furthermore, Kazakhstan is confronted with a severe economic crisis which has dramatically limited the Government's financial capacity to address critical problems in the energy sector Thus, Kazakhstan's National Program for Energy Savings must initially focus on those measures that yield immediate energy savings, are relatively low in cost and place only a limited administrative burden on the Government In

sum, the Government should develop energy savings policies and programs that can be implemented in a timely, effective and cost-efficient manner

The tradition of central planning in Kazakhstan is another characteristic that should be taken into consideration when developing appropriate energy savings policies and programs The Government is well suited to implement and administer those programs that require substantial oversight, such as mandatory efficiency regulations However, the Government should be aware that the countries with the most success in improving energy efficiency are those that have a mixed institutional structure and rely heavily on markets rather than government bureaucracies During the transition period, the Government needs to avoid programs and measures that are conducive to abuse and corruption and that promote growth of government bureaucracies in lieu of nongovernment entities

Despite an initial focus on policies and programs that can be effective in the difficult transition period and are low cost, the Government of Kazakhstan should not eliminate consideration of longer-term or more costly activities After the transition to a market-based economy is largely complete, economic growth has resumed and institutional strengthening has occurred, the focus can turn to those policies and programs that yield savings in the longer term

In developing its National Program for Energy Savings, the Government of Kazakhstan should initially place a high priority on the recommendations listed below, each of which is discussed in detail on the following pages.

1. Accelerate economic reform.
2. Increase end-user energy prices according to the principles outlined in this study.
3. Put in place incentives for the installation of equipment that measures energy consumption
4. Establish the Energy Conservation Department within the Ministry of Economy as the coordinator of the Government's energy savings policies and establish an independent Energy Conservation Agency to implement the programs associated with these policies; involve a diversity of organizations, especially the private sector, in the pursuit of energy efficiency.
5. Assess various financing options, focusing in the short term on demonstration zones,energy savings fund, and multilateral bank funded projects.
6. Focus initially on energy savings in the industrial sector, and on those energy savings investments whose costs are recoverable in less than one year once the investments are operational. Ensure that industrial facilities scheduled for energy conservation investments can survive in their market sector and are economically viable in the long term.
7. Focus initially on policies and programs achievable in a timely and effective manner during the next three years as the country progresses to a market-based economy, and then consider policies and programs that will yield energy savings in the longer term.

1. *Accelerating Economic Reform*

Sustained progress on macroeconomic reform, especially on price and market liberalization, will be critical to obtaining energy savings throughout the Republic of Kazakhstan Economic reform can be expected to lead to substantial energy savings The Government must strengthen and accelerate its efforts in the following areas [1] (a) price reform and market liberalization, (b) transfer of ownership to the private sector, (c) legal and regulatory structural reform, and (d) enterprise restructuring The most effective means by which to increase energy efficiency is to ensure that the Republic of Kazakhstan makes the transition to a market-based economy from the traditional command economy which relied primarily on governmental regulations and controls To change substantially the past behavior of energy producers and consumers from wasting energy to conserving energy primarily requires opening up markets to competition and increasing energy prices to levels that fully recover all costs, plus a resasonable rate of return for the capital investment

With the transition to a market-based economy, the government's role in the economy, including the energy sector, should be reduced substantially In 1992 government-sector jobs as a share of the total jobs in the Republic of Kazakhstan was about 86 percent in contrast to an average of 17 percent in the United States Overtime many of the current energy sector jobs being performed by Government employees need to be either transferred to the private sector or eliminated For example, the current governmental organizations empowered to enforce the rational use of energy should eventually be replaced by market determined prices allocating energy use

2. *Increasing Energy Prices*

Between 1992 and 1994, many of Kazakhstan's nominal energy prices increased by a factor of ten or more Despite these substantial energy price increases, many domestic energy prices remain at only a fraction of world equivalent levels and severe sectoral distortions continue to exist In general, Kazakhstani energy prices, as of November 1994 and measured in US dollar terms, were about 10 percent to 45 percent of Turkey's first quarter 1994 prices In November 1994, Kazakhstan's residential tariffs as a percent of the industrial tariffs ranged between 10 percent to 84 percent, compared to a January 1992 level of about 80 percent in Hungary

Rising real energy prices generally result in energy savings Based on studies by the International Energy Agency, increases in real energy prices, especially after 1978, were the most important single factor behind increases in energy efficiency in OECD countries Comparing changes in real energy prices to changes in energy intensity in many OECD countries indicate that prices can have a significant impact on reducing energy demand Based on studies covering the experiences of the OECD countries during 1973-82, the largest declines in energy intensity were experienced in the industrial and transportation sectors A survey of fifty studies suggests that the price elasticity[2] in the developing world for energy demand can be expected to range between -0 05 to -0 65

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1 In making the economic transition to a more market-based economy, there are many reform measures that need to be introduced and implemented Most of these measures can be organized under the following five categories macroeconomic stabilization, price and market liberalization, privatization, construction of a social safety net, and mobilization of international financial assistance

2 Price elasticity is an estimate of the responsiveness of the quantity demanded of a good for a given change in the price of the good

Energy Pricing Principles

The Government of Kazakhstan needs to place a high priority on the adoption of the following energy pricing principles as the economy evolves towards a more open, market-based economy

- Price levels must be set "X percent" higher than cost, with "X" representing the necessary return on investment needed to meet projected demands Cost must also take account of the need to internalize certain externalities, such as the costs associated with environmental protection

- Retail price levels also must be set "X percent" higher than costs and set to achieve government/society's goals, including contributing revenues needed to finance energy-sector related goals and stimulating conservation measures

- Price levels must be set so that marginal costs of energy supply are fully recovered, in the short term to include all variable operating costs, and in the longer term to include fixed costs

- When traded in world markets, prices of energy commodities should reflect full border equivalent prices available in export markets, fully accounting for transportation costs and quality differentials, appropriately measured

- Tariffs should reflect cost of service to different classes of customers, e g households, agricultural and industrial consumers

- Regional energy prices should reflect different transportation and distribution costs and regional supply-demand pressures within Kazakhstan

- Proper weight should be given to energy policy objectives when considering tax policies

Energy Pricing Guidelines[3]

As a general rule, energy prices should be increased to reflect real economic costs of supply, or when traded in world markets, the export value With sustained increases to world equivalent levels, most energy price subsidies will be eliminated resulting in energy savings During this transition of reform and price liberalization, emphasis should be placed on adjusting relative price relationships not just absolute price levels This is especially true during times of extreme uncertainty surrounding exchange rates The persistence of extreme imbalances between economic costs and market values will create distorting signals, eventually resulting in inefficient resource development and use Regardless of the pace of reform chosen by the Government of Kazakhstan, the Government needs to place a high priority on the adoption of pricing guidelines which focus on restructuring relative energy prices consistent with free market and internal cost price relationships

For non-grid fuels (crude oil, petroleum products, wellhead natural gas, and coal), prices should be decontrolled rapidly Producer, wholesale and retail prices of non-grid fuels should be fully liberalized

3 A spreadsheet model has been developed by which to project price guidelines or targets for the years 1998 and 2005 The price path between current levels and the projected 1998 levels represents the short to medium term while the path from 1998 to 2005 represents the longer term This model provides the basic framework by which to project future price guidelines The spreadsheet model can be expanded to include additional premises, such as different domestic inflation rates, different exchange rates and different price and cost components underlying the basic netback calculations

Full price liberalization is not expected to lead to world market prices for all these fuels in the near term as some prices in Kazakhstan will be constrained by the inter-republic linkages among other former Soviet Union republics, primarily Uzbekistan, Turkmenistan, and Russia and by Kazakhstan's substantial dependence on the Russian transport system for access to world markets

For grid fuels, or natural monopolies (natural gas, heat, and electricity transmission and distribution), the Government will need to develop price and tariff structures for the regulation of these industries In the interim, prior to establishing a regulatory framework, natural gas, heat and electricity prices should be determined on cost plus pricing principles, and increased to reflect real import, transmission and distribution costs Also, a program to eliminate the substantial cross-subsidization of households should also be adopted At a minimum the current differences (in absolute terms) between industrial and household prices of electricity, heat, and gas should not be allowed to increase The natural gas, electricity and heat tariff approval process should be speeded up by creating a quarterly fuel adjustment procedure that passes on automatically, up to an agreed upon percentage, increases in fuel costs

Also, the Government of Kazakhstan should place a high priority on enforcing the collection of payment that reflects both the market determined or regulated end-use prices and the volumes of usage Of course, end-use prices include those taxes adopted by the Government of Kazakhstan In order to improve its record of collection and enforcement, the Government should consider various measures (a) impose severe penalties for fraud or evasion, (b) provide performance incentives for tax collectors, (c) provide incentives for prompt payment of outstanding bills or taxes, and (d) provide incentives for the installation of metering equipment Metering equipment is critical to measure energy usage and energy savings accurately and to ensure that rising real energy prices impact the behavior of the individual consumers

3. Installing Energy Measuring Equipment

Since energy savings can be thought of as the difference between energy consumed with and without the implementation of energy savings measures or policies, measuring energy consumption is critical to any energy savings program This requires various types of meters and instruments Investing in metering and other measuring systems so that higher energy prices will begin to influence the consumption behavior/patterns of individuals and enterprises should be given a high priority in Kazakhstan's NPES Measuring devices will more accurately account for end-use consumption vs processing and transportation system loss or theft

A governmental entity should work closely with energy producers and consumers to determine standards for the measurement of energy consumption Metering that accurately reflects actual usage together with the right pricing policies will send signals to energy consumers and producers consistent with energy conservation

4. Establishing the Government's Role

One of the critical components of a successful energy savings program is a high-level commitment of the Government Most countries have learned that a commitment at the highest levels of government is necessary not only to develop policies and legal regulations, but also to implement and enforce legislation once in place Leadership by example is crucial to influence or change the behavior of individuals and companies to realize the benefits of energy conservation and the importance and value of energy in general

Closely related to this is the need to state clearly in legislation which government entities will have responsibility and authority for specific energy conservation activities and to establish clear lines of

reporting This is required to ensure effective coordination of policy implementation and to avoid overlap and duplication of efforts

Although governments are active in promoting energy conservation, particularly in the initial stages of a country's efforts to achieve energy savings, experience in other countries suggests that non-government organizations should play an important role in promoting energy savings State or regional governments, non-profit entities, research organizations, training firms, private energy service companies, and universities should be actively supplementing and complementing the national government's activities Gradually decentralizing energy conservation activities throughout the economy among various types of organizations places decision-making into the hands of individuals and individual companies, giving them the power to pursue energy savings activities The government can play a role in creating a legislative framework that promotes these activities, but does not become the central arbiter of decisions

The Government of Kazakhstan should establish by legislation the Government's role in energy conservation activities Specifically, Kazakhstan should consider establishing a ***two-tiered*** organizational framework, with a possible structure as specified below (see also Exhibit ES-1 on following page)

First, an Energy Conservation Department (ECD) should be established within the Ministry of Economy to provide overall direction and coordination to the development and implementation of a National Program for Energy Savings (NPES). The Department Chief of ECD should report directly to the Deputy Minister of Economy, whose portfolio includes energy conservation, and should have access to the Minister

The reasons for placing the ECD under the Ministry of Economy rather than one of the other ministries are (a) the NPES is intersectoral, (b) the Ministry of Economy has few vested interests in the energy sector, (c) the Ministry of Economy is best suited to ensure market forces play a dominant role in promoting energy savings, and (d) the Ministry of Economy can ensure that the NPES has a balanced focus, both demand as well as supply

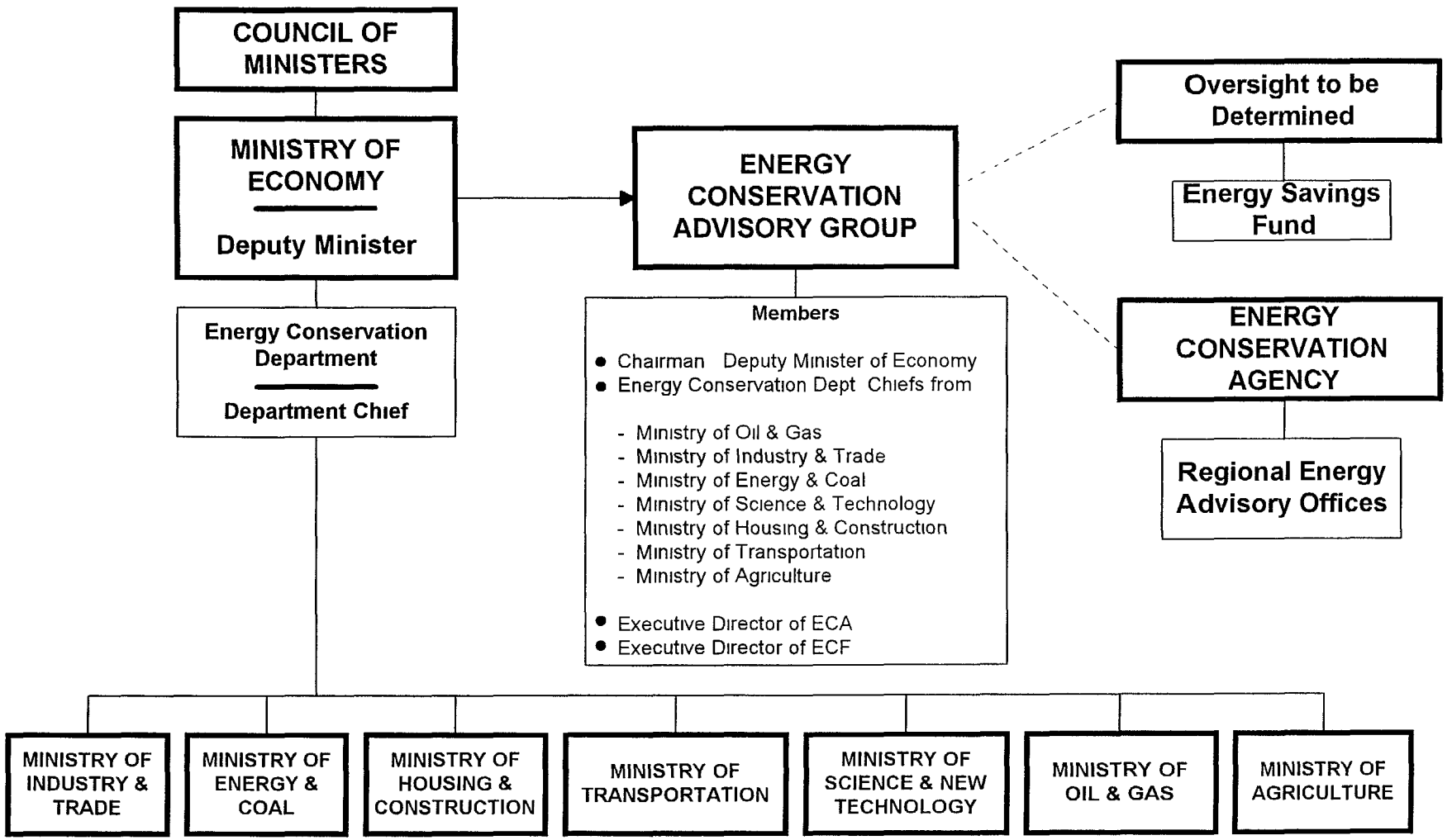
ECD should be the principal organization for coordinating the Government's role in energy savings activities It should establish clear linkages with each Ministry and research institute which should have input into the development of energy conservation policy It should actively collaborate and consult with other Government organizations in the process of conducting its activities This Department is the final authority on developing a consensus on energy savings policies and broad guidelines Each ministry which has specific activities that can be tied to energy savings should set up a department to develop and coordinate all activities associated with energy savings

The Department Chief of the ECD will establish and be the head of the Energy Conservation Advisory Group consisting of the heads of each of the energy conservation departments from the other ministries and appropriate staff persons from other selected organizations, such as research institutes The ECD will also coordinate the Government's interaction with regional and local governments in developing their appropriate policies

Listed below are some of the key issues which the ECD will need to incorporate in the NPES

- Establishing voluntary energy efficiency targets for large energy consuming facilities and power and district heating companies

Exhibit ES-1
PROPOSED ORGANIZATIONAL STRUCTURE FOR ENERGY SAVINGS ACTIVITIES IN KAZAKHSTAN



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- Strengthening and/or establishing energy efficiency standards for residential and commercial buildings and the transport sector

- Establishing tax and other financial incentives for energy conservation investments [4]

- Granting priority access to foreign exchange for energy conservation investments

- Reducing VAT and import duties on energy efficient equipment

Also, the ECD should consider undertaking immediately, or accelerate the work if already underway, the following studies which will provide critical information necessary to implement the proposed pricing guidelines and government programs or to identify revenue from potential exports which can be used to assist in financing high-priority energy savings measures

- Survey of energy consumption stratified by each major consumer category in order to establish a database on which to base a number of energy policy decisions

- Detailed cost assessment of natural gas, electricity and heat sub-sectors and of transportation costs for rail, pipelines and trucks

- Detailed assessment of current and potential oil and natural gas export options and export potential for Ekibastuz and Karaganda coal

Also, the ECD should coordinate

- Establishing a basic database system for monitoring costs of production, distribution and transportation, prices, margins over costs, and taxes The proposed rapid and substantial price and tax changes in the energy sectors necessitate timely and consistent data to implement effective energy price and taxation policy Imposition of any tax regime will also require effective verification of volumes, costs and price levels if tax policy and rates are to be enforced

- Training the staff of the Energy Conservation Department as well as individuals from the energy conservation departments within the other ministries in selected topics These topics should include energy surveys, energy demand forecasting, etc

Second, a separate Energy Conservation Agency (ECA) should be established to implement the national energy savings programs. The ECA should operate on a daily basis independently of the ECD, but is repsonsible for implementing the policies and programs developed by the Ministry of Economy A senior individual commanding respect within the energy sector should be appointed Executive Director of the ECA The ECA will be governed by a Council, composed of representatives from various organizations including the government, research institutes and private enterprises

The Agency would carry out the Government's energy savings objectives and programs These activities will, of course, depend on the policies to be included in the *National Plan for Energy Savings*, however, a sample list of activities would include

4 This policy as well as the next two should be adopted only under the following conditions (a) that the organization, to which the preferential treatment is granted, is undertaking enterprise restructuring or privatization that is consistent with the goal of becoming a market-based economy, and (b) that there is a specific time period during which these incentives can be exercised

- Conducting training programs
- Providing auditing services
- Conducting demonstration projects
- Coordinating the establishment of energy efficiency targets, standards, and labelling
- Distributing information and educational materials
- Conducting market surveys of potential energy savings in various sectors
- Attracting foreign investors to set up energy efficiency equipment manufacturing joint ventures
- Encouraging the development of energy service companies (ESCOs)

In its operations, the ECA should involve a diversity of organizations, including research institutes and non-governmental entities For example, in establishing energy efficiency targets and standards, the ECA should obtain input from industry, consumers, and research institutes not just from the staff of the ministries Over time, many of the programs and decisions associated with energy efficiency should be given to individuals and enterprises In fact, some of the activities which are initially in ECA's domain should gradually be shifted to the private sector

The ECA would initially be funded primarily by the Government or through donor agency funding but should pursue the goal of eventually being self-financed The Ministry of Finance could allocate to the ECA's budget a portion of the funds raised from energy end user taxes and from fees and/or penalties levied in the energy sector Self-financing also can be achieved by eventually allowing the Agency to charge for the services it offers (for example, technology demonstrations, audits, and training seminars)

In order to ensure effective coordination in the formulation of energy savings policy, the Government should establish an Energy Conservation Advisory Group This Group would be directed by the Deputy Minister who oversees energy savings activities in the Ministry of Economy, and consist of the Energy Conservation Department Chiefs from the relevant line ministries In addition, the Group's representation should include the Executive Directors of the Energy Conservation Agency and Energy Conservation Fund The Group is to be responsible for integrating technical input from the line ministries and to oversee the activities of the Agency and Fund This latter role is not to be implemented on a day-to-day basis, but rather to monitor periodically these entities' programs to guarantee that they are commensurate with broad, national policy and goals, as well as to ensure that they are enacted efficiently

5. Assessing Options to Finance Energy Savings

The primary sources of funding for energy efficiency investments over the next few years will be from the Government budget, a dedicated energy conservation fund, donor agencies or financial institutions, or some combination of these sources Based on the current financial market conditions in Kazakhstan, the Government should focus on the following efforts to develop funding for energy efficiency projects

- Assess the feasibility of establishing an energy efficiency demonstration zone which authorizes the repayment of western investments in energy efficient equipment and technologies in the oil sector by dedicating up to half of the oil and petroleum products saved by installing the energy saving measure to an export escrow fund

- Seek assistance from one of the multilateral banks, specifically the ADB, EBRD or the IBRD, in setting up a dedicated energy conservation fund (ECF) and providing technical assistance in the operations of the fund during its start up phase The legislation that creates and empowers the ECF should also provide for supervision and control of the funds and ensure that the costs associated with operating the ECF are minimized Overall day-to-day control of the Fund should be provided by a Board composed of representatives primarily from the Ministries of Finance and

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Economy, as well as selected financial institutions such as the National Bank of Kazakhstan and the newly-created National Development Bank As discussed, broad oversight of the Fund will be provided by the Energy Conservation Advisory Group, but the Board will ultimately report to whichever organization it is attached The Fund will provide loans to enterprises seeking to make energy conservation improvement investments, including imported energy efficiency equipment The multilateral banks involved in setting up the ECF should make recommendations regarding the organizational structure, staffing issues, including the sharing of certain ministerial technical staff, and under whose authority the ECF should reside

- Develop energy projects that the ADB, EBRD, IBRD, or IFC either separately or jointly, would be willing to fund, and include energy efficiency components in these projects These energy efficiency components could include the technical assistance associated with a dedicated energy conservation fund, creation of energy service companies, etc

- Assess private sector alternatives to the ECF The lending function should eventually be performed by various sources, including domestic financial lending institutions, major energy suppliers such as electric utilities, and suppliers of energy efficient technology and equipment

6. *Focusing Initially on the Industrial Sector*

Industry is Kazakhstan's largest energy consuming sector, accounting for 45 percent and 38 percent of end-use consumption in 1990 and 1994, respectively Evidence in the OECD countries suggests that the largest and quickest reduction in energy intensity can be achieved in the industrial sector Consequently, this project chose to focus on the industrial sector, as well as the need to encourage the Government of Kazakhstan to consider potential energy savings as one way to make their industries more competitive in the former Soviet Union and in some global markets

Facility-Level Energy Management and Savings

Why is energy management important in the industrial sector? The answer is that it makes a firm more profitable By practicing good energy management through a well structured and organized company plan, management and employees become more aware of how energy is being used, of the actual costs of energy and of the methods and equipment that can be used to control and reduce energy waste The underlying principle is cost effectiveness energy management measures must be justified in normal commercial and financial terms, like any other activity or investment A systematic and structured approach to energy management, including both technical and financial evaluations, is required to identify and realize full potential savings

The decision of company management to control energy costs is a vital first step This must be clearly stated and understood by all within the company An important part of top management commitment is to establish a department responsible for implementing the energy management program This typically involves appointing an Energy Manager and establishing an Energy Committee Evidence of top management commitment will be demonstrated in the level of support given to the Manager and the Committee, especially the resources authorized and allocated for their function

Measuring energy consumption at the plant is a critical part of any energy savings program It is essential to measure energy inputs and outputs This requires the use of various types of meters and instruments, either fixed in the plant or, in some cases, portable The terms "monitoring and targeting" are used to describe an organized approach to measuring energy consumption, analyzing the data and using the results to develop energy-saving procedures as part of the plant energy management program Setting voluntary

targets is the key to moving Kazakhstan's industrial plants towards internationally competitive levels Energy intensity or energy use data for different USA industries has been provided in this study in order to develop voluntary targets for efficiency improvements over the longer term [5]

Selected Facilities and Industries

Within the industrial sector, this study focuses on energy savings in electric power, district heating, nonferrous metals—specifically copper, and fertilizers [6] These industries were chosen based on the following criteria (a) large energy consumer, (b) viable future and important to the long term economic development of Kazakhstan, and (c) potential for exports The analysis and recommendations presented in this study on these industries were derived from information and data compiled by the Ministry of Economy, Ministry of Energy and Coal, Ministry of Industry and Trade, and technical staff at individual plants [7]

Based on the analysis completed in this study, the potential for energy savings in these industries over the longer term is immense

- Approximately 30-40 percent of the total electric energy could be saved if a comprehensive energy savings program is implemented

Of these savings, about 19 percent would be attributable to proper utilization of fuel, 32 percent to improvements in power production, 14 percent to lower transmission and distribution losses, and the remainder to improved efficiencies in end-use applications

- A total reduction of approximately 50 percent in overall energy use in district heating systems is possible Conservation, which can be encouraged through the removal of energy subsidies and the institution of rational, individual billing, has the potential to achieve energy savings of 30 percent among all end-users On the production and distribution side, improvements in efficiency could achieve savings of almost 20 percent

- Based on the energy usage at the phosphate companies during 1990, a year when the plants were at a high level of utilization, the electrical consumption per ton of phosphorus was about 16 percent higher than the typical electrical consumption for US companies Similarly the total energy consumption per ton of phosphorus was about 26 percent higher than for USA companies

- The Kazakhstan nonferrous industries are using approximately twice the energy that similar operations use in the US For copper, the energy usage per ton is about 1 6 times that experienced in the US

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5 Energy standards must be interpreted with care and international comparisons can be difficult to carry out with precision

6 Petroleum refining should also be considered one of the industries that the Government of Kazakhstan initially focuses on in the NPES Petroleum refining was not included in this study since it was previously assessed in another USAID sponsored study conducted by John Brown

7 The following plants were visited as part of this study Almaty TES-2 Power Plant, Almaty District Heating System Enterprise, NODFOS and Superphosphate companies in Dzambul, and the copper complex in Dzhezkazgan The following tasks were completed at each plant visited (a) a review of the energy management process with selected senior staff, (b) the distribution of a detailed "energy usage" questionnaire, and (c) the identification of quick, payback energy savings measures or investments

In assessing the energy efficiency of these industries and in order to establish "targets", this study attempts to compare energy consumption per unit of output at specific Kazakhstani plants with that of a well-operated plant using modern, energy-efficient technology In general, the comparative plants on which the targets would be based were in the USA The current energy consumption per unit of output is quite high in Kazakhstan compared to these target plants The Kazakhstani plants must implement measures over time that will result in the plant's energy consumption per unit of output declining towards these targets

In order to achieve these targets, several recommendations for each industry are presented in this study These recommendations were categorized in terms of short, medium, and long term energy savings measures

Short-Term Measures include no-cost or low-cost improvements in plant operation with minimum equipment modifications It is expected that most of these measures will take a maximum of 2 5 years to complete the project preparation and procurement and will have an average payout[8] of about 0 5 years

Medium-Term Measures will require investments up to several million dollars for equipment or plant modifications and probably the use of outside engineering/contractor services It is expected that most of these measures will take a maximum of 5 years to complete project preparation and procurement and have an average payout of about 3 years

Long-Term Measures include major investments in new or revamped facilities to improve and increase the plant utilization These type of investments would require justification based on significant potential for sale increases through market analyses and on a comprehensive economic analysis for each measure suggested for implementation It is expected that most of these measures will take a maximum of 9 years to complete project preparation and procurement and have an average payout of about 6 years

Until the overall macroeconomic conditions improve and/or financing can be more readily arranged, industrial plants should focus on how to implement the short term measures identified in this study[9] Listed below are those short term measures which were commonly identified in each of the selected industries

- Install low NOx burners to control the mixing of the fuel and air and reduce NOx emission
- Change/modify present instrumentation on various plant equipment to control/monitor boiler operation and systems performance accurately
- Install microprocessors which will measure and monitor signals of flow and heat rates of thermal production boilers, hot water distribution lines and transportation pumps, and automatic control and manage the supply to, and demand from, mixing stations
- Install flue gas oxygen analyzers to regulate the amount of excess air for optimum combustion efficiency of the hot water boilers

8 Payout is the time required to recover the costs of the investment once the investment is operational

9 Pursuing these short term measures will not hinder the efforts to privatize these plants Sometimes the implementation of the medium and long term measures should be delayed until the plant is privatized A case by case assessment would be required to establish whether the medium term and long term investments should be delayed until after the plant is privatized

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- Install non-contact type water flowmeter capable of monitoring water flow ranging from 5,000 to 50,000 cubic meter per hour

- Install heat meters to measure and control the quantity of heat used in space heating, ventilation, and utility consumption of individual customers

- Install or replace steam traps in steam lines going to industrial users or in boiler plants

- Improve combustion efficiency of furnaces and boilers by installing flue gas oxygen/combustion analyzers

- Add, repair, and replace insulation as necessary based on a comprehensive inspection of heat losses from various equipment and piping

- Improve maintenance program to assure continuous repair or replacement of leaky valves and pipes, damaged insulation, instrumentation, and equipment Develop a detailed maintenance history and data logging program

- Implement training programs at all levels of plant personnel through seminars, courses, and education programs

- Manage the use of vehicles better

7. Establishing Longer-Term Policies and Programs

Like all governments worldwide that have established energy savings policies and programs, Kazakhstan will have to proceed in stages somewhat dependent upon the pace at which Kazakhstan implements economic reform The Government should refine legislation, eliminate some activities, and consider implementing additional programs as the energy sector and economic circumstances change

After initially focusing on policies and programs that are achievable in a timely and effective manner during the transition to a market-based economy, the Government should then consider policies and programs that will yield energy savings in the longer term These types of programs have the benefit of providing consistent, long-term signals promoting energy conservation even in times of low energy prices Most governments have learned that the effectiveness of many energy savings programs is vitally related to the energy price environment generally, energy conservation priorities diminish as energy prices decline and businesses and households are less inclined to take advantage of government-sponsored incentives for investing in energy savings activities

Three areas that the Government of Kazakhstan needs to consider in addressing the Republic's potential for energy savings in the longer term include demand-side management[10], labelling, and the enforcement of standards in the building and transport sectors Most of the DSM activities require the installation first of specific monitoring and control equipment Establishing labelling programs requires significant time in building an industry consensus on labelling and labelling equipment is one program that could be conducive to abuse in the current environment in Kazakhstan Establishing acceptable energy efficiency standards in the building and transport sectors will take some time Consequently, adequate enforcement is likely to be achieved only in the longer term

10 DSM is the planning, implementation and monitoring of utility activities that encourage consumers to modify their patterns of usage, including the timing and level of usage

Chapter 1
INTRODUCTION

1.1 CONTEXT AND SCOPE OF STUDY

The Council of Ministers of the Republic of Kazakhstan decided in 1994 to establish a National Program for Energy Savings This program is to be comprehensive in scope covering each sector of the economy The responsibility to prepare recommendations for the development of a National Program for Energy Savings was given jointly to the Ministry of Energy and Coal and the Ministry of Economy At the request of the Government of Kazakhstan, the US Agency for International Development's (USAID) Office of Energy Infrastructure for the Newly Independent States agreed to assist in the development of such a program by providing technical assistance in specific areas which were jointly selected

This report is one of the deliverables required as part of the contract[1] executed between USAID and Burns and Roe Enterprises to provide technology based services in support of USAID's NIS Energy Efficiency and Market Reform Project This report is based primarily on data and information collected as a result of missions taken to Kazakhstan in October-November 1994, January-February 1995 and April 1995 These missions included plant visits, plant seminars, and a seminar conducted in Almaty in February 1995

In executing this study the major subtasks were divided into two major categories subtasks associated with economic and legislative energy savings measures and subtasks associated with technical energy savings measures Also, it was agreed to focus the work being conducted in the technical category only on the following sectors power, district heating, nonferrous metals and fertilizers These sectors were chosen because they are among the largest consumers of energy in Kazakhstan and because energy efficiency gains have been achieved rapidly in these industries in many other countries [2]

The primary subtasks under the economic and legislative category were

- To discuss the role of market-determined pricing as the primary economic incentive by which to encourage energy savings
- To develop future energy pricing and tariff guidelines
- To review and assess government energy savings programs and policies and organizational issues
- To discuss potential organizational structures

The primary subtasks under the technical category were

- To describe the principal functions of industrial energy management and recommend energy savings organizations for individual plants
- To compare energy consumption in the industrial sector to the levels achieved in selected other countries

1 USAID Contract No CCN-0002-Q-00-3154-00

2 Petroleum refining is another large energy consuming industry See the prior USAID study, *Economic and Technical Factors of the Kazakhstan Petroleum Refining Industry*, completed by John Brown

- To identify quick, payback as well as longer term energy savings measures
- To estimate the energy savings potential associated with these measures
- To identify potential sources of funding for these measures

1.2 BACKGROUND

The Government of Kazakhstan has committed itself to creating a market-based economy Since 1991 it has adopted many policies and legislation consistent with moving towards this goal However the task of transforming Kazakhstan's economy is immense While a private economy is beginning to emerge, the overall macroeconomic conditions over the past few years can be described as a period of economic contraction, rapid inflation and a substantial loss of traditional trade with the other republics of the former Soviet Union With the substantial decline in production, the Republic of Kazakhstan has fewer resources available to finance the economic restructuring or to provide a level of social protection during the period of transition

Kazakhstan is richly endowed in raw materials, including deposits of oil, natural gas, coal, copper and other nonferrous metals These deposits are large and were traditionally exported to the other former republics of the former Soviet Union These two sectors—energy and metals—are two of the most important sectors in the Republic These two sectors are critical in generating foreign exchange, attracting foreign investment, restoring traditional trade patterns, integrating Kazakhstan into the global economy via the development of new trading and transport routes, and providing a competitive advantage to either current or new energy intensive industries or manufacturers of metal intensive products

Exhibit 1 1 presents the projected energy balance for 1995 and the 1990 production of specific energy products With the exception of natural gas, each of the categories in Exhibit 1 1 has declined substantially since 1990, with the decline ranging between 16 and 77 percent Kazakhstan's net imports of gas and electricity are more than offset by its exports of oil and coal

Exhibit 1 2 compares Kazakhstan's energy and electricity intensities, measured as the ratio of energy or electricity consumed to the population, to those of Poland and Turkey [3] Kazakhstan's energy intensity in 1992 was about 1 7 and 3 9 times greater than that of Poland's and Turkey's, respectively Similarly, Kazakhstan's electricity intensity was about 1 3 and 3 6 times greater than that of Poland's and Turkey's respectively Over time, with the successful implementation of the National Program for Energy Savings, Kazakhstan's intensity levels will decline towards the levels experienced in comparable countries such as Poland and Turkey

1.3 IMPORTANCE OF ENERGY SAVINGS

Energy savings is important for many reasons Some of the more important reasons are listed below

- Energy and capital resources will be saved

This becomes all the more critical as energy prices are raised to world equivalent levels

- Environmental conditions will be improved

3 At the beginning of this study, a joint decision was made to attempt to provide comparative statistics, when possible and relevant, between Kazakhstan, Poland and Turkey

Exhibit 1.1
ENERGY BALANCE FOR CERTAIN PRODUCTS

			Projected 1995				
	Units	**1990 Production**	**Production**	**Imports**	**Total Resources**	**Internal Consumption**	**Exports**
Electricity	Mil kWh	87379	69630	14835	84465	78900	5565
Coal	Thou Tons	126560[1]	105000	1000	106000	73700	32300
Oil & Gas Condensate	Thou Tons	25600	21200	5400	26600	12400	14200
Natural Gas	Mil CM^3	1481[1]	2400	9500	11900	10500	1400
Gasoline	Thou Tons	3422	2386	900	3286	2836	450
Jet Fuel	Thou Tons	1082	250	90	340	280	60
Diesel Fuel	Thou Tons	4893	3530	1120	4650	3800	850
Mazut	Thou Tons	5975	4612	538	5150	3900	1250
Liquid Gas	Thou Tons	----	420	230	650	650	-----
Total	Bil Tenge	----	432 2	132 6	564 8	495 0	69

[1] 1991

Exhibit 1.2
COMPARATIVE ENERGY INTENSITIES
(1992 Unless Noted)

	Primary Energy Consumed Per Capita (Mil Btu's)	Electricity Consumed Per Capita (kWh)
Turkey	46	1026
Poland	105	2939
Kazakhstan	180	3686

In general, lower energy consumption has a positive impact on the environment, notably the global atmospheric conditions Energy production, transportation and consumption play major roles in the environmental problems existing in Kazakhstan Meeting growing domestic energy needs through conservation and efficiency measures rather than simply more production will contribute to an improvement in the environment

- Technology transfers will increase

Technology transfer, a process of conveying information necessary to improve some capability to design or produce goods or services, will be promoted as a result of Kazakhstan's development of its National Program for Energy Savings Examples of technology transfer include design concepts for efficient buildings, manufacturing capabilities for energy efficient products or energy savings products or training of energy auditors

- Additional foreign exchange will be generated or saved

As mentioned above, Kazakhstan is a major producer of energy and additional foreign exchange earnings would result from the increased exports that are freed up through the reduction of energy used by domestic consumers Also, individual enterprises which are purchasing energy imports and being required to pay in hard currency will save foreign exchange by reducing their consumption of these imports Additional hard currency earnings are likely to be essential in funding much of the economic restructuring and infrastructure rebuilding

- Competitiveness will be enhanced

The competitiveness of an enterprise or firm operating in the world economy is dependent on many factors One of these factors can be categorized as natural resources [4] Specifically, from the supply-side perspective, an enterprise operating in a country with abundant, inexpensive natural resources, especially energy, will have a competitive advantage compared to one in a country with less and/or more expensive natural resources Increased efficiency will free up more resources for export, thereby increasing revenues available to finance further efficiency measures From the demand-side perspective, an enterprise that utilizes raw materials, including energy, more efficiently will be in a more competitive position than a firm that doesn't This is especially important to the industrial sector in Kazakhstan which historically has been accustomed to cheap energy As energy prices continue to rise to world equivalent levels, the industrial firms, especially the energy-intensive ones, are going to have to become much more energy efficient if they are going to survive or to compete in world markets

Exhibit 1 3 suggest the framework by which this study has attempted to address the issue of energy utilization and international competitiveness As indicated above, the energy intensity in Kazakhstan as a whole is quite high As will be discussed in those chapters focusing on the industrial sector, this is true as well at the individual industrial plant The current energy consumption per unit of output is quite high in Kazakhstan compared to the same industry in other countries which Kazakhstan currently or in the future will have to compete with This is represented by the "1989 level" in Exhibit 1 3 [5] The Kazakhstani

4 The 1990 World Competitiveness Report published by The World Economic Forum and IMD International in Switzerland lists natural resource utilization as one of ten factors determining competitiveness

5 1989 was selected as a year when most plants were operating near their normal utilization rates versus the current depressed rates

plant must implement measures that will result in the plant's energy consumption per unit of output declining to the "international average level " Those measures identified in each of the industrial chapters (Chapters 7 to 10) as short to medium term measures are expected to assist the plant in achieving this target In order to reach the "ideal competitive level", the plant will have to pursue the longer term measures These measures generally require major capital investments in the latest technology

1.4 POTENTIAL FOR ENERGY SAVINGS IN KAZAKHSTAN

The potential for energy savings is immense in Kazakhstan, as has been demonstrated in countries with similar command economies For example, Poland's energy intensity, measured as tons of oil equivalent per capita, was reduced from 2 21 in 1988 to 1 65 in 1992, or a 25 percent reduction over four years

Based on research done by Lee Schipper and others at the Lawrence Berkeley Laboratory, and assuming that the energy systems in Kazakhstan can be characterized as similar to the energy systems of the former USSR, then again the potential for energy savings is large [6] Manufacturing fuel intensity can be reduced by 25 percent and manufacturing electricity intensity by 10 percent over the short to medium term and 40 percent to 20 percent, respectively, over the longer term These short- to medium-term reductions in intensity are achievable through a focused energy management effort (as discussed in Chapter 6), increasing energy prices to world equivalent levels (as discussed in Chapter 2), and the introduction of modern Western practices and technologies (as discussed in Chapters 7 to 10) To achieve the longer-term reductions would require more advanced technologies In contrast to these estimates of reduced energy intensities in manufacturing, a more moderate reduction would likely be achieved in the other sectors

Exhibit 1 4 presents sectoral energy consumption in 1994 and a column for estimates of potential energy savings by sector The dramatic current and future changes in the Kazakhstani economy and energy systems over the next twenty years make any standard techniques of extrapolation of previous trends of little or no value Policies and behavior are in the process of substantial change There is great uncertainty surrounding macroeconomic and sectoral developments in the short and longer term As a result, any projection of energy demand and potential energy savings at this time would be one of many possible outcomes In order to estimate the potential savings in the last column of Exhibit 1 4, both a top-down and a bottom-up approach should be utilized Based on the potential savings estimates suggested in the industrial chapters of this study and prior research done in the USSR, a top-down estimate would be 15 to 25 percent of the 1994 value of energy consumption, or about 20 to 34 billion Tenge The data in Exhibit 1 1 indicates that Kazakhstan's energy trade deficit in 1995 is expected to be about 62 8 billion Tenge The potential energy savings is about 32 to 54 percent of this deficit To project the potential energy savings for each sector in Exhibit 1 4 would require a bottoms up approach, or a detailed assessment of the current conditions and projected changes in each sector This is beyond the scope of this study

6 Lee Schipper has written many articles on energy consumption in the former USSR. The estimates presented here are discussed in "The Soviet Union Energy Conservation Dilemma," Energy Policy, May 1991

Exhibit 1.3
Energy Utilization and International Competitivenes

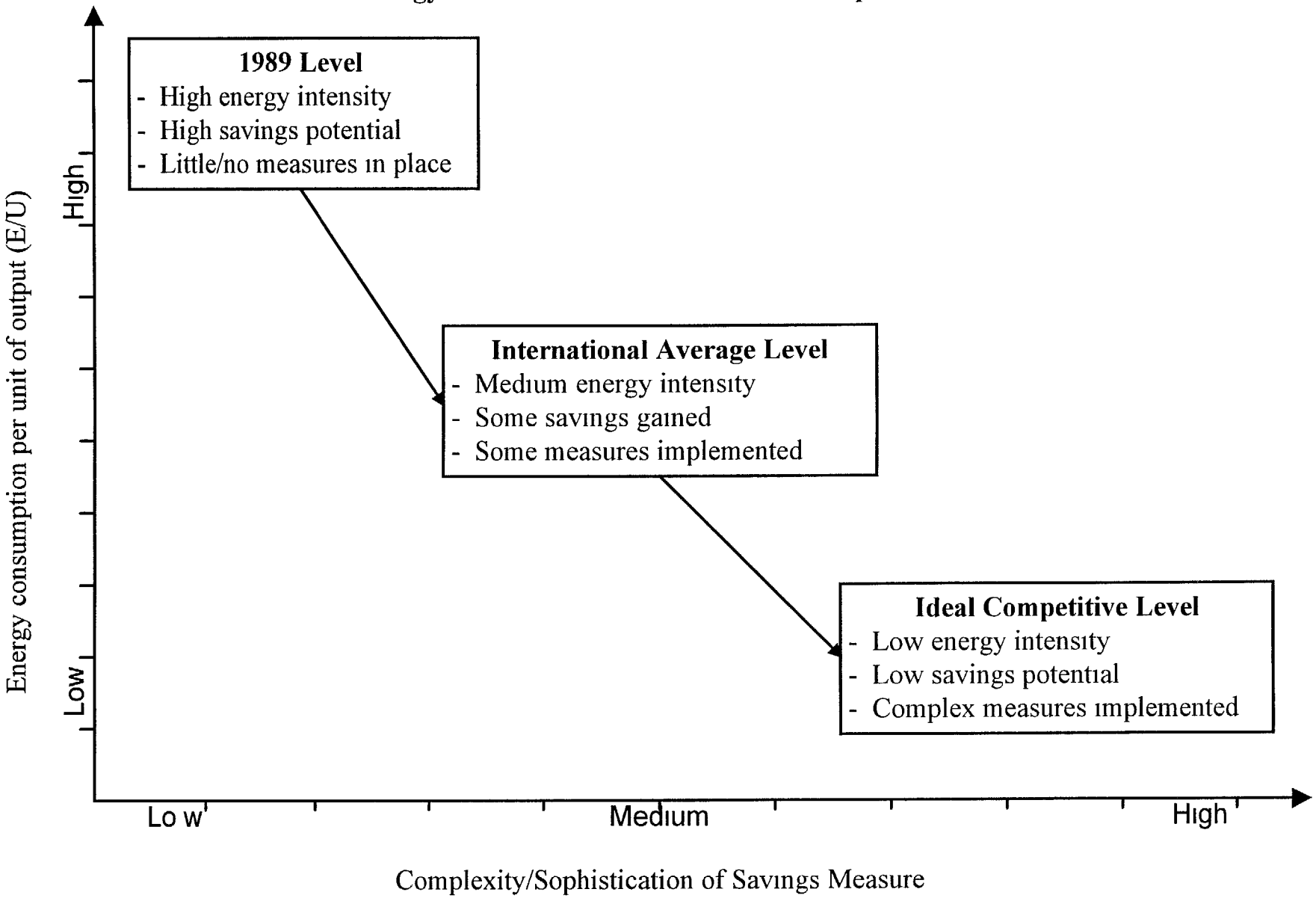

Exhibit 1.4
POTENTIAL ENERGY SAVINGS IN KAZAKHSTAN

Sectors	1994 Current Value(1) (Billion Tenge)	Expected Savings (Billion Tenge)
Construction	1 5	(2)
Residential	22 4	(2)
Public/Other	12 3	(2)
Transport	18 4	(2)
Agriculture	30 0	(2)
Industry	51 9	(2)
Total	136 5	20 to 34

(1) The annual value of fuels and electricity consumed
(2) These estimates are beyond the scope of this study A detailed assessment is required

1.5 MACROECONOMIC REFORM AND ENERGY SAVINGS

Western products and technologies can save energy but the problem is not simply inefficient equipment but inefficient practices and policies Sustained progress on economic reform, especially on price and market liberalization, will be critical in obtaining energy savings throughout the Republic of Kazakhstan Economic reform can be expected to lead to substantial energy savings The Government must strengthen its efforts in the following areas of economic reform [7] (a) accelerate price reform and eliminate state orders, (b) transfer ownership to private sector, (c) accelerate legal structure reform, and (d) promote enterprise restructuring Enterprise restructuring must place a high priority on education and training (marketing, accounting, economic and financial analysis, management and strategic planning) and the transfer of social services

Price liberalization will be a complex and politically sensitive task This task will primarily require reforms in pricing and taxation as well as institutional reform These reforms cannot be accomplished rapidly for they all require a political consensus Institutional reform in the energy sector is necessary to restructure energy enterprises and enhance their economic efficiency and development potential Enterprise governance should be strengthened and budget constraints tightened Enterprise reform should encourage competitive enterprises that are driven by the incentive to make profits The elimination of protection by the state and the imposition of financial discipline on these enterprises will strengthen the linkage between hard budget constraints and pricing

1.6 ORGANIZATION OF THE REPORT

Chapter 2 discusses key principles of pricing and proposes guidelines for moving Kazakhstani prices to world-equivalent levels *Chapter 3* reviews the factors underlying energy demand and proposes a methodology by which to project energy demand and potential energy savings *Chapter 4* reviews government energy savings programs adopted by several countries, focusing on financial and tax incentives, regulations and information programs, and assesses various organizational structures by which to separate institutional responsibilities *Chapter 5* lists several potential sources of funding for energy savings projects and discusses energy savings funds, project finance and performance contracting via energy service companies *Chapter 6* discusses energy management issues at the plant level focusing on measuring energy consumption and audit procedures *Chapter 7* provides an overview of Kazakhstan's power sector, recommends various energy savings measures and estimates the potential energy savings associated with these measures *Chapter 8* discusses the district heating system in Almaty and, based on the Almaty system, recommends various energy savings measures and estimates the potential energy savings associated with these measures *Chapter 9* presents an overview of the fertilizer plants located in Dzambul, Kazakhstan, recommends various energy savings measures and estimates the potential energy savings associated with these measures *Chapter 10* presents an overview of the nonferrous metals industry based on the copper complex at Dzhezkazgan, Kazakhstan, recommends various energy savings measures and estimates the potential energy savings associated with these measures

7 In making the economic transition to a more market-based economy, there are many reform measures which need to be introduced and implemented Most of these measures can be organized under the five following categories macroeconomic stabilization, price and market liberalization, privatization, construction of a social safety net, and mobilization of international financial assistance

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Annexes A through F present additional detailed material related to various pricing, economic and legislative issues ***Annexes G through K*** contains additional detailed information on facility level energy management and energy consumption questionnaires for individual power, district heating, nonferrous metal, and fertilizer plants ***Annex L*** reviews those key measures or investments needed to significantly improve the overall performance and achieve substantial energy savings at the TES-2 power plant in Almaty ***Annex M*** describes the Russian Gas Distribution Rehabilitation and Energy Efficiency Project (RGDREEP)

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Chapter 2
ENERGY PRICING PRINCIPLES and GUIDELINES

2.1 PRICING PRINCIPLES

The Government of Kazakhstan needs to place a high priority on the adoption of the following basic energy pricing principles as the economy evolves towards a more open, market-based economy

- Price levels must be set "X%" higher than cost, with "X" representing the necessary return on investment needed to meet projected demands This will assure the energy sector can self-finance the investments needed to meet future demands

- Retail price levels also set "X%" higher than costs and set to achieve government/society's goals, including

  - Contributing revenues needed to finance selective energy-sector related subsidies
  - Contributing to the state budget
  - Establishing inter-fuel price relationships which encourage the development and use of indigenous resources
  - Encouraging fuel use patterns which reflect the full environmental costs of fuel consumption
  - Stimulating conservation measures

- Energy prices must also take account of the need to internalize certain externalities, such as the costs associated with environmental protection

- Energy prices should be characterized by transparency so that consumers and producers can make economically efficient decisions

- Price levels must be set so that marginal costs of energy supply are fully recovered in the short term to include all variable operating costs and in the longer term to include fixed costs

- When traded in world markets, prices of energy commodities should reflect full border equivalent of available export markets, fully accounting for transportation costs and quality differentials, appropriately measured

- Tariffs should reflect cost of service to different classes of customers, e g households, agricultural and industrial consumers

- Regional energy prices should reflect different transportation and distribution costs and regional demand pressures

- Proper weight should be given to energy policy objectives when considering tax policies

- Quantities of energy demanded and supplied must be permitted to vary in response to changes in price not allocated according to an annual plan developed by the Government

- All citizens should have the essential minimum supply of vital fuels at an affordable price

Guidelines for determining the desired rate of full energy price and trade liberalization are presented below, specifically as potential constraints to the assumed liberalization steps cited, but also as standards which might serve to establish a more acceptable path of price and trade liberalization

- Rapid price decontrol could so strain personal/household incomes as to create a major slowdown in economic activity and increase the risk of political turmoil discouraging badly needed foreign investment One macro-policy guideline, therefore, is to evaluate the rate of energy price increases in terms of some acceptable percentage of household income spent on energy, and in the case of key economic sectors (e g agriculture) on the basis of some acceptable percent of total operating costs accounted for by energy These ratios could serve as guidelines for assessing the necessary degree and duration of subsidies to the household and key economic sectors, and suggest the necessary data to collect in order to make an informed assessment of energy subsidy policy and costs under alternative energy price decontrol paths Complete price decontrol should not out-pace the ability of Kazakhstan to measure, analyze and develop a reliable response strategy to the income and social effects it generates

- Internal price and trade liberalization should also not out-run the development of realistic free world export markets Thus, if pipeline capacity to reach free markets is not available for the short term, efforts to accelerate decontrol ahead of this schedule will be constrained by the lack of legitimate market opportunities or outlets On the other hand, a clear statement and reasonably reliable schedule of a price liberalization plan is needed to encourage much of the foreign investment and financial participation needed to develop the infrastructure projects which increase access to export markets

- In the process of decontrolling absolute price levels, it is important that a decontrol path for each major fuel be set which is compatible with the maintenance of realistic relative price levels among the fuels so distorting price signals which would mis-allocate resource investments will not be sent on either an inter-fuel or inter-regional basis Such distortions affect the potential economic return on pipeline and transmission line investments, site and fuel selection for major end-use plants, processing or resource development projects Price decontrol should not proceed without a better understanding of its likely impact on relative price levels, and the range of tax and tariff policies needed to correct perceived distortions

- Price decontrol should not out-pace the ability of the key policy-makers to measure real production costs, so that the rule of pricing to recover long-run marginal costs can be pursued with some reliability, and so that price decontrol does not create a situation in which excess profits are created Excess profits result in a mis-allocation of precious resources and call to question the effectiveness of the tax system to capture and re-invest these profits in high priority investments

- Price decontrol should not proceed so rapidly as to worsen the energy payment and collection process, however, it must keep pace with inflation Price increases can negatively impact the quantity and quality of service provided by worsening cash flow and margin conditions for energy suppliers In short, price increases should not out-run and threaten the financial system which support the payment process, and ultimately the quality and quantity of energy service provided

2.2 LIMITATIONS TO MARKET-BASED PRICES

In theory, energy prices determined by free market forces should produce an optimal allocation of energy resources Energy prices set by free market forces should provide the broad signals for conservation measures to be undertaken There are, however, a number of factors which prevent the market for energy conservation from working with full efficiency As a result the free market must be supplemented with specific energy savings government programs and regulations, as discussed in Chapter 4 Some of the conditions under which the free market must be supplemented are discussed below

Barriers to Economic Pricing

Energy prices are often volatile causing short-term market considerations to influence short-term marginal cost estimates and distort long-term marginal cost Another barrier is the energy sector's strong tendency towards monopoly During the last decade energy markets have become much more competitive as a result of increased inter-fuel competition and deregulation in the natural monopolies and the electricity and gas utility sectors Finally, government and other public authorities are prone to intervene in setting energy prices This intervention has led to price distortions in many countries, including general attempts to hold down energy prices in the interests of other policies, such as the promotion of industrial development, the reduction of inflation or to help the poor

Externalities

External costs and external benefits which are not fully reflected in market prices include environmental, security and other social costs and benefits The market-place allocates resources on the basis of costs and benefits reflected in prices It may not always take into account wider social costs and benefits to which economic activity gives rise A number of such externalities are particularly relevant to energy conservation The more efficient use of energy on an economic basis is of primary importance for achieving the objectives of both energy and environmental policy Means to promote the efficient use of energy are, with very few exceptions, free of environmental disadvantages and the environmental problems associated with energy production and consumption are therefore reduced if less energy is used

Heavy reliance on imported fuels from insecure or unstable sources results in external costs to national economies that are also not fully reflected in market prices Such costs may be reflected directly in the costs of maintaining fuel stock or indirectly in national expenditures related to defense, but they are most often only clearly visible when those imported supplies are interrupted or manipulated

Specific Market Limitations

There are several specific market limitations which prevent or hinder prices from being reflected in the behavior of energy consumers Some of these limitations are presented below

> ***Lack of the information and/or technical skills*** Small- and medium- sized and even large companies in non-energy-intensive industries and consumers often lack sufficient information and probably cannot provide sufficient skills themselves to accomplish potential energy savings Information can be confusing and sometimes conflicting Consequently, consumers will often do nothing

Invisibility of energy use, costs and conservation. Many energy consuming systems and services do not, or inappropriately, measure energy consumption Thus, there is little feedback to encourage consumers to conserve For example, a central meter for an apartment building provides poor feedback to the individual consumer

Separation of energy expenditures and the associated benefits. A consumer who uses energy often does not pay directly for his consumption For example, a landlord can make an energy savings investment while the benefits derived can go to the tenant who pays the energy bills

Obstacles to development and introduction of energy efficient technologies. Often many of the manufacturers of energy-conserving technologies cannot afford the resource commitment to the required research, development and demonstration efforts

2.3 CURRENT STATUS OF ENERGY PRICING

Price developments since 1991 are summarized in Exhibit 2 1 All of the price data in Exhibit 2 1 are denominated in US dollars (Exhibit A-1 in Annex A presents the 1992 data in Rubles and the 1993/1994 data in Tenge)

As shown in Exhibit 2 1, increases in energy prices have varied substantially by fuel type and consumer class Between 1992 and 1994, with the exception of fuel oil and coal at the minemouth the energy prices increased by a factor of ten or greater In November 1993 Kazakhstan introduced its own currency, the Tenge Between November 1993 and November 1994, the Tenge/US dollar exchange rate rose from 5 Tenge per US$ to 51 4 Tenge per US$ The majority of the prices presented in Exhibit 2 1 had increases between November 1993 and 1994 large enough to offset the depreciation of the Tenge However, the price increases of petroleum products, residential natural gas and minemouth coal were less than the depreciation, consequently, the prices of petroleum products, residential natural gas and minemouth coal declined, when measured in US dollars Tariffs for natural gas, electricity and heat are differentiated by type of consumer The November 1994 prices of natural gas, electricity and heat consumed by the population rose to levels that were 11%, 84%, and 56% of industrial levels, respectively In January 1992 these residential tariffs, as a percent of the industrial tariffs, were 9%, 44% and 62%, respectively In comparison, 1992 household tariffs for natural gas and electricity in Hungary were about 80% of industrial tariffs [1]

Despite these substantial energy price increases made since 1991, domestic energy prices remain at only a fraction of world equivalent levels and severe sectoral distortions continue to exist, as illustrated in Exhibit 2 2 [2] With the exception of industrial natural gas, Kazakhstani energy prices, as of November 1994 and measured in US dollar terms, were about 10% to 45% of the first quarter 1994 Turkish prices In contrast, Poland's prices as a percent of Turkey's prices were 45% or greater In fact, with the exception of electricity tariffs, Poland's prices were in general approaching Turkey's price levels

1 In the market-based economies of the OECD countries, tariffs to households are typically 1 5 to 2 5 times that of industrial consumers

2 The data were supplied by the Ministry of Energy and Coal These data, especially for natural gas, need to be confirmed and more recent petroleum product prices obtained

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Exhibit 2.1
KAZAKHSTAN'S ENERGY PRICES (US DOLLARS)[1]

	January 1992	November 1993	November 1994[2]
Crude Oil			
Wellhead, per Ton	3 18	20 00	31 13
Refined Products			
Gasoline, per Ton	9 61	242 40	98 15
Diesel fuel per Ton	8 47	149 00	105 24
Fuel Oil per Ton	26 18	66 40	37 28
Natural Gas			
Wellhead, per Thous CM[3]	0 68	46 00	78 13
Industrial, per Thous CM	7 91		140 66
Residential, per Thous CM	0 67	56 00	14 70
Ekibastus Steam Coal			
Minemouth, per Ton	0 29	2 20	1 86
Power plant, per Ton	0 29	-----	4 12
Electricity			
Industrial, per kWh	0 002	0 022	0 035
Residential, per kWh	0 001	0 008	0 029
Heat[4]			
Industrial, per Gcal	1 33	10 90	30 40
Residential, per Gcal	0 82	5 06	16 91

1 Exchange rate premises were as follows Jan '92 110 Rubles/USD
Nov '93 5 Tenge/USD, May '94 36 8 Tenge/USD, June '94 42 Tenge/USD
Sept '94 47 2 Tenge/USD, Nov '94 51 4 Tenge/USD

2 Petroleum products are for May 1994, steam coal for June 1994 and heat tariffs for September 1994

3 CM is Cubic Meters

4 Heat tariffs for Almaty

Sources World Bank's 1993 Kazakhstan study, Ministry of Economy

Exhibit 2.2
COMPARISON OF END-USE ENERGY PRICES

End-Use Sector	Kazakhstan (Nov 1994)	Turkey (1994:Q1)	Poland (1994:Q1)	Kazakhstan % of Turkey
Electricity (US¢/kWh)				
Industrial	3 5	8 6	3 7	40%
Residential	2 9	8 5	4 4	34%
Natural Gas (US$/10^7KCAL GCV)				
Industrial	156	136	117	115%
Residential	16	158	143	10%
Motor Fuel (US$/Litre)	23	52	46	45%
Coal (US$/M Ton)				
Industrial	8 8	36	33	24%
Residential	-----	55	79	----

Although the Government of Kazakhstan endorses the reform of energy pricing and taxation, the data presented in Exhibit 2 2 indicate it wishes to follow a gradual process of transformation Such a pace is thought to result in fewer social and economic disruptions Experience from other countries that have faced energy price shocks, such as the OECD countries during the 1970s and the Central and Eastern European countries during the past few years, suggest that economic restructuring has been most successful when the full level of increased energy prices has been passed on to industry and final consumers as rapidly as possible

International price comparisons require care in specifying not only a common reference point (i e delivered vs minemouth, import vs domestic), but also tax vs ex-tax levels, and the date of price determination Also, converting the local currencies to a common currency requires careful consideration There is value in comparing and monitoring international and inter-fuel price comparisons Any nominal comparison of price levels is subject to numerous qualifying adjustments Nevertheless through diligent examination of the underlying costs and perceived economic value attributed to various energy price and tax levels, such price relationships offer a useful guide for rationalizing price and tax levels internally and maintaining a competitive position in the international market Moreover, as the overall economy becomes more open and integrated with the rest of the world, many Kazakh price relationships will more closely reflect the price relationships of other nations This process will necessitate the development of timely and accurate price and cost data, including data needed for performing tariff studies, and for developing management information systems to document and monitor energy price and taxation levels internally and in the surrounding republics

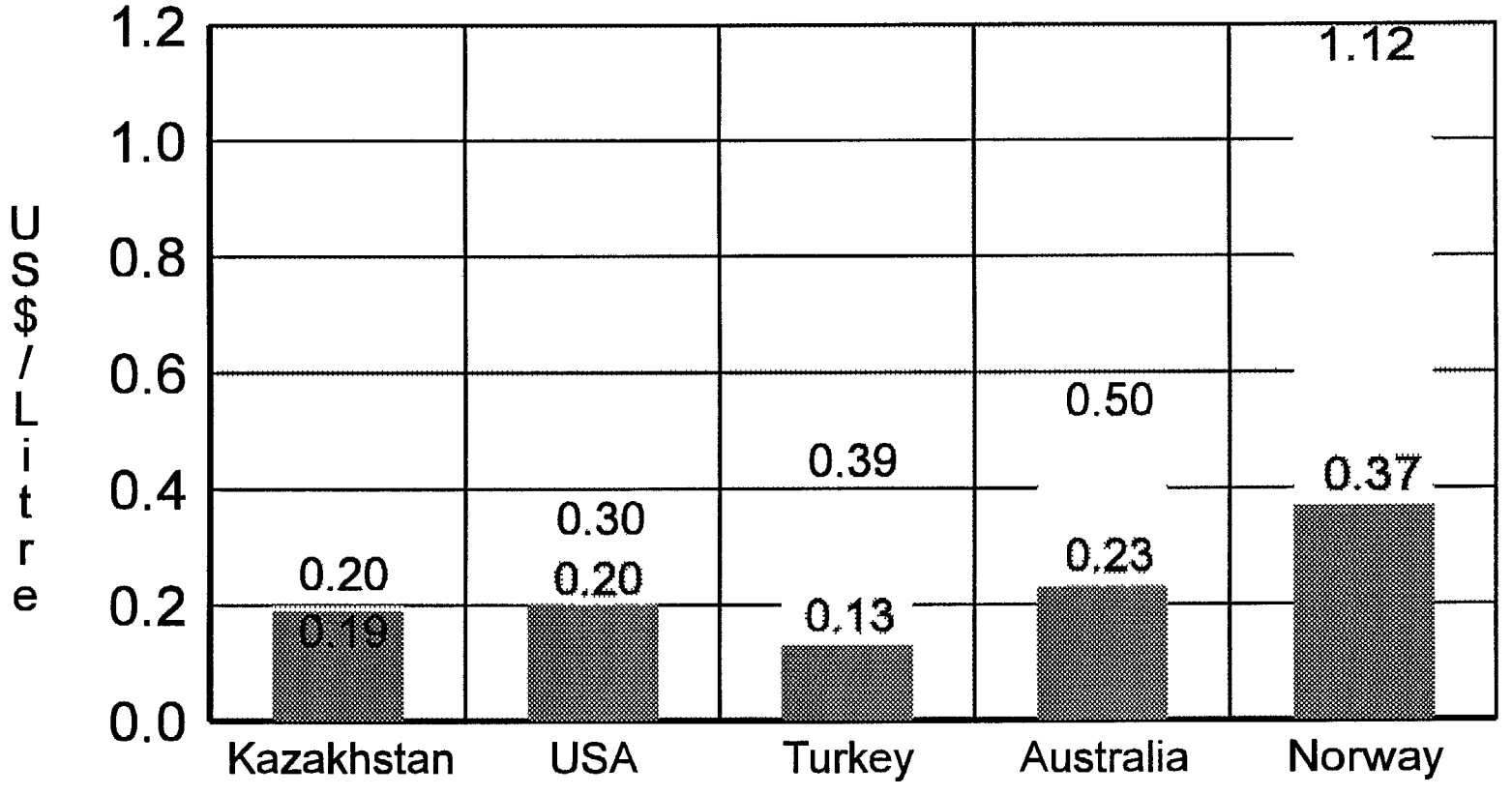
Through taxation, governments can affect consumer prices and hence, energy demand and efficiency However, tax policies generally reflect much broader concerns than energy objectives, in particular, fiscal and various macroeconomic, social, regional and industrial considerations The need for governments to raise revenue in a convenient and effective way is a primary consideration in virtually all countries There is a wide variation among countries and among energy commodities in the proportion of final energy prices represented by taxation In general, energy taxes in the OECD countries are heavily concentrated on petroleum products, particularly gasoline, where they are easy to collect and where there is an easily explained justification, the need to construct and maintain roads End-use gasoline tax as a percentage of the retail gasoline price varies between 33% in the USA and 67% in both Turkey and Norway, as shown in Exhibit 2 3, compared to only 5% in Kazakhstan Annex A presents additional comparative price and tax data In general, the tax component of end-use energy prices for coal, electricity and natural gas range between 5% to 17%

2.4 FUTURE ENERGY PRICING GUIDELINES

As a general rule, energy prices should be fully increased to reflect economic costs of supply, or when traded in world markets, the export value With sustained increases to world equivalent levels, most energy price subsidies will be eliminated resulting in energy savings During this transition of reform and price liberalization, emphasis should be placed also on adjusting relative price relationships not just absolute price levels This is especially true during times of extreme uncertainty surrounding exchange rates The persistence of extreme imbalances between economic costs and market values will create distorting signals, and eventually result in inefficient resource development and use Regardless of the pace of reform chosen by the Government of Kazakhstan, the Government needs to place a high priority on the adoption of pricing guidelines which focus on restructuring relative energy prices consistent with free market and internal cost price relationships Sections 2 4 1 and 2 4 2 discuss pricing guidelines for non-grid fuels (crude oil, petroleum products, natural gas, and coal) and grid energy (electricity and gas) consistent with the principles discussed in Section 2 1 Section 2 4 3 then presents long term price projections consistent with the proposed guidelines

Exhibit 2.3

COMPARISON OF GASOLINE PRICES AND TAXES



2.4.1 Non-Grid Fuels

For non-grid fuels, prices should be decontrolled rapidly Producer, wholesale and retail prices of non-grid fuels should be fully liberalized This should be done in parallel with abolishing the system of state orders for these commodities Restructuring and commercialization of these sectors should be undertaken as rapidly as possible Full price liberalization is not expected to lead to world market prices for all non-grid fuels in the near term as some prices in Kazakhstan will be constrained by the inter-republic linkages between other former Soviet Union republics, primarily Uzbekistan, Turkmenistan, and Russia

The key factors affecting the speed of this transition for the primary projected export "growth" fuels (crude oil and natural gas) will be the completion of export pipeline projects and the rate of energy price and market reform pursued by Russia, as Kazakhstan will remain highly dependent on Russia for access to world markets In the short term, critical short-term determinants of non-grid fuel prices in Kazakhstan will be the domestic prices of these fuels in the key surrounding republics, especially Russia, and the value of these fuels netted back to Kazakhstan from key world market pricing points

Exhibit 2 4 provides a detailed analysis of representative "netback" values of key fuels to Kazakhstan based on hard currency border prices at key world market pricing points, netted back by the cost of transport, related services, fees (e g storage, and export fees, where appropriate) loss and representative quality differentials between the "world" standard shown in column 2 of Exhibit 2 4 and the Kazakh fuel It should be noted that these are only "rough" estimates at best, and substantial additional data compilation is required to establish accurate estimates The primary purpose is to introduce the methodology and concept since netback pricing is important in developing future pricing guidelines for non-grid fuels This analysis requires the development of information systems to document and monitor timely price and cost data including all taxes and special fees, for Kazakhstan, surrounding republics and world market prices

Exhibit 2.4
COMPARISON OF WORLD NETBACK PRICES TO KAZAKH PRICES

Energy Type	World Price Assumption	Netback* (US$/MT or MCM)	Netback** (Tenge/MT or MCM)	1994 Kazakh Price (Tenge/MT or MCM)	Ratios (Percent)
1	2	3	4	5	6 (5/4)
Crude Oil	FOB Black Sea	78	4009	1600	40
Diesel Fuel	Rotterdam Gasoil	106	5439	3873	71
Natural Gas	Turkey Imports	104	5323	4016	7
Steam Coal	EEC Imports	14	694	190	27

* These numbers are rounded
** Exchange rate premise 51 4 Tenge/US$

Looking first at crude oil, the estimated $108/ ton crude oil price FOB Novorossiysk is netted back to $78/ton ($10 61/barrel) at Aktau and compared to the current official domestic price of 1600 Tenge/ton to arrive at the ratio of domestic price to world market netback, as shown in Column 6

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A similar process was followed for diesel fuel In this case utilizing a representative Rotterdam price netted back through the Baltic port of Ventspils and after deducting representative[3] rail transport costs

For natural gas, a delivered Turkish electric power plant price of $153/mcm was utilized and netted back for comparison with the domestic November 1994 wellhead price of 4016 Tenge per mcm This calculation also includes a five percent pipeline loss factor

The coal calculation was based on average EEC import prices An approximate adjustment was made for the differing calorific and other quality levels between the EEC standard for steam coal and the typical Ezibastuz steam coal It should be noted that the per ton mile rail tariff utilized to net back to the mine mouth in Kazakhstan was the lowest long-haul rate available in the US Utilization of average rail rates would move the netbacks well below zero suggesting that Europe is not a viable export market for Ekibastuz steam coal Currently about 30% of Ekibastuz coal is exported to Russia As discussed in Box 2 1, Ekibastuz coal pricing should be tied to a regional coal market not world markets

2.4.2 Grid Energy

For natural monopolies (natural gas, heat, and electricity transmission and distribution) the Government will need to develop price and tariff structures for the regulation of these industries Comprehensive studies will be required to assess costs and determine appropriate structures for price and tariff designs When this is completed, regulatory bodies will need to be established These studies should be initiated as rapidly as possible In the interim, prior to establishing a regulatory framework, natural gas, heat and electricity prices should be determined on cost plus pricing principles, and increased to fully reflect import, transmission and distribution costs Also, a program to eliminate the substantial cross-subsidization of households should also be adopted At a minimum the current differences (in absolute terms) between industrial and household prices of electricity, heat, and gas should not be allowed to increase

Tariff structures are usually designed in two parts to reflect the capital costs (the "capacity charge") and the fuel costs (the "energy charge") of making supply available to a consumer Tariffs in two parts like this are a useful way of passing separate price signals for the "lumpy" element of costs (investment in new capacity to meet expected peak needs) and for the more continuous energy element From the point of view of energy supply investments, such tariffs can offer a rational approach to cost recovery

3 The rail tariff estimates utilized included actual published data where available, and otherwise incorporated "low end" unit distance cost estimates representative of Western rate structures By assuming higher rail tariffs which exist in some Western markets, then the netback price would have only been about $50/ton resulting in the domestic price already being higher than the netback price This indicates the need for the construction of product pipelines which should lead to lower transportation costs

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Box 2.1 Regional Export Market for Ekibastuz Steam Coal

In 1994 production from Ekibastuz deposit, largely steam coal with a high (i e 40 -45 percent) ash content accounted for roughly 75 % of total coal output, with the Karaganda deposit (60 percent coking coal and 40 percent steam) accounting for most of the balance About 30% of Ekibastuz' production was exported to Russian power plants

Coal's major market worldwide is the power generation sector On a global basis, the use of coal for power generation is expected to grow in absolute terms in the 21st century However, some market share may be lost due primarily to increased competition from natural gas Similarly, in Kazakhstan and Russia, coal's share of the power generation, district heating and combined heating and power (CHP) sectors in the future will be influenced significantly by prices for natural gas delivered to power plants, CHP and district heating facilities A review of mining costs in the world's major exporting countries indicates that the world coal market is highly competitive

Ekibastuz's major regional competitors are the Kuznetsk (also referred to as Kuzbass) and Kansk-Achinsk basins A major recent USAID study indicated that for Kuzbass coal, just like Kazakhstan coal, to penetrate world markets would require potentially operating the mines at a loss To sell to the Japanese coal market, Kuzbass FOB mine costs would have to range from minus US$ 3 25/mt to US$ 6 75/mt For the European market, it would require minus US$ 5 75/mt to $18 75/mt Consequently, Kuzbass and Ekibastuz will compete to supply coal to power plants in the Urals/ West Siberia region of Russia

As of April 1995, production costs for the steam coal at Ekibastuz were estimated to be approximately US$2 75/mt, among the lowest in the world, and about 40% of the production costs at Kuzbass Ekibastuz coal pricing and production levels will be largely constrained by Russian market utility coal prices, utility demand for steam coal exports and rail tariffs and rail access In general, the price of Kuzbass steam coal delivered to the power plants in the Urals/Western Siberia region of Russia imposes a ceiling on the price of Ekibastuz steam coal delivered to this region

The immediate need is to set coal prices on a path which fully recoups transportation, production and upgrading investment costs To finance such potential upgrading projects as a major ash removal process at Ekibastuz, the coal pricing needs to be adjusted to allow for the recovery of the investment costs of such projects Such projects are likely to improve substantially the export potential of Ekibastuz.

For the largest gas and electricity consumers it is possible, using complex metering, to charge separately for the capacity and the energy elements in the tariff In practice, more approximate tariffs are designed for medium-sized and smaller consumers in the domestic, commercial and industrial sectors using simpler meters, based on two-part or multi-part tariffs These tariffs are usually based on the time-profiles (load curve) of consumption for average consumers in each class Typically, the average price of electricity or gas falls as consumption rises since the capacity used is spread among a greater number of units consumed

Over the longer term, as Kazakhstan becomes more integrated into the world economy, the costs of electricity supply will rise towards international cost levels Exhibit 2 5 presents representative international costs of electricity supply Coal-based generation costs vary, in general, between 2 5 cents per kilowatt hour to 4 5 cents per kilowatt hour depending on individual plant operating costs and differing levels of pollution control equipment Hydro-based generation cost range between 1 95 cents to 3 5 cents per kilowatt hour The 1 95 cents per kilowatt hour is based on Hydro Quebec's generation cost,

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some of the lowest in the world It can be anticipated that Kazakhstan's coal-based plants' major competitors for the long term will be hydro-based generation plants Exhibit 2 5 also suggests representative international transmission and distribution costs Based on a world-wide representative sample and assuming coal-based plants, the low end of the range of the total cost to high voltage customers will be about 4 50 cents compared to 7 50 cents for low voltage customers As of November 1994 electric tariffs for industrial and residential consumers in Kazakhstan had risen to 3 5 cents and 2 9 cents, respectively

Exhibit 2.5
REPRESENTATIVE COSTS OF ELECTRICITY SUPPLY*

(US cents/Kwh)		
Generation Cost (coal-based)	2 50	4 50
Transmission	2 00	3 00
Cost to HV customer	4 50	7 50
Distribution & Connection	3 00	5 00
Cost to LV customer	7 50	12 50
Generation Cost (hydro-based)	1 95	3 50

Note *Assuming efficient operations and low loss levels
Source Hydro Quebec reports and de Lucia & Associates' estimates as presented in briefing report for The World Bank

2.4.3 Future Price Guidelines

Preliminary price guidelines through 2005 are shown in Exhibit 2 6 These projections are based on November 1994 real prices at a fixed exchange rate of 51 4 Tenge per US dollar It is also premised that there is no real increase in the world prices shown in Exhibit 2 4 Exhibit 2 6 has been developed to provide the basic framework by which to project future price guidelines The simple spreadsheet model underlying Exhibit 2 6 can be expanded to include additional premises, such as different domestic inflation rates and different premises on exchange rates and each of the price and cost components underlying the basic netback prices shown in Exhibit 2 4

Future export prices for hydrocarbons will continue to be determined primarily by the rate at which Russia and neighboring republics increase their domestic prices towards world levels and by the time required to complete an export pipeline In general, the objective is to achieve parity with world prices first for crude oil, as Kazakhstan's growth in energy production and export potential is likely to be led by crude oil The rate of movement to the world equivalent goal is necessarily dependent on Russian pricing policy and access to the Russian transport systems, at least until major export pipeline systems have been completed Given the uncertainty surrounding the completion of the proposed Caspian pipeline consortium's proposed line to Novorrosiysk or any other pipeline and the time required to construct a new line or expand substantially the current Russian system, increasing oil prices to free world prices by mid-1998 is a realistic target As shown in Exhibit 2 6, real crude oil prices, measured in US dollar terms, need to rise about 25% per year in order to reach the netback level of US$ 78/MT by 1998 Post 1998, a Caspian crude oil pipeline project is likely to be completed, and numerous small development and transportation projects should be underway to supplement this major export line, allowing greater access

to world markets and higher netback price levels The proposed longer term guidelines in Exhibit 2 6 assume real netback prices, measured in US dollars, increase by $7/MT by 2005

Price levels for petroleum products should be flexibly set to allow refinery production operations to be optimized both in the short term with respect to obtaining maximum product value relative to operating costs for a given barrel of crude, and the longer-term to allow a reasonable degree of cost recovery for investment needs On an absolute basis, refined product price should be set to loosely correlate to the overall "ramp" established for crude oil, with sufficient latitude provided to reflect the range of relative product values among the products The latest available data would suggest that petroleum product prices, excluding excise taxes, are approaching world equivalent levels For example, retail gasoline prices, excluding excise or end-user taxes at the pump were about US$ 0 19/ liter compared to US$ 0 20 and US$ 0 23 in the United States and Australia, respectively Also, May 1994 wholesale diesel fuel prices were about 71% of the netback price, as shown in Exhibit 2 4 Real diesel fuel prices, measured in US dollar terms, should be increased to the netback level of US$ 106/MT by 1998 The proposed longer term guidelines in Exhibit 2 6 assume real wholesale diesel prices, measured in US dollars, increase an additional $8/MT by 2005 to allow for the additional costs associated with stricter product quality standards

In the case of natural gas, the rate of movement to free world price equivalents will also be influenced primarily by Russian, Uzbekistan and Turkmenistan domestic pricing policies, and access to pipelines In the short term, price policy should focus on rationalizing internal price and transportation tariff relationships, creating price and tax incentives for investments in gas processing, pipeline transmission, distribution and gas storage, and related infrastructure, coupled with an overall gas resource development plan This development plan should include an assessment of likely regional export gas pipelines and likely export markets In calculating the netback prices in Exhibit 2 4, Turkey was chosen as the end use market rather than Western Europe because the potential for Kazakhstan to export substantial gas to Turkey seems more likely than to Western Europe November 1994 wellhead natural gas prices were about 75% of the netback price, as shown in Exhibit 2 4 Real natural gas prices, measured in US dollar terms, are assumed to rise to 80% of the netback level of US$ 104/ MCM by 1998 The proposed longer term guidelines in Exhibit 2 6 assume real gas prices, measured in US dollars, reach the netback level by 2005 assuming an alternative export route from the current trans-Russia alternative is available

Coal prices are effectively decontrolled Any effort to raise Kazakh export prices above Russian levels would be constrained by both the allowable electricity tariffs in Russia, and by the comparative delivered cost of Russian coal As discussed in Box 2 1, long term coal pricing guidelines need to be tied to the Urals/ Western Siberia export market Real Ekibastuz steam coal delivered to power plants[4], measured in US dollar terms, are assumed to rise to US$ 8/MT and to US$ 14/MT in 1998 and 2005, respectively

These projected guidelines assume rail transport charges increasing from US$ 002/MT/KM in 1995 to US$ 007, a charge similar to long hauls of Powder River Basin coal in Wyoming and Montana The real minemouth price is premised to increase from a 1994 level of about $1 86/MT to a level in 2005 of $7/MT, similar to the costs associated with Wyoming coal in 1992 [5] This minemouth price is based on the principle of full cost recovery, including all operating costs and a capital recovery charge on investments, including mine-mouth washing and ash removal investments

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4 The guidelines shown in Exhibit 2 6 assume a distance of 1000 km, or the approximate distance to both Almaty and Sverdlovsk

5 IEA documents present data that suggests $7 50 for Wyoming surface coal

Exhibit 2.6
KAZAKHSTAN ENERGY PRICE GUIDELINES

	1994 (1a)	1998 (1b)	2005 (1b)
Crude Oil,wellhead USD/MT T/MT	31 1600	78 (2) 4009	85 (3) 4369
Diesel Fuel, refinery USD/MT T/MT	105 3873	106 (4) 5448	114 (5) 5860
Natural Gas,wellhead USD/MCM T/MCM	78 4016	83 (6) 4266	104 (7) 5346
Coal power plant USD/MT T/MT	4 173	8 (8) 514	14 (9) 720
Electricity, households USD/kWh T/kWh	029 1 50	0704 (10) 3 62	0985 (10) 5 06

Notes
(1a) Based on latest available 1994 price data and the market exchange rate existing at that time
(1b) Assumes a fixed exchange rate of 51 4 Tenge/$
(2) Prices rise to the netback price as shown in Exhibit 2 4
(3) Reflects higher crude netback price once export pipeline from Kazakhstan is built
(4) Prices rise to the netback price as shown in Exhibit 2 4
(5) Reflects primarily stricter product quality requirements by 2005
(6) Prices rise to 80% of the netback price as shown in Exhibit 2 4
(7) Prices rise to the netback price as shown in Exhibit 2 4 once an export pipeline is built
(8) Assumes an Ekibastuz minemouth price of $3/MT and a rail transport charge of $ 005/ mt/km
(9) Assumes an Ekibastuz minemouth price of $7/MT to reflect ash removal and some cleaning and a rail transport charge of $ 007/mt/km
(10) Assumes electricity prices increase commensurately with the increase in coal prices

The cost structure for electric power generation, its transmission and distribution in Kazakhstan will converge towards international costs in the longer term A practical, simple approach to projecting average costs of electric power is to assume that electricity prices rise in parallel fashion with steam coal prices Coal prices are selected as the appropriate link to future electricity prices since 80 percent of electric generation is coal-based Assuming electricity tariffs increase proportionately with steam coal prices as shown in Exhibit 2 6, the real electricity tariff, measured in US dollars, for household consumers is projected to rise from US$ 0 029/ kWh to US$ 0 07 in 1998 and US$ 0 099 in 2005 This would result in household tariffs reaching the low end of the range of international costs, as presented in Exhibit 2 6, by 1998 and reaching the middle of the range by 2005 Such substantial increases in household tariffs should result in the elimination of cross subsidies to households by the industrial consumer

Annex B presents pricing principles by which to develop long term guidelines for regional electricity tariffs

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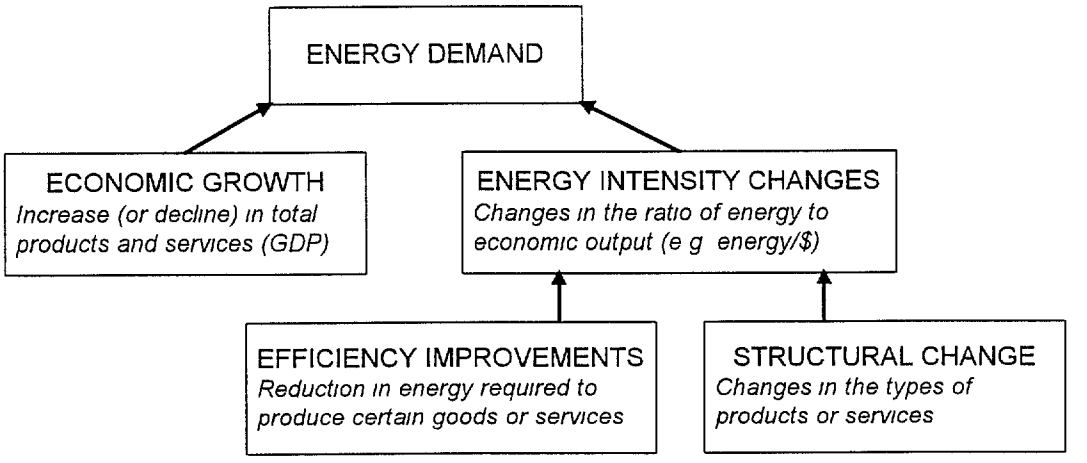
Chapter 3
ENERGY DEMAND, ENERGY PRICING AND ENERGY SAVINGS

3.1 DEFINITION OF ENERGY SAVINGS AND FACTORS DETERMINING ENERGY DEMAND

Energy savings is the difference between energy consumed with and without the implementation of energy savings measures or policies A country's energy demand, or the total amount of energy consumed in the country is determined by many factors Exhibit 3 1 provides a framework for assessing the factors that contribute to changes in energy demand over time in a particular country

Exhibit 3.1
FACTORS DETERMINING ENERGY DEMAND



As presented in Exhibit 3 1 energy demand is a function of economic growth and changes in energy intensity Energy intensity is usually measured as the ratio of energy to economic output However changes in energy intensity reflect the combined effects of structural changes in economies, real energy prices and changes in energy efficiency Structural change is the change in the types of goods and services produced by an economy Improvements in energy efficiency are observed as reductions in the energy required to produce a particular good or service Changes in energy efficiency can be operational or technological Energy efficiency can be measured in many different ways and often depends on the end use Usually, an approximation of changes in energy efficiency is obtained by estimating the energy intensity Energy intensity across several countries varies depending on economic structures, historical price developments, indigenous resource bases, end-use patterns, climate and geography For example, a country that has a colder climate, more heavy industries, or more abundant resources will tend to have a higher energy intensity when compared to a second country which has similar overall energy efficiency In general, the rate of change in energy intensity of a country is a good indicator of a country's progress towards achieving energy savings

3.2 PRICE AND INCOME ELASTICITIES

Analyzing the effects of economic growth, structural changes in the economy, real energy prices and changes in energy efficiency on energy demand is quite difficult Frequently, analysis begins with the estimation of price and income elasticities Price elasticity refers to the responsiveness of the quantity

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demanded of a good for a given change in the price of the good Simply measured, it is the percentage change in quantity divided by the percentage change in price Similarly, income elasticity is the percentage change in quantity demanded of a good for a given change in income

3.2.1 Developing Country Elasticity Estimates

Exhibit 3 2 presents information on price and income elasticities in the developing world[1] for total energy demand Most of the short-term price and income elasticity estimates lie between -0 05 to -0 16 and between 0 2 to 0 9 respectively In general, the medium-term and long-term elasticities for both price and income have higher values The range for medium-term price elasticity is between -0 1 and -0 5 compared to 0 3 and 1 5 for medium-term income elasticity The bulk of the long-term price and income elasticities fall between -0 1 and -0 65 and between 0 8 to 1 7, respectively

The estimates shown in Exhibit 3 2 consider only total energy demand As discussed later in this chapter structural changes in an economy can be important in determining energy demand In fact, with the potential for rapid structural change in the Kazakhstani economy during its transition to a market-based economy, estimates of price and income elasticities on a sector basis will be critical to long range forecasting

3.2.2 OECD Price Elasticity Estimates

Based on studies by the International Energy Agency, increases in real energy prices, especially after 1978, were the most important single factor behind increases in energy efficiency Rising real energy prices encourage the adoption of energy efficient technologies and equipment and structural shifts away from energy intensive industries The responsiveness to rising prices varied by end-use sector and by different OECD regions Based on a period of rising energy prices, the long-term price elasticity for energy demand in OECD countries was about -0 5, or at the higher end of the range of developing country price elasticities shown in Exhibit 3 2 A price elasticity of -0 5 means that,on average, a 10% increase in end-use prices will result in a 5% decrease in demand Also, it is important to point out that similar analysis during a period of falling energy prices indicated the price elasticity was substantially smaller than -0 5 Or, a 10% decrease in energy prices will result in a long-term increase in demand of less than 5%

3.2.3 Recent Developments in Poland and Kazakhstan

The reforms introduced in Poland since 1990 have been rapid and broad-based, and are often cited as a model for reforms throughout the former Soviet Union As post-1990 data on Poland's energy prices and demand are available, some analysis can also be conducted

During 1987-92, real energy prices increased on average about 15% per year However, as indicated in Exhibit 3 3, there was a wide variation among the different categories of end-users With the exception of industrial natural gas, average annual price increases varied between 5 and 38 % During 1988-91, there was significant output declines with industrial production declining 15% per year Over the same time period, total final energy consumption declined about 9% per year

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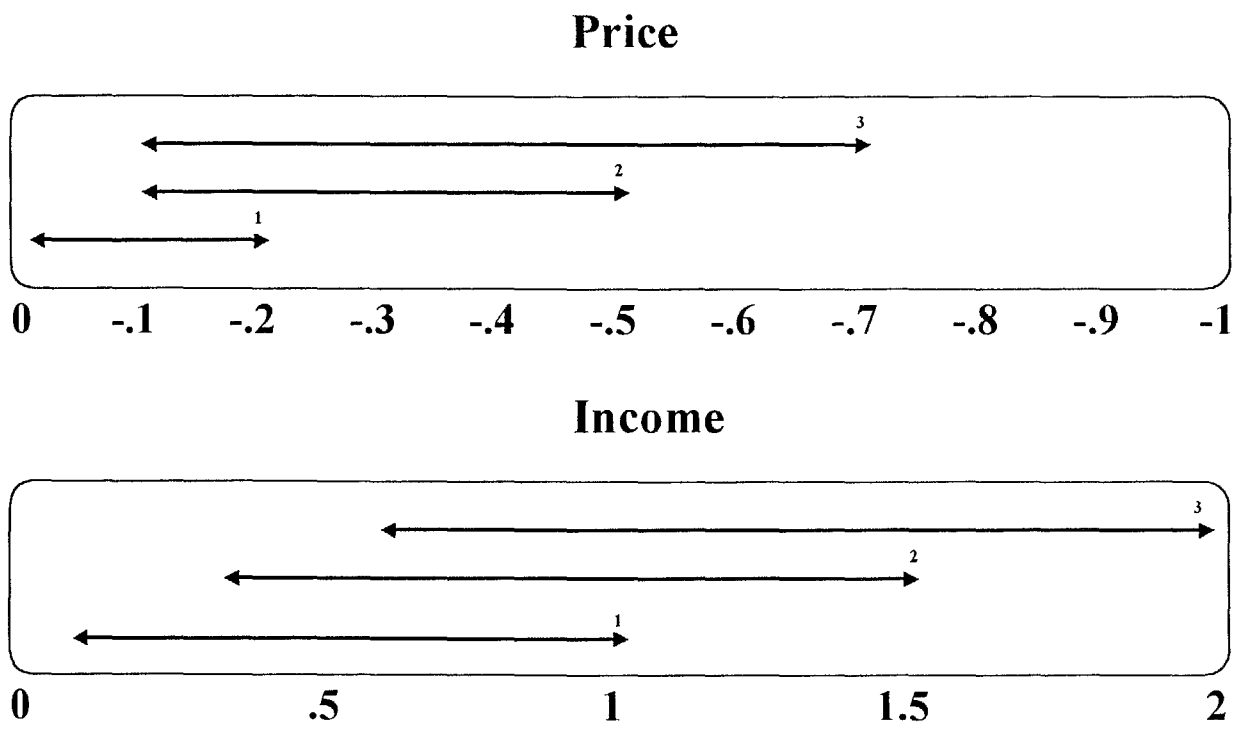
1 This information appears in " A Survey of Energy Demand Elasticities for the Developing World," Carol Dahl, The Journal of Energy and Development, Vol 18, No 1 The elasticity estimates presented reflect a survey of 50 studies from different regions, time periods and models The models ranged from simple ordinary least squares to sophisticated nonlinear three stage least squares

Exhibit 3.2: Energy Demand Elasticities



1 Short-Term
2 Medium-Term
3 Long-Term

Exhibit 3.3: Poland Energy Pricing and Consumption

	Average Annual Growth Rates	
	Real Prices (1987-92)	**Energy Consumed (1991-92)**
Gasoline	6.9	
Electricity		
Industrial	8.7	-5.8
Households	25 5	-6 3
Natural Gas		
Industrial	-0 9	-16 5
Households	38 4	
Steam Coal		
Industrial	12 6	-4 7
Electrical Power	5 1	
Households	17 9	

The critical question regarding energy prices and savings is this after economic growth resumes in the countries undergoing transition to a market-based economy will energy consumption return to its historical growth pattern, decline, or grow at a substantially slower rate? If rising real energy prices do matter, then energy consumption should follow one of the latter two variants During 1992, industrial production increased 4% while total final energy consumption declined 1 5% Based on these data, we can see that prices do matter The largest decline in energy consumed in 1991-92 occurred in the industrial sector, consistent with the 1973-82 experience in most OECD countries Natural gas consumed by industrial users declined 16 5% or over twice the decline observed in residential electricity

Exhibit 3 4 presents energy consumption in Kazakhstan for the first nine months of 1993 and 1994 This was a period of substantial price increases and declining output, as shown in Exhibit 2 1 The expected decline in real GDP for 1994, as estimated by the Research Institute of Economic and Market Relations, was about 25% Under these conditions, one would normally expect a decline in energy consumption However, as shown in Exhibit 3 4, six of the categories indicate increases rather than decreases The reliability of the data is a major concern at this time [2]

The development of reliable price and income elasticities for Kazakhstan will provide valuable information for preparing forecasts of energy consumed and estimates of potential energy savings However, this will take time It is premature to estimate elasticities for the Kazakhstani economy, as there are many problems to overcome, including insufficient availability of data

It is useful to examine the experience in Poland and other East European countries since 1989 and longer-term trends in other countries whose economic structure, policies and economic environment are similar to the future Kazakhstan For example, the long run price and income elasticities for electricity consumed by the industrial sector in Turkey are estimated to be -0 19 and 1 23, respectively [3] Turkey's price elasticity is at the low end of the long-term price elasticities shown in Exhibit 3 2 and Turkey's income elasticity is near the middle of the long-term income elasticities in Exhibit 3 2 Comparative analysis of this type will support preliminary estimates of Kazakhstan's longer-run price and income elasticities Over time, as additional data become available, economic growth resumes, and the transition to a market economy is completed, the initial estimates can be revised

3.3 THE FRAMEWORK FOR PROJECTING ENERGY DEMAND IN KAZAKHSTAN

The dramatic current and future changes in the Kazakhstani economy and energy systems over the next twenty years make any standard techniques of extrapolation of previous trends of little or no value Policies and behavior are in the process of substantial change Thus, the analytical methodologies presented in this chapter provide the initial framework by which to begin to estimate energy demand assuming different key premises, including the rate of increase in energy prices

2 The reliability of the price and output data is an issue of major concern For example, do the official prices being reported really reflect actual transaction prices Also, the official output and GDP statistics are probably not accurately capturing the rising activity in the newly emerging non-state sectors If this is true, then the official statistics are overestimating the decline in GDP Also, the natural gas consumption data in Exhibit 3 4 are only for sales by Alaygas and the petroleum products are sales by Munay Onemdery only

3 These estimates were derived using ordinary least squares regression over the period 1982-1990

Exhibit 3.4
KAZAKHSTAN ENERGY CONSUMPTION

	1993 (9 months)	1994 (9 months)
Electricity (Bil kWh)		
Industry	35 1	28 3
Households	6 3	6 9
Heat (Mil GigaCalories)		
Industry	17 8	18 3
Households	13 3	9 1
Coal (Mil Tons)		
Industry	16 1	16 5
Households	3 1	2 5
Power Stations	32 8	33 6
Natural Gas[1] (Bil cubic meters)		
Industry	1 7	4 0
Households	0 8	1 2
Power Stations	2 1	1 1
Petroleum Products[2] (Mil Tons)		
Gasoline	2 5	1 2
Mazut	3 4	1 8
Diesel Fuel	4 2	2 3

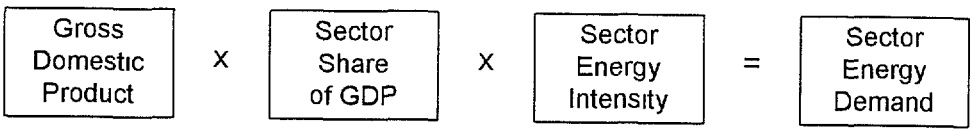
1 Sales by Alaygas

2 Sales by Munay Onemdery

Current rapid changes occurring in Kazakhstan and the lack of reliable detailed data make it difficult to perform the kind of analysis normally undertaken in OECD countries to project long-term economic growth and energy demand Trends based on historical data provide limited information about Kazakhstan's future as Kazakhstan makes the transition to a market-based economy There is great uncertainty surrounding macroeconomic and sectoral developments in the short and longer term As a result, any projection of energy demand and potential energy savings at this time would be one of many possible outcomes Consequently, projecting a range of outcomes versus one path is recommended

The basic framework is a top-down simple spreadsheet model which focuses on the overall rate of growth of Gross Domestic Product, the secular changes in the individual sector shares of Gross Domestic Product, and the changes in energy intensity of the individual sectors As suggested in Exhibit 3 5, energy demand by sector results by simply multiplying the information in each of the blocks shown below Summing up the individual sector demands results in total energy demand Different scenarios can be developed by assuming different values for each of these three elements

Exhibit 3.5
SECTOR ENERGY DEMAND



Comparative analysis based on selective countries should prove useful in choosing the different values for this simple model For example assuming the continuation of market reforms and increases in energy prices such that they approach OECD levels, then Kazakhstan's economic and energy structures should begin to move towards those in OECD countries The pace at which this is likely to happen is unknown However changes that have already occurred in Central and Eastern Europe can serve as a guide to some degree

There have been massive declines in output in all of these countries How much of the decline is attributable to the general macroeconomic decline versus structural change is unknown There is a major concern that the official data are not accurately capturing the rising activity in the non-state sectors As a consequence, current available data could present a biased view of the current economic structure All of these issues significantly impact the ability to assess and project future energy demand If structural change during the past few years and future structural change are not adequately accounted for, then projections of energy demand are likely to be biased [4]

3.3.1 Gross Domestic Product

A projection of economic growth is required in order to project future energy demand A forecast of economic growth up to 2000, has been prepared by the Republic of Kazakhstan 's Research Institute of Economics and Market Relations and is shown below

4 In general, this will lead to an overestimation of energy demand or at least an overestimation of the industrial share of total energy demand, since the traditional heavy industries will be given too much weight relative to service and light industrial sectors

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Year	Real Gross Domestic Product (Billion Tenge 1994)
1993	629
1994	472
1995	388
1996	365
1997	361
1998	367
1999	377
2000	391

Although the forecast has supporting details, especially about individual sectors, a structured model is needed A structured, simple macromodel of the Kazakhstani economy would prove useful to the Government of Kazakhstan on many issues Such issues would include not only projecting energy demand and potential savings but also revenues generated by the energy sector In the remainder of this section, a simple macromodel that would be used initially for projecting Gross Domestic Product is described This model could be expanded for other uses

A recursive macroeconomic (spreadsheet) model should be developed to project gross domestic product in the Republic of Kazakhstan Such a model would be separated into two major elements population/ employment and productivity per employee Key inputs will include (a) population, (b) employment, (c) sectoral employment shares, and (d) productivity per employee[5] in each sector The major outputs would be GDP by sector and total GDP

Assumptions would be derived for (a) population projections based on recent historical trends or slightly different rates, (b) projected changes in the sectoral shares of employment based on the expectations of future growth in the industrial and service sectors, and (c) productivity per employee Assumptions (b) and (c) would be linked to key macroeconomic premises which reflect how well Kazakhstan makes the transition to a market based economy and the extent to which Kazakhstan's economy integrates into the world economy These macroeconomic premises include privatization of state enterprises, attractiveness of foreign investment, including joint ventures, barriers to international trade, liberalization of domestic prices and markets, and sound fiscal and monetary policies

3.3.2 Sectoral Shares of GDP

One of the key features of the Kazakhstani economy is the very large share of industry and agriculture in the overall economy This is due to the political emphasis on heavy industry during the centrally planned era Recent World Bank economic reports indicate that agriculture and industry shares of employment in 1992 were about 24% and 30%, respectively These are about the same shares as reported for 1980 The percentages of net material product originating in the agricultural and industrial sectors in 1993 were about 31 and 51, respectively Gross domestic product and GDP by origin/sector are basic accounts compiled regularly by the governments who are members of the IMF Over time, Kazakhstan will begin to report economic growth in terms of GDP [6]

5 Productivity per employee is defined as gross domestic product per employee

6 In the latest World Bank economic report, GDP by origin is presented It suggests the percentages of GDP attributable to agriculture and industry in 1992 were about 8 and 45, respectively

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Exhibit 3 6 presents the 1991 shares of GDP in Central and Eastern Europe as well as how these shares are expected to change by 2010 As shown, considerable structural change is projected Over time, the structure of these economies are assumed to resemble increasingly the structures of OECD Europe The assumed growth rates of individual sectors will differ from the growth of total GDP The service sector is expected to grow faster than that of GDP while industry and agriculture are expected to grow slower than that of GDP

Exhibit 3.6
SHARES OF GDP IN CENTRAL AND EASTERN EUROPE
(Percent)

	1991	2010	1989 OECD Europe
Agriculture	15 5	10 0	3 7
Services	33 5	50 0	62 6
Industry	51 0	40 0	33 7

Source IEA

A similar trend can be expected in Kazakhstan, but the rate at which the service sector share increases is uncertain Different scenarios should be developed assuming different rates of change

Exhibit 3 7 presents such an approach for China In the reference case the share of agriculture declines to 20% by 2000 and 16% by 2010 Industry is assumed to grow slightly slower than the overall economy and its share declines from 46% in 1991 to 42% in 2010 The service sector is assumed to continue to expand much faster than the overall economy and its share rises steadily to 42% by 2010 These changes in the overall structure are quite dramatic for a period of 20 years but are feasible assuming fast economic growth In the low growth scenario the underlying conditions are assumed to lead to an economic structure by 2010 that is not significantly different from that in 2000 under the reference case

Exhibit 3.7
SHARES IN GROSS DOMESTIC PRODUCT IN CHINA

			2000	2010	
			Reference	Reference	Low Grow
Agriculture	28 4	26 6	20	16	20
Industry	48 6	46 1	44	42	44
Services	23	27 2	36	42	36

Source IEA

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3.3.3 Energy Intensity[7]

As shown in Exhibit 1 2, Kazakhstan's energy intensity historically has been quite high It has been comparatively high for a multitude of factors the share of industry in the economy is quite high compared with other countries , wasteful use of materials as well as the presence of old technologies result in the inefficient use of energy, the fuel mix in Kazakhstan is heavily weighted towards coal which tends to be less efficient as a fuel[8] in end-use applications, low energy prices provide few incentives for saving energy, and finally, energy is, to a large extent, inefficiently produced Projecting future long-term energy intensity in Kazakhstan requires both a bottoms up and a top down approach The bottoms up approach requires a detailed assessment of each factor and an assessment of how these factors are likely to change This is a major undertaking beyond the scope of this study However, the top down approach is to conduct comparative analysis of several countries over many years and of particular energy intensive sectors This information will provide a range of values which will capture the likely future long-term trend in Kazakhstan Projecting in which part of the range Kazakhstan is likely to fall requires a careful assessment of many structural and macroeconomic issues

Comparing changes in real energy prices to changes in energy intensity over the same period in many countries indicates that prices can have a significant impact on reducing energy demand Exhibit 3 8 depicts changes in real energy prices to changes in energy intensity during 1978-82 for the United States Germany, Canada, and the total OECD [9]

The last column in Exhibit 3 8 reveals that there are no simple generalizations, other than the decline in intensity is partially attributable to real price increases The largest sector impact as measured by the ratio of intensity changes to price changes, when considering the entire sample of OECD countries, was in the transportation sector The industrial sector was a close second However, the results within individual countries are more relevant In Germany, the largest impact was in the industrial sector with almost no impact in the transportation sector Canada experienced the largest absolute changes in real energy prices in each of the three sectors However, with the exception of transportation, Canada experienced the smallest impact As expected, the impacts in the USA were similar to the overall OECD average

7 There are many definitional and measurement problems in estimating energy intensity which is the ratio of energy to economic output Using physical or natural units in both the numerator and denominator avoids many problems associated with value calculations, especially across countries

8 Coal in terms of Btu efficiency is typically lower than petroleum products, natural gas and electricity in end-use, whether in intermediate heat and power plant operations or end-use commercial and residential applications

9 1978-82 was chosen because it was a period during which real energy price increases exceeded 30% in each of the three sectors residential/commercial, industry and transportation

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Exhibit 3.8
REAL ENERGY PRICES AND ENERGY INTENSITY
(Cumulative Percentage Change)

	Changes in Real Energy Prices[1] 1978-82	Changes in Energy Intensity[2] 1978-82	Ratio of Intensity Changes to Price Changes 1978-82
Residential/Commercial[3]			
United States	40 6	-11 4	- 28
Germany	23 5	-4 0	- 17
Canada	78 9	-9 0	- 11
Total OECD	46 2	-14 1	- 31
Industry[4]			
United States	42 1	-23 4	- 56
Germany	32 0	-24 8	- 78
Canada	77 7	-29 5	- 38
Total OECD	49 9	-24 9	- 50
Transportation			
United States	32 8	-18 6	- 57
Germany	34 5	-2 8	- 08
Canada	34 9	-23 6	- 68
Total OECD	30 8	-18 3	- 59

1 Change in end-use prices
2 Change in the index of final energy demand divided by the change in the index of real GDP
3 Includes public and agricultural use
4 Includes non-energy use

Source IEA Energy Price Data and Energy Balances of OECD Countries

In order to understand why the impacts vary across countries within an individual sector requires a closer examination of the different policies, technologies and capital stock in each country However, based on the data in Exhibit 3 8, the largest changes in intensity, with the exception of the German transport sector, occurred in industry and transportation If the time period is extended to 1973-82, then the following results are evident (1) that the largest changes in intensity were experienced in the industrial sector regardless of whether the time frame is short or long, and (2) in the longer term, the largest impact, as measured by the ratio of intensity changes to price changes, occurred in the transportation sector

Comparing long-term energy intensity trends in selected countries over a period of both rising and declining energy prices is an instructive exercise to better appreciate the potentially different paths that might develop in Kazakhstan Also, it is important to examine the long-term trends of fuels in comparison to electricity Exhibit 3 9 depicts long-term intensity trends in Turkey and Australia from 1970 to 1992

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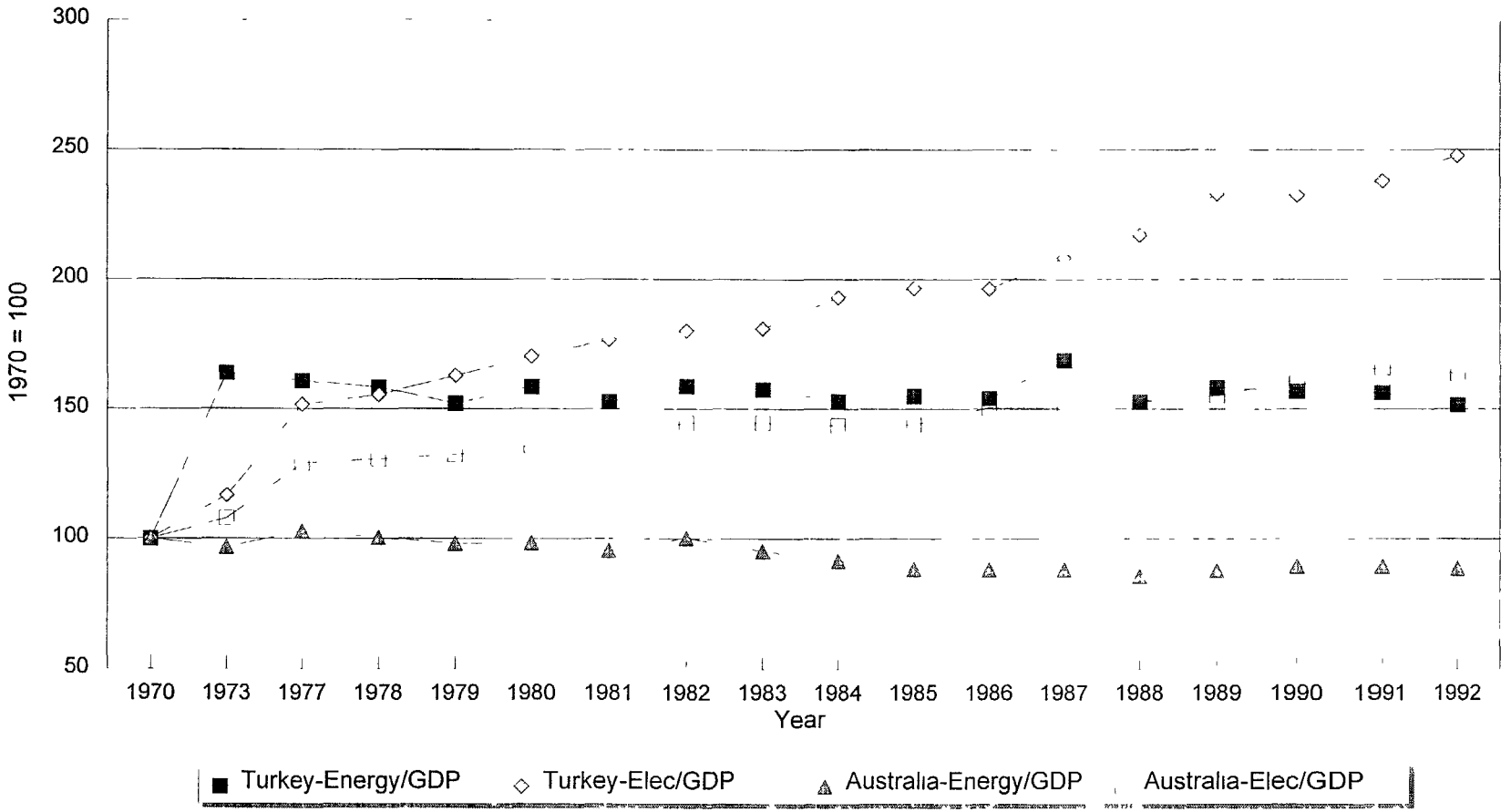
Exhibit 3.9
ENERGY AND ELECTRICITY INTENSITY
in Turkey and Australia 1970-1992



Source IEA 1991-1992 Energy Balances of OECD Countries
Note Energy is Total Primary Energy Supply, Electricity is Final Consumption, GDP is Gross Domestic Product in 1985 US Dollars

Energy intensity in Australia in 1992 was about 11% below its 1970 level Most of this decline occurred during 1982-1985 In general, the long-term trend of energy intensity in the most advanced industrialized OECD countries is best described as declining through the mid 1980's followed by a relatively constant period for the last several years Energy intensity in Turkey in 1992 was about 7% below its 1973 level [10] But with the decline in energy prices since the mid 1980's, there has been no further declines since 1987, similar to the trend in Australia

The long-term trend of electricity intensity is different In general, electricity intensity has been rising since 1970 in most countries However, over the longer term the rate of increase becomes smaller as the penetration of electricity into an economy matures For example, in Turkey, the average annual rate of increase in electricity intensity was about 5 4% in the 1970's followed by about 3 2% in the 1980's and early 1990's Over this time frame, the average annual rates in Australia were about 3 1% in the 1970's followed by 1 7% in the subsequent years

Taking into account both the declining trend of energy intensity and the rising trend of electricity intensity indicates that the long-term trend for fuels intensity has been a sharper decline than total energy at least in the advanced, industrialized countries In general, the long-term intensity trend of a specific fuel requires individual analysis for specific countries

Industry is Kazakhstan's largest consumer of energy Evidence in the OECD countries suggests that the largest change in energy intensity occurs in the industrial sector Consequently, it is constructive to examine the intensity issue in the context of industrial intensity trends As mentioned in section 1 1, this project chose to focus on the industrial sector in Kazakhstan for these reasons as well as the need to encourage the Government of Kazakhstan to consider potential energy savings as one way to make their industries more competitive in the former Soviet Union as well as in some global markets

Exhibit 1 3 in Chapter 1 emphasizes moving selected industries in Kazakhstan towards international competitive levels in terms of energy consumption per unit of output Exhibit 3 10 provides energy intensity or energy use data for eight different industry groups in the USA as of 1991

These data can be used by plant energy managers or energy analysts to assess the efficiency of a plant relative to one in the USA, or to develop targets for efficiency improvements over the longer term Energy standards must be interpreted with care and international comparisons can be difficult to carry out with precision [11]

10 As indicated, between 1970 to 1973, energy intensity grew about 18% per year Since the large increase in energy prices in 1973, in general there has been a small declining trend

11 An attempt is being made to show some of the standards in Exhibit 3 9 in terms of Btu's per physical units rather than in terms of 1991 US $ The physical units avoid many problems associated with value calculations that are especially difficult now in Kazakhstan

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Exhibit 3.10
1991 MANUFACTURING ENERGY INTENSITY IN THE USA

Industry Group	(1) Total Energy Consumed	(2) Total Electricity Consumed	(3) Total Shipments[1]	Intensity (1)/(3)	Intensity (2)/(3)
	Trillion Btu's		Billion 1991 US$	Btu's per 1991 US$	
Meat Packing Plants	49	12	48 25	1016	249
Textile Mill Products	274	101	65 17	4204	1550
Plastic Materials & Resins	633	50	31 72	19956	1576
Phosphatic Fertilizers	65	6	4 57	14223	1313
Petroleum Refining	5762	99	138 32	41657	716
Cement, Hydraulic	312	32	3 70	84324	8649
Blast Furnaces & Steel Mills	1673	130	40 69	41116	3195
Primary Copper	21	4	4 55	4615	879

Note [1] Source for shipments is Annual Survey of Manufactures The source for the energy and electricity consumption is the Manufacturing Energy Consumption Survey

Kazkhstan needs to develop an extensive energy consumption database by each major consumer category It should start with the industrial sector beginning with those plants that are economically viable over the longer term The initial data should be collected on plants for the period when they were operating at utilization rates closer to 90% rather than the current extremely low rates [12] With this information, the plant energy managers and, in cooperation with government staff, can set energy use targets For example, Exhibit 3 11 presents recent historical energy usage as well as potential targets for specific industries in China As shown below, pure efficiency gains averaged about 1 to 2% per year between 1980 to 1990 in the steel, cement, and ammonia industries The last column of Exhibit 3 11 gives some idea of the scope for improvement in new plants This column reflects the competitive level that China or Kazakhstan needs to pursue in the longer term Technological leapfrogging is quite possible but in practice is difficult due to the scarcity of capital

Exhibit 3.11
INDUSTRIAL ENERGY INTENSITY
(TEC/ton)[13]

	1980	1990	(%p.a.)	Developed Countries
Steel	1 2	1 0	-1 8	0 65 - 0 85
Cement	0 207	0 188	-1 1	0 12 - 0 13
Ammonia	1 53	1 36	-1 5	1 0 - 1 15

12 During this project an effort was made to initiate this process The engineering teams prepared, translated and distributed the detailed questionnaires shown in Annexes I, J and K to the plants which the teams visited Also, substantial training was provided to Mr Alexander Homyakov in order to continue this effort

13 TCE is one ton of coal equivalent, which equals 0 7 ton of oil equivalent

3 3.4 Sector Energy Demand

As discussed at the beginning of this section, energy demand by sector results by simply multiplying the information in each of the blocks shown in Exhibit 3 5 Summing up the individual sector demands results in total energy demand Then the shares of energy consumption by sector can be calculated

Exhibit 3 12 presents the shares of end-use energy consumption in Turkey, Poland and Kazakhstan over the period 1973-2010 As indicated by Turkey, shares of end-use energy consumption can change dramatically In the case of Turkey, the industrial share rose significantly from 23% in 1973 to 37% in 1990, reflecting the overall rapid industrialization which took place during this period In the case of Kazakhstan, the industrial sector is expected to be consolidated and grow in the longer term at a rate less than the overall economy The most rapid sector of growth is expected to be services Beyond 2000, the industrial share should continue to decline, probably at a rate more rapidly than that projected for the period 1990 to 2000 The projected trends as shown for Poland should serve as a guide for projecting the longer term in Kazakhstan

Exhibit 3.12
SHARES OF END-USE ENERGY CONSUMPTION

	1973	1990	2000	2010
Turkey				
Industrial	23	37[1]	41	49
Transport	22	22[1]	20	18
Other[2]	55	42[1]	39	33
Poland				
Industrial	--	63	60	58
Transport	--	9	9	9
Other	--	28	31	33
Kazakhstan				
Industrial	--	45	43	--
Transport	--	10	13	--
Other	--	45	44	--

[1] 1991 data
[2] Other includes
Source Kazakhstan's Ministry of Energy and Coal IEA and Poland's Ministry of Industry and Trade

3.4 LONG-TERM POTENTIAL ENERGY SAVINGS

Policy mechanisms and behavior by individuals and enterprise managers and employees are in the process of substantial change The overall conclusion is that the potential for energy savings in Kazakhstan is quite large but to estimate it accurately is quite difficult The model presented in this chapter provides a simple framework by which estimates of energy savings can be derived based on assumed economic activity levels, changes in the relative shares of the basic sectors contributing to economic growth, and efficiency trends

3.4.1 Energy Savings Resulting from Rapid Price Reform

If increases in real energy prices do matter, then one can expect energy savings if the Government of Kazakhstan pursues a rapid implementation of complete price liberalization versus a slower pace of

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reform A simple variant of the methodology presented in section 3 3 above can be used to estimate potential energy savings resulting from rapid price reform In a more rapid scenario world equivalent energy prices are achieved within three years compared to a slow scenario in which six years are required to reach world equivalent energy price levels If one assumes the forecasted real levels of GDP as presented in 3 3 1 and assumes that in the rapid scenario energy intensity declines 23% over the three years from the 1994 level compared to a 15% decline in the slow scenario, then energy demand in the rapid scenario is estimated to be about 6 million tons of fuel equivalent (MTFE) lower in 2000 compared to energy demand in the slow scenario This potential energy savings of 6 MTFE is about 7% of the 1994 total energy consumption in Kazakhstan

Chapter 4
GOVERNMENT POLICIES AND PROGRAMS

In the period of rising energy prices in the 1970s, the Governments of the industrialized countries of the Organization of Economic Cooperation and Development (OECD) implemented a wide array of energy conservation policies and legislation in an effort to achieve energy savings In addition, many developing countries, some heavily dependent on oil imports and suffering from rising oil prices, also began implementing energy savings regulations Thus, throughout the world government action has been deemed necessary to build awareness of the importance of energy and send strong signals to individuals and businesses to utilize energy more efficiently

The following section reviews specific government programs and policies that have been utilized, and evaluates the most appropriate for the Government of Kazakhstan (GOK) This Chapter concludes with recommendations on legislation that the GOK should consider for immediate incorporation into the draft energy legislation to be submitted to Parliament

4.1 GOVERNMENT ENERGY SAVINGS PROGRAMS AND LEGISLATION[1]

4.1.1 Energy Management Regulations for End-Users and Supply Companies

Many governments have instituted requirements for facilities whose energy consumption is above a fixed threshold For plants that consume above the established level, a government can require that the facility meet certain regulations such as

- *Appoint an energy manager* (who has the authority to overrule production managers to ensure good energy practices)
- *Set energy efficiency and consumption targets and periodically report progress to the government* (e g once per year, or every two years)
- *Periodically conduct a complete energy audit*
- *Develop an energy conservation plan for the plant incorporating recommendations from the audit and report on the progress of implementation*

In Tunisia for example, industrial plants consuming above 2,000 tons of oil equivalent and commercial enterprises consuming at least 500 tons of oil equivalent must conduct an energy audit every three years In South Korea, firms consuming more than 500 tons of coal equivalent per year must report on energy consumption and conservation activities annually and employ an energy manager These types of regulations also are employed in the Philippines, Italy, Japan, and other countries

For energy supply companies such as power, gas and district heating utilities, governments can require not only the types of regulations described above for their production, transmission and distribution facilities, but also mandate the installation of end-use controls and instrumentation, especially in residential and commercial buildings Equally important, however, is that governments can require that these energy

1 This section draws on a large body of previous analyses, including *A Review of Electricity Conservation Programs for Developing Countries*, American Council for an Energy Efficient Economy (1991), and *Accelerating Private Investment in Energy Conservation Identification and Analyses of Key Barriers and Policy Tools*, USAID Office of Energy, prepared by Hagler Bailly (1987) These are subsequently referred to as "ACE[3] 1991" and "USAID 1987," respectively, in this chapter

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supply utilities, by law, must incorporate energy conservation activities into their budgets and long-term planning (See the discussion later in this Chapter on Demand Side Management)

An additional feature of mandatory regulations is that they can be accompanied by a system of penalties levied by the government for failure to comply These can be based on the level of consumption of the facility in question, the profit levels of the enterprise, or could be linked to the current market price/value of the fuel wasted

Advantages Establishing mandatory energy savings requirements and regulations for large energy consuming facilities and energy supply utilities can be very effective in directly influencing consumption patterns and efficiency levels If vigorously and effectively enforced these regulations can yield energy savings in the short-term (1-3 years) In addition, if a penalty system forms part of the regulations, the fines levied can result in revenues for the government which, in turn, can be utilized to support the government's expenditures incurred in administering the regulations or for other energy savings programs These requirements also tend to function more effectively in countries with a government command and control or interventionist tradition Finally, programs of this nature, owing to the reporting requirements and data tracking features, provide the government with invaluable information necessary to monitor the nation's energy use patterns

Energy Management Regulations in Portugal

Firms consuming over 1,000 tons of oil equivalent per year must:

- Implement & facilitate energy management program
- Have energy use patterns reviewed every 5 years.
- Develop 5-year plans for the rational use of energy to be approved by the Government

Source: USAID 1987

Disadvantages The main disadvantage in this type of government energy savings legislation is the administrative burden imposed on the government In order to yield the greatest results, these regulations require facility inspections, data collection and monitoring, the establishment and maintenance of an energy use data base, established reporting mechanisms, and a system for determining, implementing, and following-up penalties levied This system, therefore, requires administrative resources which will be a cost to the government In addition, these requirements need to be reviewed periodically for their effectiveness and necessity Over time, as an energy conservation ethic becomes more ingrained throughout the economy, specifically in the mentality of businesses and individuals, many enterprises will, in the normal course of operations, institute some of the requirements which the government has required Another disadvantage is that the system required to implement these regulations must be enforceable and free from abuses, and this is often difficult to achieve

4.1.2 Information and Education Programs

All governments around the world that have implemented energy savings legislation have included some form of information and education activities Spreading the word on the benefits of energy savings and the importance of energy in general is a key part of all energy conservation programs These are particularly crucial at the outset of a government's efforts, but most countries continue efforts in this area long after a society and economy have developed a mature energy conservation ethic One reason why these programs must be maintained over a long period of time is the very nature of the activity itself the goal of energy information and education programs is to change the energy use behavior of businesses and individuals By definition, this is a long-term process Activities in this area can include

- Conducting plant and building audits
- Carrying out technology demonstration
- Providing information dissemination and public outreach (e g publicity campaigns, advertisements, brochures)
- Providing advisory services
- Establishing regional information centers
- Developing and disseminating technical handbooks
- Establishing an energy labelling system

Governments have learned that their information and education activities are more effective if supplemented and complemented by other organizations These other entities can include state and/or regional governments, utilities, universities, research institutes businesses, community organizations, and non-profit institutions Several governments have legislated that energy management or energy auditing be required courses for certain engineering degrees at universities Surveys conducted recently in the US have indicated that for information and education programs to be effective they need to be highly focussed on a particular type of consumer (e g a commercial enterprise household, or industry sector) General awareness campaigns or broad-based appeals to energy savings are usually not successful In addition, efforts in this area must be part of an overall, comprehensive government energy conservation program or strategy[2]

Despite these caveats, OECD governments continue to utilize energy information and education programs as part of their overall energy savings policy As a result of budgetary constraints, however, governments have attempted to re-focus these activities and leverage non-government financial sources For example, in recent years several governments including Norway, Finland, Australia, and Britain have revitalized the use of energy information centers Some of these centers are jointly funded by industry groups or utilities The US National Energy Policy Act of 1992 calls for the Department of Energy (DOE) to "make grants to nonprofit institutions, state and local governments, universities, and utilities to establish or enhance one regional building energy efficiency center in each of the 10 regions served by a DOE regional support office " The activities of these centers will include

- Providing information, training, and technical assistance to building professionals
- Operating an outreach program to inform building professionals of the benefits and opportunities of energy efficiency and of the services of the center
- Providing displays demonstrating building energy efficiency methods and technologies
- Coordinating activities and programs with other institutions within the region
- Serving as a clearinghouse to ensure that information about new building energy efficiency technologies is disseminated to end-users
- Studying the building energy needs of the region and make available region-specific energy efficiency information to facilitate the adoption of cost-effective energy efficiency improvements
- Assisting educational institutions in establishing building energy efficiency engineering and technical programs and curricula

Labelling of appliances and equipment, providing buyers with comparative information on the energy efficiency of the item they are purchasing, has been an important element in the energy savings policies of OECD countries for many years Column No 1 of Exhibit 4 1 indicates the countries that have adopted labelling As shown, it is clear that most countries have implemented this type of program in the

2 *Moving Consumers to Choose Energy Efficiency,* The Alliance to Save Energy (1991)

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residential sector, while it is less common in other sectors Currently this activity is being actively extended to homes several countries have enacted programs to rate the energy efficiency of homes, information which can be used by consumers to assess the energy requirements of the residence and estimate energy bills In addition, the rating information can be utilized by lenders when determining the loan amount for the purchase of the home For example, the US Energy Policy Act of 1992 established voluntary, uniform home energy guidelines, as well as an energy efficient mortgage pilot program in five states, which grants higher loan amounts for the purchase of homes that meet certain energy efficiency requirements

Advantages The principle advantage to government-sponsored information and education programs is that, if properly implemented and maintained, attitudes and behavior toward the use of energy will improve over time

Disadvantages The results of information and education programs are more qualitative and difficult to measure it is usually not feasible to assess the results in terms of actual energy savings In addition, these programs can be expensive for a government to implement, with attendant administrative burdens

4.1.3 Energy Efficiency Standards

Developing and strengthening minimum energy efficiency standards and codes for industrial equipment and facilities, commercial and residential buildings and household appliances has been an important part of government energy savings programs throughout the world

Significant efforts have been conducted in the last decade to establish minimum efficiency standards for major electricity consuming equipment, especially in the residential and commercial sectors Column Nos 2 and 3 of Exhibit 4 1 highlight those countries and sectors with standards For example, in 1987 the US established standards for household appliances such as refrigerators, window air conditioners, water heaters, gas furnaces and boilers These codes are expected to reduce peak summer electricity demand by a cumulative of 29,000 MW from 1987-2000 Similar standards were implemented in the 1980s in Taiwan and resulted in a cumulative savings of 795 MW of generating capacity in the years 1981-1988[3] In addition, many states in the US have implemented minimum efficiency standards for commercial equipment including electric motors, lighting systems and central air conditioning systems

Residential and commercial buildings standards are used worldwide to achieve energy savings As indicated in Column No 3 of Exhibit 4 1, standards for residential and commercial buildings are common in the OECD countries These standards can incorporate many mechanisms including

- Stricter building construction codes (more efficient materials)
- Requiring installation of high efficiency heating, air conditioning and ventilation systems
- Mandating higher levels and better quality of insulation
- Requiring minimum thermal efficiency levels for windows
- Establishing efficiency requirements for lighting fixtures and systems
- Requiring installation of metering and other control instrumentation (for monitoring heat, electricity, and gas usage)
- Setting penalties for failing to meet the minimum standards (which can be added to the electricity bill)

3 ACE[3] 1991

- Mandating that these building codes be required for all new residential and commercial buildings, and/or require the gradual efficiency improvement of existing structures

Singapore, where commercial buildings account for 30 percent of electricity consumption, implemented building codes in 1979 that have reduced electricity use in buildings 6-10 percent These codes are accompanied by penalties for non-compliance[4]

Many governments also have instituted minimum efficiency standards in the transportation sector These codes generally incorporate mechanisms such as fuel consumption standards (measured in miles per gallon or kilometers per liter) for various classes of vehicles, fuel consumption ratings[5] for vehicles to provide consumers with comparative efficiency information, emission standards, gasoline taxes, and taxes on vehicles (see Exhibit 4 2 and Annex C)

The primary goals of these policies are to reduce dependence on oil in the transportation sector and to enhance environmental protection The importance of the former objective is highlighted by the fact that in a sample year of 1988, over half of the petroleum products consumed in the US UK, and Canada were for transportation, and gasoline alone accounted for at least 50 percent of all transportation petroleum consumption

The link between the transportation energy consumption and the environment is indisputable in the same sample year of 1988, the transportation sector accounted for 67 percent of all carbon monoxide emissions, 41 percent of all nitrogen oxide emissions, and 34 percent of all lead emissions For this reason, within the OECD countries emission standards are among the most common transportation efficiency regulations One of the most important of such standards implemented by the US is the Clean Air Act of 1990 regulating the emissions of automobiles and trucks (See Annex C)

The US also has had great success improving transportation efficiency with the implementation of Corporate Average Fuel Economy (CAFE) Standards, initially established in 1978 CAFE standards mandate that automobile manufacturers meet an established minimum fuel efficiency (measured in miles per gallon or MPG) Exhibit 4 3 presents these standards for various classes of vehicles If a manufacturer fails to meet the minimum fuel efficiency standard of 27 5 MPG for cars (or 8 6 liters per 100 Km) a fine is levied $5 for each 0 1 mile per gallon by which the manufacturer falls short, multiplied by the number of cars in violation

Taxes are also an effective and common mechanism to achieve greater transportation sector efficiency As illustrated in Column Nos 4 and 5 of Exhibit 4 2, all of the OECD countries incorporate taxes into the retail price of gasoline and, in most cases, the percentage of taxes account for at least 60 percent of the final price In addition, taxing the purchase of vehicles based on weight, engine size, horsepower, number of cylinders, or some other criteria is common Vehicle taxes are also levied based on fuel efficiency and are called "gas guzzler" taxes automobiles with poor MPG ratings are subject to penalties levied on the purchaser The guzzler tax depends on how far below the minimum standard a vehicle is As of 1991, the tax in the US ranges from $1,000 to $7,700 per vehicle Conversely, a "gas sipper" rebate can be offered to the purchaser if the vehicle has a high fuel efficiency rating

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4 ACE[3] 1991

5 The term "standards" is used in this report to refer to formal regulations or laws "Ratings" refers to the requirement that manufacturers place information on the product informing the consumer of its energy efficiency

Exhibit 4.1
GOVERNMENT ACTIVITIES TO IMPROVE END USE EFFICIENCY IN OECD COUNTRIES

Country	(1) Equipment/ Appliance Labelling	(2) Equipment/ Appliance Standards	(3) Building Standards	(4) Financial Incentives	(5) Audits
Canada[1]	R	I,R,C	R C	I R C	I R C
United States	I R C	I R C	R C	I R C	I R C
Australia	I[2] R[2] C[2]	I[2] R[2] C[2]	R C[2]	R[2]	I C
Japan	R C	I R,C	R C	I,R C	I R C
New Zealand	R[3]	R[4]	R C[5]	-[6]	I C[7]
Austria	-[8]	R[9]	R	I R,C	I,R C
Belgium	R	-	R	I R C	I C
Denmark	R[10]	-	R C	I R,C	I R C
Finland	-[5]	-	R C	I R C	I C
France	I R	R[11]	R	I R C	I
Germany	R	R	R C	I R C	-
Greece	R	R C	I R	-	
Ireland	-	-	R C	R	I C
Italy	R[12] C[12]	I[2] R[2] C[2]	R C	I,R C	I
Luxembourg	-	R	R[4] C[4]	I R C	I R[13] C[13]
Netherlands	R	I,R,C	R,C	I R C	I R,C
Norway	R[13]	-	R C	I,R C[14]	-
Portugal	-	R	R C	I C	I,C
Spain	R	R,C	R C	I R C	I R C
Sweden	R	-	R	I,R,C	I
Switzerland	I	R	R	R	-
Turkey	-	-	R C	I	I
United Kingdom	R	R C	I R C	I R	I

R = Residential C = Commercial I = Industrial
Source IEA 1994

Notes

1 Includes activities of the federal and provincial governments and utilities
2 Introduction or expansion under consideration
3 Voluntary and applied to some domestic appliances only
4 Voluntary application of electric hot water cylinder standard only
5 Under preparation
6 Loan programme for public sector
7 Provided by the Government on a commercial basis
8 In preparation in accordance with EU regulation, energy consumption of some larger electric household appliances (e g refrigerators), freezers, televisions, washing machines) has to be shown in a user guide according to Federal Law No 120/1980
9 In accordance with CENELEC (European Committee for Electrotechnical Standardisation) standards
10 Introduced in 1993
11 For electric water heaters
12 Regulations that have existed for several years are to be updated according to EU rules by the end of 1994
13 From 1 January 1994
14 For introduction and dissemination of new energy technology

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Exhibit 4.2
PUBLIC SECTOR ACTIVITY TO IMPROVE END-USE EFFICIENCY, TRANSPORT SECTOR

Country	(1) Fuel Consumption Ratings	(2) Fuel Consumption Standards	(3) Light Duty Vehicle Emission Standards	(4) Percentage of Taxes[1] in Gasoline Prices (1992)	(5) Vehicle Taxation[2]
Canada[3]	V	V	US Standards	45 9	X[4]
United States	X	X	US Standards	33 9	X[4]
Australia	V	V[5]	Australian Standards	45 9[6]	X[4]
Japan	V	V	Japanese Standards	46 7	CC W
New Zealand	-	-	-	45 1	Fixed Rate
Austria	by importer	-	US Standards	64 8	CC[7]
Belgium	-	-	EU Directive	70 1	CC HP
Denmark	-	-	US Standards	62 0	W[8]
Finland	by manufacturer	-	US Standards	68 0	X[9]
France	-	-	EU Directive	77 1	HP
Germany	by manufacturer	-	EU Directive	72 4	CC
Greece	-	-	EU Directive	69 1	CC HP
Ireland	X	-	EU Directive	66 6	CC
Italy	-	-	EU Directive	75 7	CC HP
Luxembourg	-	-	EU Directive	62 8	CC
Netherlands	by importer	-	EU Directive	73 1	W + fuel type
Norway	by importer	-	US Standards	60 7[10]	W Fixed rate
Portugal	by importer	-	EU Directive	75 4	CC X[11]
Spain	X	-	EU Directive	69 8	CC, HP
Sweden	X	-	US Standards	69 2	W
Switzerland	by importer	-	US Standards	62 5	W
Turkey	-	-	X (for big cities)	63 7	W CC
U Kingdom	X	-	EU Directive	69 3	Fixed rate

Source IEA 1994

X = Mandatory V = Voluntary

Notes

1 IEA *Energy Prices and Taxes Fourth Quarter 1992* (Paris OECD 1993) or as provided by Member countries includes VAT and other taxes unless otherwise specified

2 W = vehicle weight, HP = horsepower CC = cylinder capacity

3 Fuel consumption standards for light-duty vehicles of less than 8 500 lbs (3 850 kg) One province Ontario has a "gas guzzler" tax/rebate programme that review a C$ 75 tax on about 89% of new car sales, while about 9% of new car sales qualify for a rebate of C$ 100 per vehicle Canada's light-duty vehicle emission standards are expected to be harmonised with US standards (excluding those in California) by the 1996 model year
Percentage of taxes in gasoline prices is based on equal weighing of sales in each grade

4 Basis for registration fee varies by state or province

5 Voluntary resumption of National Average Fuel Consumption targets being negotiated Mandatory targets remain an option

6 Sales weighted across states

7 Since May 1993 taxation has been based on JP (kW)

8 Registration tax on value, annual tax on weight

9 Vehicle tax is defined by the following formula 1 02 x import value - Mk 4 600 i e the tax depends only on the import price of the vehicle

10 Unleaded excluding VAT

11 Annual tax varies according to vehicle age, cylinder capacity and fuel used

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Some countries have coupled these specific standards with strict requirements governing the quality of fuels in order to reduce the environmental impact of transportation sector energy use For example the US has banned the sale of leaded gasoline and has instituted strict production requirements for refiners on the content of benzene, aromatics, oxygen sulfur and nitrogen oxide in gasoline and other transportation fuels However, complying with these codes to produce "reformulated gasoline" in the US does not come without a cost refinery industry officials have estimated that the reconfiguration of refineries will require capital investments in the range of $20-30 billion to reformulate all gasoline by the year 2000

In Europe, the European Community's Directive No 85/210/EEC mandated that by October 1989 all member states should have unleaded gasoline available, the lead content of gasoline cannot be greater than 0 40 g/liter and the level should be reduced to 0 15 g/liter as soon as member states judge it appropriate to attain this standard EC Directive 87/219/EEC provides that after January 1989 the sulfur content of diesel fuel and heating oil may not exceed 0 3 percent by weight However, member states are empowered to impose a lower level of 0 2 percent by weight

Exhibit 4.3
CORPORATE AVERAGE FUEL ECONOMY (CAFE)
STANDARDS FOR AUTOMOBILES AND LIGHT TRUCKS IN THE US, 1978-1993[a]
(miles per gallon)

Model Year	Automobiles	Light Trucks[b]
	CAFE Standards	CAFE Standards
1978	18 0	c
1979	19 0	17 2
1980	20 0	c
1981	22 0	c
1982	24 0	17 5
1983	26 0	19 0
1984	27 0	20 0
1985	27 5	19 5
1986	26 0	20 0
1987	26 0	20 5
1988	26 0	20 5
1989	26 5	20 5
1990	27 5	20 0
1991	27 5	20 2
1992	27 5	20 2
1993	27 5	20 2

Source US Department of Transportation, NHTSA, "Summary of Fuel Economy Performance " Washington DC September 1993

[a] Only vehicles with at least 75 percent domestic content can be counted in the average domestic fuel economy for a manufacturer
[b] Represents two- and four-wheel drive trucks combined Gross vehicle weight of 0-6,000 pounds for model year 1979 and 0-8 500 pounds for subsequent years
[c] Standards were set for two-wheel drive and four-wheel drive light trucks separately but no combined standard was set in this year

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Minimum efficiency standards in all sectors are an example of a government regulation which must be periodically reviewed and updated Once standards are promulgated, they should be evaluated for

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effectiveness, impact, and compliance If the market has adapted to codes, then developing stricter standards should be considered

Many OECD countries are moving toward more cooperative and voluntary arrangements with industry and manufacturers as a way of gradually raising the minimum efficiency levels of specific products This represents an overall trend of governments focussing their activities on the "upstream," i e working directly with producers, rather than exclusively on the "downstream," or with consumers The benefit of this approach is the ability of a government to leverage a smaller amount of financial assistance to stimulate significant activity by focussing on a specific target (i e a particular industry, or manufacturer)

Rather than forcing the establishment of stricter standards governments are setting targets for manufacturers to achieve, and rely on the industry to meet that goal voluntarily For example the US has no national building codes, except for minimum efficiency requirements for federally-financed housing and Government buildings Individual states in the US have voluntarily implemented their own building standards based on the model codes developed by the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) and the Council of American Building Officials (CABO)

Despite the lack of a uniform national building standard in the US the National Energy Policy Act of 1992 emphasized the strengthening of voluntarily meeting codes developed by ASHRAE and CABO In preparing this legislation, the US Government consulted not only ASHRAE and CABO, but also other industry organizations including the National Association of Home Builders, the Illuminating Engineering Society, the American Institute of Architects, and the National Conference of the States on Building Codes and Standards [6] Thus, the US Government is using a variety of institutions in the building energy efficiency industry to establish a consensus minimum efficiency standard, and then require the gradual strengthening of these codes on a voluntary basis

Selected Building Energy Efficiency Legislation in the US National Energy Policy Act of 1992

Section 271. "The Secretary of Energy shall issue voluntary guidelines that may be used by state and local governments, utilities, builders, real estate agents and others to enable and encourage the assignment of energy efficiency ratings to residential buildings "

Section 304. "Each state shall certify to the Secretary of Energy that it has reviewed and updated the provisions of its commercial building code regarding energy efficiency Such certification shall include a demonstration that such state's code provisions meet or exceed the requirements of ASHRAE Standard 90 1-1989 "

Section 307. "The Secretary of Energy shall support the upgrading of voluntary building energy codes for new residential and commercial buildings "

Finally, it is important to note that standards vary across countries, as Exhibits 4 1 and 4 2 illustrate Kazakhstan should develop standards appropriate for its local conditions and phase-in over time those standards which the economy cannot presently absorb

Advantages As indicated above, government-mandated minimum energy efficiency standards can achieve significant energy savings In addition, standards are an effective device to provide consistent and strong signals to meet energy efficiency goals even in periods of low energy prices, when energy savings priorities are diminished

6 These organizations are all non-profit institutions which represent their industry's interests and provide forums and publications for exchange of information

Disadvantages Arriving at agreed upon, acceptable minimum energy efficiency standards may take some time Many players may be involved, and not all will have the same interests The Government manufacturers, consumer groups, research institutes, and industry representatives all may participate Moreover, there may be a lag from the time a law becomes effective to the time when the equipment meeting the standard penetrates the market to a sufficient enough degree to achieve noticeable energy savings (See discussion in Section 2 of this chapter on this question)

4.1.4 Institutionalization of Government Energy Savings Activities

All of the OECD countries have found the need to establish within the government an entity responsible for developing energy policy Moreover, legislation clearly establishes where energy savings activities will be conducted in the government and the specific responsibilities However, different structures or approaches for implementation are utilized Most OECD countries have established the authority for policy formulation under ***existing*** Ministries which have broader economic policy responsibilities[7] These organizations usually have a separate division for energy and/or a deputy minister responsible for energy matters However, seven countries have established a separate Department or Ministry of Energy[8]

Some countries have organizations which are outside the typical government, departmental structure and operate more independently The delegation of responsibility for energy conservation to non-ministerial entities depends in large part on the tradition of a country and/or the size of the central government For example, France has the French Agency for Energy Management which operates as a quasi-governmental agency The Netherlands also has three separate non-ministerial organizations the Dutch Energy Conservation Information Agency, the Dutch Energy Development Company (for demonstration), and the Management Office for Energy Research, each with different responsibilities

It is also important to note that typically there are other organizations within a government that deal with energy-related issues For example, Ministries of Environment, Housing, Transportation, Agriculture, and Industry are other entities which may have input into energy policy development or some jurisdiction or implementation authority in energy matters The critical point is to ensure effective coordination among these entities and to establish clear lines of authority and reporting Fragmenting responsibilities for energy savings activities across numerous ministries will result in weak, ineffective implementation and duplication of activities

Legislative bodies, such as a parliament or congress, also play a role in adopting and passing energy conservation legislation The process differs in each country, with some ministries assuming ultimate responsibility for the development of the laws, while in other countries the legislative body plays a more active role In addition, many countries utilize advisory bodies to assist in the legislative process (consisting of other government agencies, the private sector, or academia) The degree to which these outside advisory entities are used or are successful depends on the tradition of government-industry cooperation in the country

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7 Austria, Belgium, Finland, France, Germany, Greece, Italy, Japan, Netherlands, New Zealand, Portugal, Spain, Sweden

8 Canada, Denmark, Ireland, Luxembourg, Norway, Turkey, and the US In Australia responsibility for energy is placed with responsibility for other primary industries, including agriculture, in the Department of Primary industries and Energy In Switzerland there is a Federal Department for Transport, Communication and Energy In the United Kingdom most energy responsibilities rest with the Department of Trade and Industry Responsibility for the efficient use of energy rests with the Department of the Environment

All OECD governments issue energy policy documents or statements periodically Furthermore, promoting the more efficient use of energy has been the main objective of all of these policies The effectiveness of these documents varies, but an attempt is made to state clearly the government's goals and plan to achieve them

Experience in other countries also suggests that non-government organizations can play an important role in promoting energy savings As discussed in the section on information and education programs, in the OECD countries a very mixed structure of energy conservation activities has evolved and worked successfully There are numerous types of organizations involved in developing and implementing energy savings activities national governments, state or regional governments, non-profit entities, research organizations, training firms, private energy service companies, and universities are all very active and supplement and complement the national government's activities

Thus, although governments are active in promoting energy conservation, particularly in the initial stages of a country's efforts to achieve energy savings, gradually decentralizing activities throughout the economy into various types of organizations has proved successful The ultimate goal of many countries' energy conservation activities is to place decision making into the hands of individuals and individual companies giving them the power to pursue energy savings activities The government can play a role in creating a legislative framework that promotes these activities, but does not become the central arbiter of decisions The following presents a comparative overview of the institutional structure and experience in three countries Poland, Korea and Turkey

Poland has proposed a structure which concentrates energy policy making within the existing Ministry of Industry and Trade[9] A separate Energy Department within this Ministry will be responsible for a broad array of issues, as illustrated in Exhibit 4 4, including establishing guidelines for energy savings policies as well as program design to carry out the Government's objectives The Government has proposed, however, the establishment of a separate, quasi-independent National Energy Conservation Agency designed to be the ***implementing*** organization for Government energy savings activities As the main Government organization which sets energy policy, the Ministry of Industry and Trade will exert influence on the Agency However, the latter has been established to operate as a joint stock company, and its day-to-day operations and funding are independent of the Ministry The Agency does not set policy, but can provide expertise to the Government on policy matters The Polish Energy Efficiency Center was established in 1991 with US donor funding and, although it still receives the bulk of its funds from this source, it was designed to operate ultimately as a for-profit and self-financing organization through revenues generated by services rendered As indicated in Exhibit 4 4, some of the proposed activities of the Agency will overlap with those of the Efficiency Center (e g training and education) This will not necessarily be a problem it has been discussed throughout this Chapter that the diversification of energy savings activities among different types of organizations has proved to be beneficial in achieving energy savings across a broad spectrum of society

9 This section based on information in *Energy Policy of Poland and the Draft Programme to the Year 2010*, Polish Ministry of Industry and Trade (1992)

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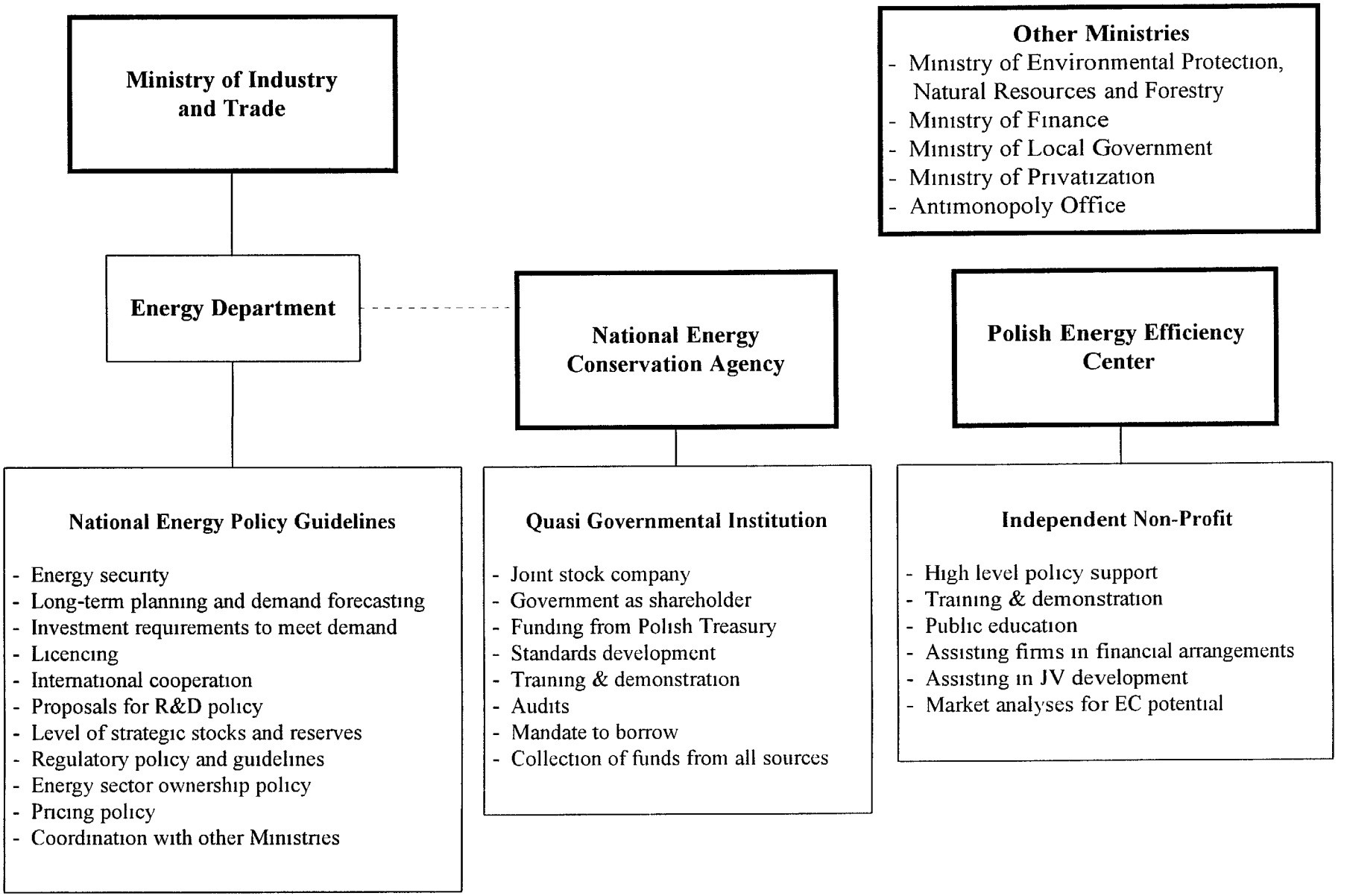
Exhibit 4.4
PROPOSED STRUCTURE OF ENERGY CONSERVATION ACTIVITIES IN POLAND



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It must be noted, however, that Exhibit 4 4 represents a ***proposed*** organizational structure for Poland and many facets of how it will actually work cannot be determined until put into practice For example, it is not clear exactly how much independence the Agency will have as a joint stock company with the Government as a share-holder and significant funding initially coming from another arm of the Government Furthermore, it is not clear if the Agency will become, (or will be allowed to become) a for-profit organization These questions illustrate that it will be necessary to define more clearly the mandate, lines of reporting, and modalities of operation of this proposed structure, and in particular those of the National Energy Conservation Agency

The proposed structure in Poland is similar in several ways to the structure that has been functioning in ***Korea*** for more than a decade, but with some important differences[10] As illustrated in Exhibit 4 5, the Ministry of Trade, Industry and Energy has an Energy Conservation Policy Office, and below this an Energy Conservation Policy Division Similar to Poland, the Ministry's role in Korea is limited to the development of broad energy policy guidelines This includes the drafting of a National Energy Conservation Plan, creating a blueprint for the Government's objectives in achieving energy savings The Korean Energy Management Company (KEMCO) was established in 1980 as the entity designed to implement the Government's policies and programs KEMCO does report to the Ministry (through the Energy Conservation Policy Division) and receives 50 percent of its funding from the Ministry Thus although it has considerable day-to-day operational independence, KEMCO, unlike the proposed National Energy Conservation Agency in Poland, is under more direct authority of the Ministry

The Korean structure also varies from the Polish model in the extent of its responsibilities within the mandate of KEMCO is the operation and administration of Energy Service Centers and an Energy Rationalization Fund This Fund operates in a fashion similar to that described in Section 1 of this Chapter it provides loans and grants for energy conservation activities and obtains its funding from a tax levied by the Government on energy imports Therefore, the majority of energy savings ***implementation*** activities in Korea is concentrated in KEMCO Poland on the other hand, in addition to the proposed National Energy Conservation Agency, has an independent Energy Efficiency Center contributing to energy savings activities Although Korea has not evolved a structure with a wide variety of organizations, instead concentrating the principal responsibilities in one main entity, this structure has worked well Owing to the ability of KEMCO to generate 50 percent of its revenue from services offered, as well as its large and well qualified staff, it has been successful in achieving energy savings

Turkey has a more complex structure of energy conservation activities, as indicated in Exhibit 4 6[11] The energy policy-making authority lies primarily with the State Planning Office (SPO), the entity responsible for coordinating and developing overall economic policy and planning in the Government Thus, the Turkish Ministry of Energy and Natural Resources through its Department of Energy's subordinate bodies, develops national energy policy guidelines to recommend to the SPO which, in turn, must review, edit, alter, and approve these proposals The SPO is the final authority determining all economic policy and planning, including energy savings programs

10 This section based on information in *Survey of the Republic of Korea's Energy Policies*, IEA (1994)

11 This section base on information in *Energy Conservation Policies and Programmes in Turkey*, BCEOM, Paris, France (1989)

Exhibit 4.5
STRUCTURE OF ENERGY CONSERVATION ACTIVITIES IN KOREA

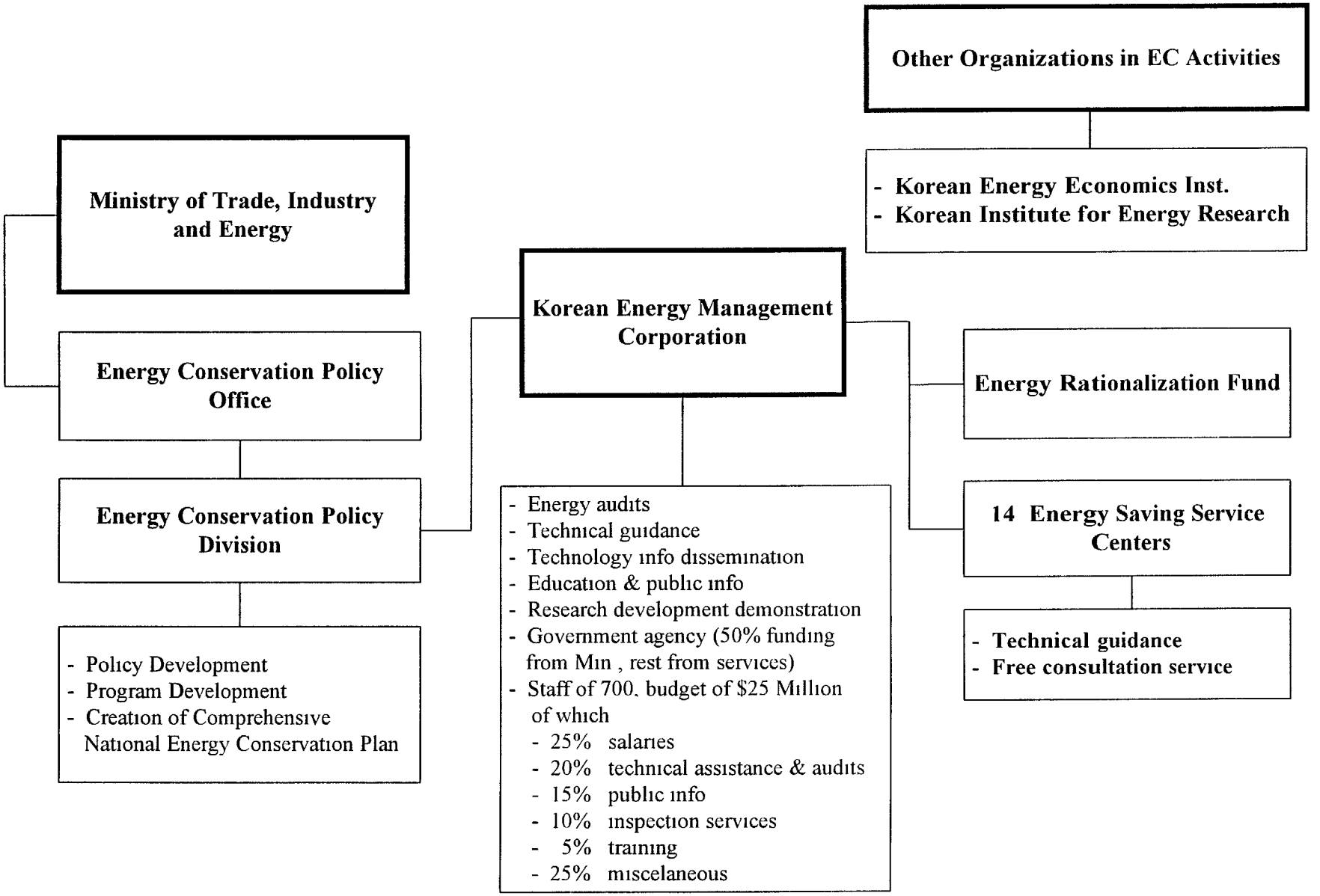
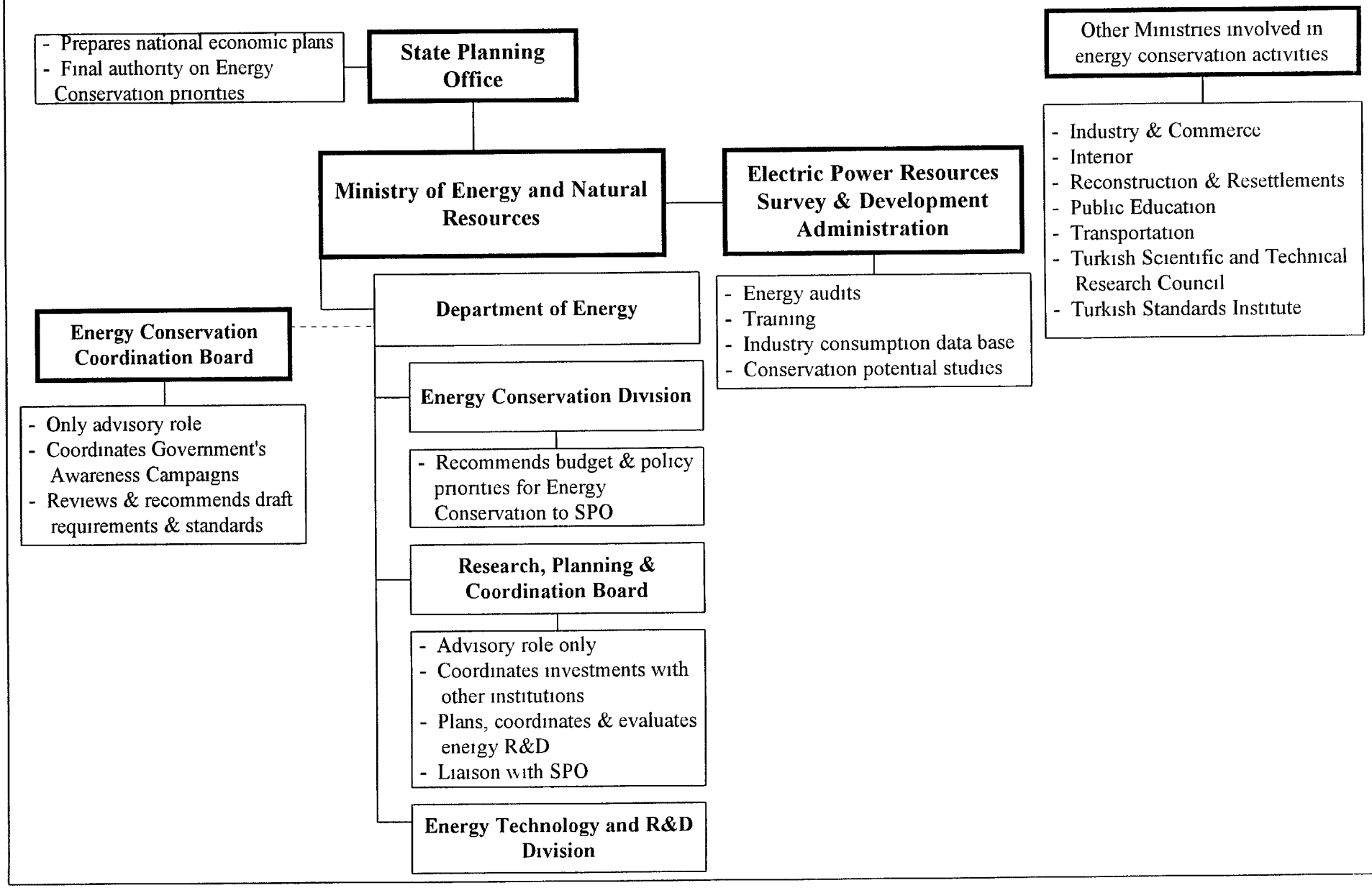


Exhibit 4.6
STRUCTURE OF ENERGY CONSERVATION ACTIVITIES IN TURKEY



Energy savings policy formulation and implementation is fragmented, with considerable overlap in responsibilities For example, as mentioned the Ministry formulates policies and programs but the SPO, a non-energy entity, has the right to override the Ministry's authority and expertise Moreover, there is an Energy Conservation Coordination Board (ECCB) comprising members from various ministries and other Government groups involved with energy conservation The ECCB is only an advisory body, meets only sporadically, and works with a Ministry which does not have the final authority in establishing the Government's energy conservation guidelines Two bodies, the Research, Planning & Coordination Board and the Energy Technology and R&D Division (both within the Ministry) appear to have responsibilities for R&D, and three groups, the ECCB the Turkish Scientific and Technical Research Council and the Turkish Standards Institute all have a role in standards development The Electric Power Resources Survey & Development Administration is the primary energy savings implementation entity, but suffers from a lack of resources and a poor record of coordination with the Ministry Thus, the energy savings institutional structure is not well focussed and responsibilities are ill-defined

Advantages The advantages to centralizing a government's energy conservation activities are a greater level of coordination, effectiveness in implementation, and a higher level of visibility of energy issues

Disadvantages There are also difficulties with centralizing energy conservation activities By focusing all the national energy savings programs in one organization, the energy activities of other government entities or Ministries may not receive sufficient attention or resources For example, building codes may need to be developed and/or implemented with the Housing & Construction Ministry Furthermore, if the principle government organization responsible for energy conservation programs is not granted sufficient resources to operate effectively, or if it does not receive high-level, committed leadership, then the entire government energy savings program will be weakened An additional danger with centralization, particularly in countries initiating comprehensive government energy savings legislation for the first time is that energy conservation activities are placed in an existing Ministry (e g Energy or Industry) which traditionally has been responsible for energy ***supply*** functions Energy conservation programs, which focus on improving energy consumption and end-use efficiency may not receive the attention and resources required in an organization historically dedicated to providing absolute quantities of energy supplies and concerned more with sales, revenues, and supply logistics

4.1.5 Research and Development

Most governments are actively involved in supporting the research and development (R&D) of energy efficient technologies However, this support can take different forms depending on the philosophy of the government and the industry and economic structure of the country Two areas of differing approaches are

- *Long-range development of **advanced or non-commercial** technologies vs demonstration and market penetration of **existing** technologies* Some governments support longer range R&D programs geared toward achieving state-of-the-art advances on basic technologies and moving into the next generation Others provide financial support which focusses on the demonstration and introduction of existing technologies which have not become sufficiently commercialized or achieved a high degree of market penetration

- *Level of government and industry cooperation* Some governments take the lead in R&D activities and leave demonstration and technology transfer to the respective industries The US, for example has traditionally followed this pattern Others form a closer alliance with industries to engage in a wide range of R&D and demonstration programs, for example, focussing on either the R&D or technology transfer approach Britain has worked more

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closely with industry assisting in the technology transfer or market penetration equipment The approach utilized by a government mostly depends on how active the respective industries, such as transportation, manufacturing or buildings, in that country are in R&D and technology transfer activities

Government support of R&D is also provided to national laboratories, research institutes, and state, local or regional governments for their own programs Overall, energy efficiency R&D expenditures can form a large part of a government's total energy savings program budget In the US, R&D accounted for approximately 30 percent of total energy conservation program expenditures (or about $120 million) in 1992[12] However, energy conservation R&D represents a relatively small share of total energy R&D expenditures in 1993, energy conservation R&D accounted for 6 3 percent of total energy sector R&D activities in the OECD countries Nevertheless, the expense of R&D activities has prompted most OECD governments to move toward more cooperative relationships with industry and manufacturers to stimulate R&D activities

US Government R&D

In the US, Government R&D support and cooperation with the private sector has assisted in the commercialization of 24 technologies since 1978, resulting in energy savings of 372 quadrillion BTUs through 1991

Source IEA

Government R&D activities need to be periodically evaluated for their effectiveness and progress in order to be effective and have the greatest impact Moreover, in order to be successful, R&D activities require up-to-date and reliable data and information on energy trends, particularly consumption

Advantages Government support of R&D activities, technology demonstration and transfer can leverage public funds for significant advances in energy efficient technology that the market alone may not stimulate In addition, governments can provide valuable support to the private sector in assisting their efforts to develop and commercialize efficient equipment and appliances

Disadvantages Government R&D activities can require substantial expenditures For this reason more governments are moving toward greater collaboration with manufacturers and utilities in order to leverage limited resources

4.1.6 Financial and Tax Incentives

Perhaps the most beneficial financial incentive is a Government's implementation of overall fiscal and monetary policies which permit reduction of nominal interest rates to reasonable levels and, on a controlled basis, creation of sufficient liquidity in the financial system to permit long-term lending to borrowers based on enterprises' credit-worthiness and prospective returns from the proposed funds borrowed However, significant barriers to financing energy savings investments exist in Kazakhstan Essentially, a functioning domestic financing market does not exist owing to

- Expensive and restrictive bank credit
- Deteriorating balance sheets of State enterprises and banks that support them
- Non-competitive product prices on world markets adversely affecting balance of trade
- An overvalued and non-convertible (or only partially convertible) currency

12 *DOE's Efforts to Promote Energy Conservation and Efficiency,* US General Accounting Office (1992)

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- Lack of privatization in the manufacturing industry

Thus, financing support for energy savings investments has to be underwritten by the government which has, in turn, its main source of money from foreign institutions in the form of grants, transfers, and loan forgiveness schemes Nevertheless, certain specific policies can be helpful, and governments have considered some of the following policies and programs (Exhibit 4 7 summarizes the advantages and disadvantages of all of the financial incentives discussed in this Section)

Reduction or elimination of the VAT and duties on imports of energy efficiency equipment This will encourage the importation of much needed equipment not found in the domestic market

Priority access to foreign exchange for industries making energy efficiency investments Importing specialized energy efficiency equipment and services has a high foreign exchange component Facilitating access to foreign exchange can increase access to these services and equipment

Grants/No-Risk loans for audits and preliminary engineering studies. In order to enhance knowledge of the potential benefits of energy efficiency and to alleviate some of the risk and uncertainty attendant with first time investments, governments can establish grants or no-risk loans for preliminary engineering work or audits The enterprise would be obligated to repay the loan only if the audit/engineering work identifies energy efficiency opportunities

Subsidized-interest loans Under this type of program, the government can make credit available to energy users for energy efficiency investments at a lower cost of capital than could be obtained from financial institutions at market rates

Loan guarantees Financial institutions may not be prepared to make loans to enterprises for energy efficiency investments owing to the perceived risk and uncertainty of such projects or concern about the stability of the borrower A mechanism to address this problem is for the government to guarantee qualifying loans, often 80-90 percent of a loan

Preferential export treatment for enterprises making energy conservation investments In order to provide incentives to enterprises with export earnings generation potential, the Government should consider offering preferential export treatment to enterprises that make energy conservation improvements at their facilities This preferential treatment can include loosening export quota restrictions and easing licensing procedures In addition, these incentives can be applied to foreign companies that establish joint ventures with local companies, if the foreign company (and the local enterprise) invest in improving the energy efficiency of the facilities

Tax Incentives for Energy Efficiency

- Japan allows a 7 percent tax credit on energy saving investments plus a special depreciation allowance equivalent to 18 percent of the acquisition price of energy saving measures.
- The Indian government offers a 25 percent investment tax credit for cogeneration, depreciation over one year of 100 percent of capital investments in energy conservation, and a reduction in the corporate income tax.

Source. USAID 1987.

Exhibit 4.7
FINANCIAL INCENTIVES TO PROMOTE ENERGY SAVINGS

POLICY	ADVANTAGES	DISADVANTAGES
1 Reduce/eliminate VAT & import duties	• Encourages importation of equipment & technologies	• Reduces revenue to government
2 Priority access to foreign exchange	• Increases access to imports of equipment & technologies	• Could crowd-out foreign exchange for other sectors
3 Grants/no risk loans	• Small amount of government funds can result in significant energy and capital savings • Introduces new technologies	• Increased administrative burden
4 Subsidized interest loans	• Credit made available at lower cost of capital than from financial institutions at market rates	• Actual capital cost not lowered, only financing cost • Capital expenditure by government
5 Loan guarantees	• Projects implemented at low cost to government	• Does not reduce cost to borrowers, rather reduces risk of lender
6 Energy conservation fund	• Functions as revolving credit facility - ultimately self-financing • Financial resources in fund dedicated only for energy savings activities	• Administrative burden • Usually requires initial capital from donors
7 Tax related incentives	• Provides direct stimulus to discrete energy conservation investments • Leaves enterprises with more capital to invest in energy savings activities • Creates awareness • Easily implemented	• Mainly used by entities with existing high tax burden and higher income households

Source International Resources Group, Ltd , and USAID 1987

Dedicated energy conservation fund Energy Conservation Funds are used throughout the world providing a dedicated reserve for energy savings financing that cannot be used for other purposes Typically the initial financing or start-up money comes from a donor organization (bilateral, multilateral, or a combination) and/or from the government Supplemental funding can come from energy taxes or surcharges (for example on imports), penalties levied elsewhere in the energy sector (for example from failing to meet energy standards, or the minimum facility efficiency requirements), or from other services that the fund may offer (such as conducting energy, training, or demonstration programs)

The fund provides loans to enterprises seeking financial assistance for energy conservation investments The fund usually establishes an application process for the loans and the investment must meet certain requirements, such as investing in specific energy efficient equipment, setting a minimum amount of energy saved resulting from the investment, or requiring a certain payback period Loans are made at interest rates below the prevailing market rates and with favorable repayment schemes in order to attract investors and provide another source of funding other than the commercial sector As loans are repaid, or other funds are made available, additional loans can be made Funds can be operated and money loaned directly by the government or through financial institutions

The success of such dedicated funds depends on properly promoting its existence, avoiding complicated application procedures, conducting evaluations of project proposals in a timely fashion, and ensuring interest rates on the loans at below market rates

Governments have also established tax incentives to promote energy savings, providing benefits for enterprises making energy conservation investments or for manufacturers producing energy efficiency equipment (See Exhibit 4 7) These incentives can include

Tax credits An enterprise would be able to claim a certain of percentage of a qualifying energy savings investment and reduce the enterprise's overall tax liability by this amount The percentages can vary according to the complexity of the investment, for example, 10 percent for process improvements and 25 percent for cogeneration

Lower tax rates on corporate profits This incentive is applied to firms implementing energy conservation programs

Tax holidays For an enterprise implementing energy conservation projects, a certain period of time would be granted during which it would not be required to pay taxes either all or a fixed percentage

Accelerated depreciation Allow an enterprise to accelerate the writing-off of investments in energy conservation projects, including cogeneration, thus reducing tax liability

It is important to note that tax-related incentives are only as effective as the general tax code itself Since energy conservation tax incentives form part of the broader tax code, they will only be effective if the general tax code of the country is enforced In addition, the process of claiming the tax benefits needs to be user-friendly, and the overall program of tax incentives needs to be promoted and publicized so that potential beneficiaries are aware of the law These problems have led to the failure of these tax programs in many developing countries In addition, tax credits tend to benefit (and thus are used to a greater degree) by enterprises that already have a significant tax burden

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The US experimented with energy conservation tax credits from 1978-1982 The Residential Energy Tax Credit allowed a credit of 15 percent for up to a limit of $2,000 worth of conservation-related expenditures Thus, the maximum credit that could be claimed was $300 Conservation investments that qualified were items such as insulation, weatherstripping, and replacement burners for furnaces There was also a Renewable Energy Tax Credit which allowed a tax credit of 40 percent for up to $10 000 of expenditures related to the use of renewable energy sources, for a maximum of $4,000 Qualifying projects included solar, wind and some geothermal technologies In this period there was also a Business Energy Tax Credit, allowing for a 10 percent credit for specially defined energy property and cogeneration equipment

The tax credit law in the US was allowed to expire owing to several reasons which were revealed in a number of surveys conducted of the program

- Households and businesses that used the credits indicated that they would have made the investments even without the incentive of the credits
- Many households or businesses that would likely benefit from the incentives already made investments
- Many consumers and businesses did not know about the incentives
- Many claimed that it was too much trouble to file the necessary forms
- Some stated that the amount of the credit was too small to claim

4.2 ENERGY SAVINGS LEGISLATION AND THE TIME FACTOR

It is important to emphasize that energy conservation legislation and policy development/implementation is very time-sensitive in several critical ways First, as discussed earlier most countries have learned that the effectiveness of energy savings legislation constantly needs to be reviewed and updated on a periodic basis as economic and social circumstances change over time Second, periods of high or rapidly escalating energy prices and/or perceived threats to a nation's energy security, such as energy shortages, generally lead to a more active period of energy conservation legislation development and implementation Law-makers are more often rallied to action during these periods of crisis than may otherwise be the case Finally there may be a lag between the time energy savings legislation becomes law and when actual savings are realized This will depend on several factors, primarily on the type of energy conservation program enacted and the effectiveness of government promotion and/or enforcement of the regulations

As an example of the relationship between time and the type of energy conservation program, note the differing implementation environment surrounding energy conservation R&D programs and a policy to reduce import duties on energy efficient equipment Research and development activities are long-term, taking time not only to implement, but also to yield results In contrast, lowering import duties is a relatively standard administrative task which, if properly promoted, can have a substantial immediate impact

To illustrate this relationship, Exhibit 4 8 presents a selected list of US energy savings legislation enacted since the early 1970s This list is not comprehensive there have been many more energy sector laws promulgated Those presented below are only those most relevant to energy conservation Exhibit 4 9 illustrates the trend in US energy intensity (measured as energy consumption per dollar of Gross Domestic Product) in the period 1970-1990, approximately the period in which the primary US energy savings laws were enacted and/or amended There are two important revelations in these exhibits

- There was a flurry of energy conservation legislative activity during the 1970s and again in the late 1980s The 1973 oil embargo, the fall of the Shah in 1979 and the attendant dramatic

increase in energy prices throughout most of the decade prompted the US Government to take action to intervene in the market and adopt policies to promote greater energy efficiency The crisis atmosphere surrounding much of the legislation enacted in the 1970s is particularly evident in the title of Public Law 96-102, *Emergency Energy Conservation Act of 1979* The legislation enacted in the late 1980s and early 1990s, a period of substantially lower real energy prices, was a result of growing environmental awareness and the perceived need to address the linkages between energy and environment

- *There has been a steady decline in energy intensity* Rising energy prices and increased government intervention in the form of energy conservation legislation has been responsible, in large part, for stimulating the steady decline in energy intensity in the US in the period 1970 to 1990 Conversely, the collapse of oil price prices in 1985-1987 lessened the urgency to improve the efficiency of energy use, legislative activity diminished, and the pace of the decline in energy intensity slowed or flattened out

Exhibit 4.8: Compilation of Selected Energy Conservation-Related Legislation in the US

- Automotive Fuel Efficiency (Title V of the Motor Vehicle Information and Cost Savings (Public Law 92-513) of 1971
- Energy Policy and Conservation Act (Public Law 94-163) of 1975
- Energy Conservation and Production Act (Public Law 94-385) of 1975
- National Energy Conservation Policy Act (Public Law 95-619) of 1977
- Public Utility Regulatory Policies Act of 1978
- Emergency Energy Conservation Act (Public Law 96-102) of 1979
- Low-Income Home Energy Assistance Act of 1981
- National Appliance Energy Conservation Act of 1987
- Clean Air Act of 1990
- National Energy Policy Act of 1992

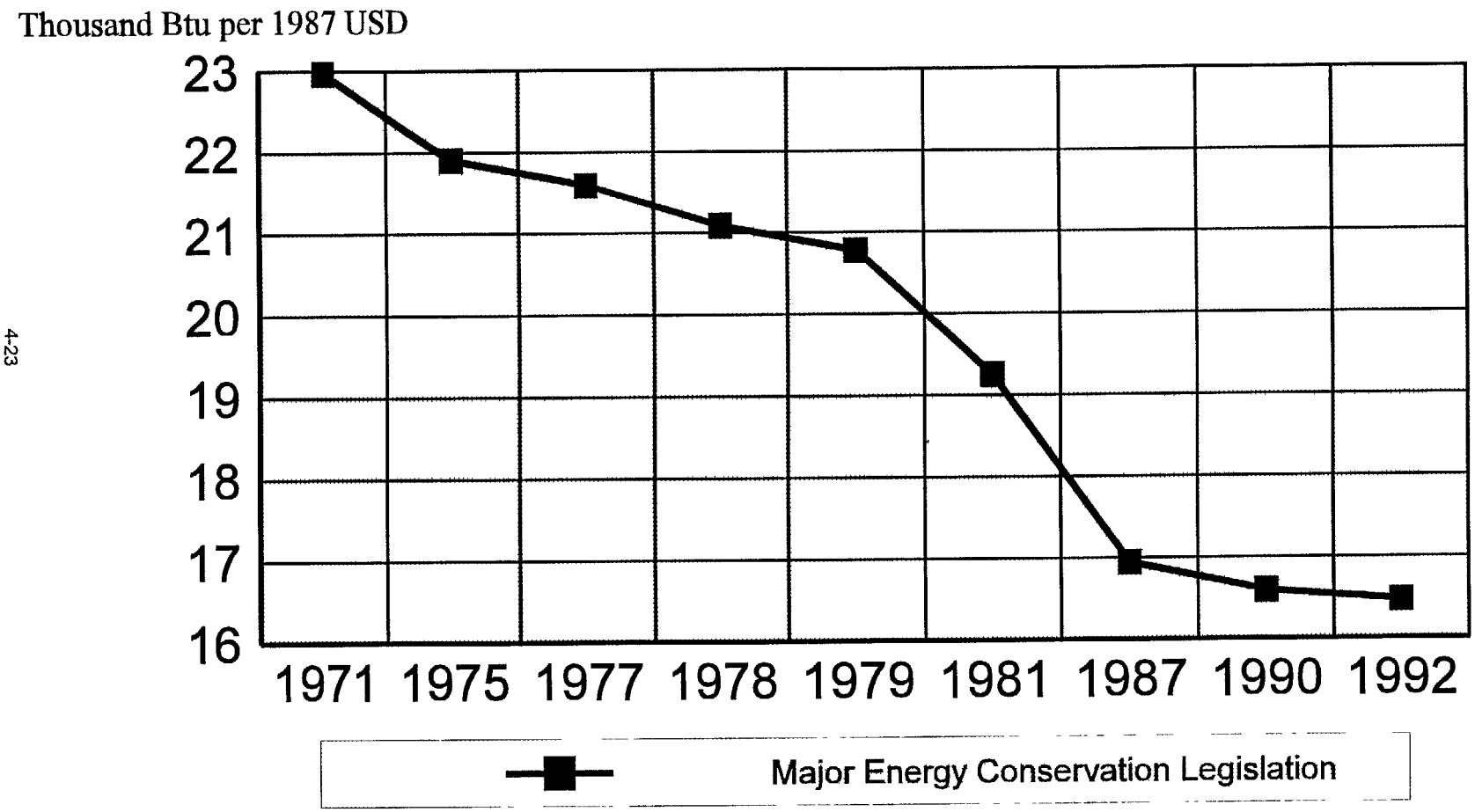
Compilation of Energy Organization-Related Legislation in the US

- Federal Energy Administration Act of 1974
- Energy Reorganization Act of 1974
- Department of Energy Organization Act (Public Law 95-91) of 1977

Moreover, Exhibit 4 9 illustrates the lag between the time legislation is enacted and when its impact is achieved Although most of the energy efficiency legislation in the US became law in the period 1971-1979, the sharpest decreases in energy intensity were realized in the period 1979-1987 The reason for this is that it takes time for individuals and businesses to absorb and react to the signals sent from the government For businesses, incorporating energy savings legislation incentives can involve significant operational changes In addition, much of the legislation enacted in the 1970s was intended to stimulate substantial industry and sector-wide changes which, by definition, are achieved in the long-term

An additional salient feature of this legislation is that each of these laws contains some sections that amend, repeal, supersede, or expand previous laws For example, there are sections of the *Energy Conservation and Production Act of 1975* which are amended in the *National Energy Conservation Policy Act of 1977* Furthermore, the *National Energy Policy Act of 1992* also amends sections of the 1977 law as well as the *Public Utility Regulatory Policies Act of 1978* Thus, energy conservation legislation in the US has been revised or amended, at differing time intervals, over the past 25 years

Exhibit 4.9
US ENERGY SAVINGS LEGISLATION AND ENERGY INTENSITY 1970-1992



Source US Department of Energy and International Resources Group, Ltd

4.3 DEMAND SIDE MANAGEMENT (DSM)[13]

Since the mid-1980s, electric utilities, especially in the US, have assumed an active and aggressive role in promoting end-use efficiency among their customers These activities are broadly called demand-side management (DSM) programs

DSM is the planning, implementation, and monitoring of utility activities designed to encourage consumers to modify their patterns of electricity usage, including both the timing and level of electricity demand DSM is cost effective whenever it is less expensive to conserve a kWh than to generate a kWh The economic value is derived from the savings that result when the marginal cost of generation is greater than the marginal cost of the DSM activity DSM could help utilities reduce the cost of providing electricity, making them more competitive, without the need to take the financial risks of large-scale construction programs DSM is typically categorized as follows

Activities that lower or shift peak load

Direct Load Control Consumer load that can be interrupted during the annual system peak load by direct control of the utility system operator Usually involves residential consumers

Interruptible Load Consumer load that is interrupted by direct control of the utility system operator, or by the consumer at the request of the system operator and implemented in accordance with previous contractual arrangements Large volume commercial and industrial consumers obtain interruptible rates, a discount in return for the consumer's agreement to cut loads upon request from the utility

Programs that reduce energy consumption in all periods, across all consumer classes

Conservation and other Programs Incorporates most DSM programs

- Weatherization retrofits
- Efficient building construction
- Appliance and lighting efficiencies
- HVAC efficiencies
- Energy management services
- Electric and thermal energy storage
- Rate incentives
- Fuel substitution
- Self-generation

The principle objectives of DSM are improved efficiency, reduced consumption, and/or reduced consumption in a specific time period Since utilities' costs of producing power generally differ by time of day and season, most DSM programs target electricity demand reductions in specific time periods, primarily peak periods Utilities can provide (a) direct installation of improved equipment and more efficient technologies, (b) rebates or subsidies (including zero or low interest loans for the purchase or installation costs of efficient technologies), and (c) information about opportunities and benefits of using

13 This section is based on information in *Electric Utility Demand-Side Management,* US Energy Information Administration Feature Article (1992)

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electricity more efficiently, including on-site inspection of the customer facility to identify cost effective options

Rebate programs in the US entail the utility offering the customer a cash incentive for the installation of energy efficient equipment or appliances For example, rebates can range from $20-$100 for more efficient refrigerators or water heaters Florida Power and Light utility offers from $63-$400 to households installing central air conditioning systems which meet certain energy efficiency criteria This particular program reduced summer peak demand by a cumulative 63 MW in its initial three years[14]

US National Energy Policy Act of 1992

Section 111. "The rates allowed to be charged by a State-regulated electric utility shall be such that the utility's investment in energy conservation and other DSM measures are at least as profitable as its investments in the construction of new generation, transmission, and distribution equipment "

Another important area of DSM activities are rate incentives to stimulate end-use efficiency of electricity It should be noted that in order for these incentives to be implemented successfully appropriate metering and instrumentation controls need to be available and installed Rate incentives can include

- Inverted rates — Rates that rise as consumption increases
- Discount rates — Lower rates that are offered to facilities meeting certain conservation requirements
- Time-of-use rates — Rates that are higher during the utility's pead demand hour or season
- Demand charges — Charges based on a customer's highest peak demand in a billing period
- Interruptible rates — Rates that require customers to reduce their use when so requested by the utility

These rate incentives are common in the US and most OECD countries However, many lower income countries are also implementing rate reforms to promote energy efficiency Time-of-use rates were instituted for high- and medium voltage industrial consumers in Brazil in 1982 For example, the tariff for high voltage customers during the peak period is two to five times the non-peak tariff This program is estimated to have shifted 2,100 MW from peak to non-peak hours in the period 1982-1987[15]

The US regulatory system at both the state and federal levels actively promotes or requires electric utilities to incorporate DSM programs Many states in the US have regulatory requirements mandating the incorporation DSM for utilities, ensuring that end-use efficiency measures receive full and equal consideration along with investment in full-scale construction of new generation capacity However, many utilities now routinely utilize DSM programs voluntarily as DSM has proven successful As Exhibit 4 10 highlights, in 1990 in the US, the DSM activities of electric utilities saved approximately 17 billion kWh Moreover, 25 US electric utilities spent three times more money on DSM programs in 1991 than the US Government spent on its energy efficiency activities

14 ACE³ 1991

15 ACE³ 1991

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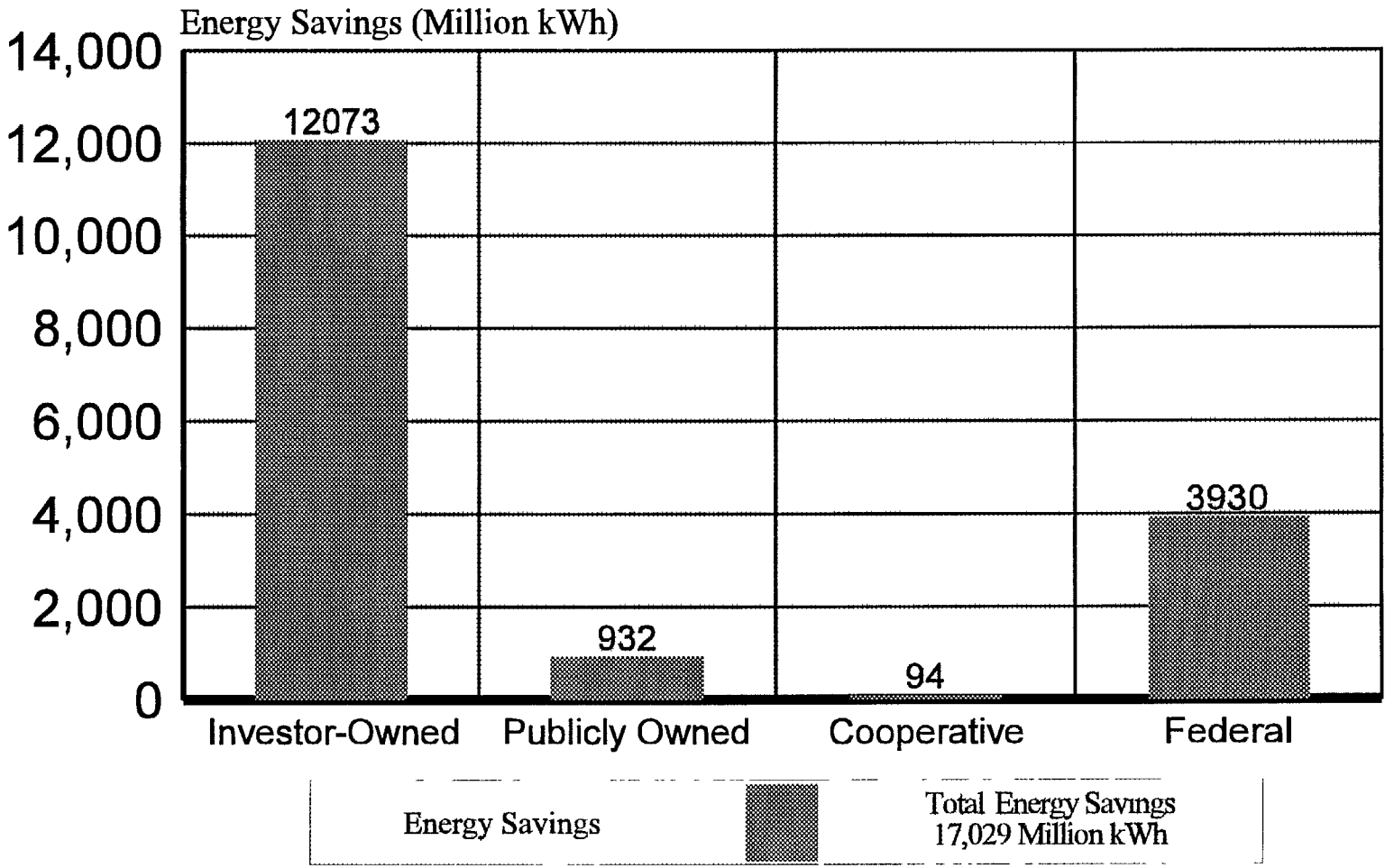
Exhibit 4.10
Actual Demand-Side Management Energy Savings for Electric Utilities, 1990



Source: US Department of Energy

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4.4 RECOMMENDATIONS FOR KAZAKHSTAN

The preceding analysis reveals that there are many different types of energy savings programs available to governments However, not all of the mechanisms discussed are appropriate for every country selecting the most suitable energy conservation policies depends on the unique context of a particular country ***The energy sector in Kazakhstan is characterized by five fundamental problems which any energy savings legislation implemented by the Government must address***

- Low/subsidized prices
- High energy intensity
- Inefficient technology
- Inadequate access to capital
- Weak institutional and legislative framework
- Weak energy conservation "ethic"

Furthermore, Kazakhstan is confronted with a severe economic crisis which has dramatically limited the Government's financial capacity to address critical problems in the energy sector Thus, in order to achieve the greatest impact, Kazakhstan's energy efficiency program must yield ***immediate*** energy savings (preferably within 3 years), and be relatively low cost and of a limited administrative burden to the Government to implement In sum, ***the Government should develop energy savings legislation which can be implemented in a timely, effective, and cost-beneficial manner.***

Despite this focus on programs that address short-term needs and low cost measures, the Government of Kazakhstan should not eliminate consideration of longer-term or more costly activities These types of programs have the benefit of providing consistent, long-term signals promoting energy conservation even in times of low energy prices Most governments have learned that the effectiveness of many energy savings programs are closely related to the energy price environment generally, energy conservation priorities diminish as energy prices decline and businesses and households are less inclined to take advantage of government-sponsored incentives for investing in energy savings activities For example, tax incentives are more likely to be effective in periods of high energy prices, and interest in utilizing their advantages wane in periods of price declines On the other hand, establishing stricter minimum efficiency codes in the residential and commercial buildings sector and providing funding for R&D of more efficient technologies provide a consistent stimulus for energy savings and long-term insulation against energy price fluctuations

The tradition of central planning in Kazakhstan is another characteristic which should be taken into consideration when developing appropriate energy savings legislation The Government will likely be well suited to implement and administer those programs that require substantial oversight, such as mandatory efficiency regulations However, the Government should be aware that the countries with the most success in improving energy efficiency (especially in reducing energy intensity and consumption levels) are those that have a mixed institutional structure Eventually, Kazakhstan should move toward the promotion and development of organizations and activities that compliment Government programs As discussed, this involves the participation of the private sector, universities, independent or non-profit centers, state-run or private research institutions, and many others

In the long-term, Kazakhstan should move toward more cooperative programs with private industry and manufacturers As discussed above, the OECD governments, facing their own budget constraints, are pursuing more voluntary and cooperative arrangements with private industry, utilities and others in order to leverage increasingly scarce government funds

Exhibit 4.11
ENERGY SAVINGS LEGISLATION: PRIORITY RECOMMENDATIONS FOR KAZAKHSTAN[a]

1 Policy/Program	2 Problem Addressed	3 Cost/Admin. Burden to Government[b]	4 Time Frame to Achieve Impact[c]	5 Implementation Environment
1. **Energy Management Regulations**	• High Energy intensity • Weak energy conservation ethic	High	Short-term	• Effective at early stages of energy savings activities • Easier to implement in economy with central control tradition • Must be enforceable and guard against abuses
2 **Information & Education Programs** - Brochures - Publicity campaigns - Training and seminars - Audits - Demonstration	• Weak energy conservation ethic	High	Long-term	• Impact difficult to measure • Must be part of broader program • Usually introduced in period of initial price increases
3 **Minimum Energy Efficiency Standards** - Buildings - Transportation	• High energy intensity • Inefficient technology	Low Low	Medium-term Short-medium	• Provide long-term signals • Easy to adapt to regional conditions
4. **Financial Incentives** - Energy savings fund - Tax programs - Priority access to foreign exchange - Reduce VAT & import duties	• Inadequate access to capital • Inefficient technology	Med-high Low Low Low	Medium Short-term Short-term Short-term	• Tax incentives must be well-integrated with general tax code and frequently reviewed • All financial incentives need to be publicized • Effective at targeting specific groups, e g industrial sector • Must be strongly coordinated with Ministry of Finance policy
5 **Institution Building** - Energy Conservation Department within Existing Ministry - Energy Conservation Agency	• Inadequate organizational structure • Weak legislation	Low Medium-high	Short-term Medium-term	• Necessary to establish strong institutions with clear responsibilities • Authority must be codified in law • Strong, high profile leadership required

Source IRG, Ltd

Notes a) Other programs may be developed, some at a later stage These represent priority recommendations for immediate incorporation into the NPES
b) The burden to the Government is based on a survey of country experience worldwide, existing capabilities of the Government, and relative to all the programs considered
c) Estimations are based on a survey of country experience worldwide, short-term = 0-3 years, medium-term = 3-5 years, and long-term = greater than 5 years

Like all governments worldwide that have established energy savings legislation, Kazakhstan will have to proceed in stages Initially, the programs developed will have to address the immediate problems confronting the energy sector during this transitional economic phase and take into consideration the other characteristics described above Gradually, however, as economic reform progresses the Government can refine that legislation, eliminate some activities, and implement additional programs as the energy sector and economic circumstances change This is particularly important for Kazakhstan the ultimate goal of the reform process is to develop a free market and a private sector which promote energy efficiency, obviating the need for specific Government-sponsored energy efficiency legislation

The Recommendations below begin with some general conclusions based on 20 years of experience around the world, there are a core of key ingredients which most governments have found necessary for the successful implementation of energy savings policy This is followed by specific priority recommendations for the Government of Kazakhstan to include in its ***National Program for Energy Savings*** which address the unique problems described above Exhibit 4 11 highlights the priority recommendations for the Government

4.5 GENERAL RECOMMENDATIONS

Develop high level and sustained government commitment and leadership

Most countries have learned that a commitment at the highest levels of government is necessary not only to develop policies and legal regulations, but also to implement and enforce legislation once in place Leadership by example is crucial to influence or change the behavior of individuals and companies to realize the benefits of energy conservation and the importance and value of energy in general

Establish energy as a high priority at all relevant Government entities

Government leadership and commitment must be demonstrated at all levels of the government, and in all organizations which have responsibilities for the development, implementation and administration of energy savings legislation Since energy conservation policies span an array of disciplines, such as technical, financial, organizational, legal, and social, it is necessary to ensure that the various agencies with implementation and oversight responsibilities share a common and vigorous commitment to the success of the overall policy

Delineate clear institutional responsibilities

Closely linked to the above, is the need to state clearly in legislation which government entities will have responsibility and authority for specific energy conservation activities and to establish clear lines of reporting This is required to ensure effective coordination of policy implementation, avoid overlap and duplication of efforts, and to achieve a level of centralization If a new government energy conservation entity is to be established, its charter and responsibilities must be enshrined in legislation

Implement energy savings programs and regulations comprehensively

Since energy savings policies and activities attempt to affect the way in which individuals, households, and businesses use energy, legislation must be comprehensive and complementary in order to achieve the greatest impact

Conduct information and education activities

In the aftermath of rising energy prices in the 1970s, the governments of the Western industrialized countries developed information outreach and dissemination activities to educate consumers and businesses on the need for, and benefits of, energy savings These programs continue to form an important part of government-sponsored energy savings programs

Evaluate periodically the effectiveness of energy savings legislation.

National economic circumstances and policy priorities change over time, necessitating the reevaluation of the effectiveness and desirability of programs in place Governments have found that legislation needs to be revised, updated, strengthened, or eliminated to reflect changing circumstances

4.6 PRIORITY RECOMMENDATIONS

This section presents 7 priority recommendations to the Government of Kazakhstan for incorporation into the National Program for Energy Savings Although many programs were reviewed in this Chapter and the Government may certainly develop and implement others for the NPES, the following are this report's priority actions that the Government should consider Exhibit 4 11 summarizes these recommendations and provides a visual framework and quick reference for analyzing how these recommendations were determined First, each recommendation (Column No 1) addresses at least one of the principal problems or obstacles which confront the Government in achieving energy savings (Column No 2) Column No 3 of Exhibit 4 11 estimates the burden to the Government of implementing the proposed policy, measured in terms of financial cost and administrative complexity This burden is assessed based on a survey of other countries experience around the world, and the existing human resource capabilities of the Government Column No 4 evaluates the length of time it will take the policy to achieve an energy savings impact This measure is arrived at primarily by evaluating the experience of other countries, as well as reviewing the administrative complexity of implementing the program Finally, Column No 5 provides several key factors and/or characteristics surrounding the implementation of the policies/programs

1. ***Strengthen or establish energy efficiency standards for residential and commercial buildings and the transport sector.***

As discussed, residential and commercial buildings standards can achieve significant energy savings One of the most severe energy problems in Kazakhstan is the lack of energy metering few residences (apartment buildings) or commercial establishments such as schools, hospitals or hotels have the instrumentation required to control and monitor heat, gas or electricity usage For example, individual apartments do not have thermostats customers are charged a fixed rate based on the area to be heated rather than the amount used

The Government should consider strengthening existing codes or developing new minimum efficiency standards, specifically

- Mandating that all new residential and commercial buildings are equipped with metering and other control instrumentation (for monitoring heat, electricity, and gas usage)
- Setting penalties for failing to meet minimum standards
- Stricter building construction codes (more efficient materials)
- Requiring installation of high efficiency heating, AC and ventilation systems
- Mandating higher levels and better quality of insulation

- Requiring minimum thermal efficiency levels for windows
- Requiring the gradual efficiency improvement of existing structures (through installation of metering and other control instrumentation for monitoring heat, electricity, and gas usage

In the transportation sector, the Government should consider developing the following initiatives immediately as part of the NPES to improve efficiency

- High vehicle purchase taxes, based on engine size or horsepower
- Higher vehicle import duties, especially for larger engine sized cars
- High annual ownership, licensing, and registration taxes
- Higher gasoline taxes
- Stricter speed limits (and enforcement)

In the long-term, the Government should develop fuel specification standards, vehicle emissions standards, and a range of other programs that are premature at this stage (see Annex C)

Developing standards for appliances should be undertaken by the Government in the future, but this process will take time and should be planned in subsequent revisions of the NPES

2. ***Reduce VAT and import duties on energy efficient equipment.***

Kazakhstan needs to improve/change the capital stock of existing equipment in industrial facilities, power companies, district heating plants, and buildings This will require access to foreign technology and equipment One mechanism to increase access to more efficient foreign technology is to reduce the import duties on a broad array of energy efficient equipment, making it more financially attractive to companies which want to make energy conservation investments This has been effective in some developing countries Kazakhstan should delineate a list of specific equipment and technologies that qualify, creating different duty categories with more sophisticated items receiving the lower duties This incentive will be most applicable during the initial economic transition phase since energy is one of the most important economic sectors in the economy and in the near-term will be the engine generating foreign exchange, attracting foreign investment, and integrating the country into the global economy However, this incentive mechanism should not be used for an extended period once the free market and the private sector actively begin to utilize such efficient equipment routinely

3. ***Establish by legislation the Government's role in energy conservation activities.***

The energy savings legislation developed by Kazakhstan should consider establishing a two-tired organizational framework, with a possible structure as specified below (see also Exhibit 4 12)

a) *An existing Ministry to be granted the authority for developing national energy policy* An Energy Conservation Department (ECD) should be established within the Ministry of Economy, specifically to address energy savings issues This ECD will develop broad policy guidelines, set goals, and establish a plan (with timetables) for achieving objectives The Chief of the ECD should report directly to a Deputy Minister to elevate the importance of energy efficiency activities within the government The Deputy Minister should have direct access to the Minister and ultimately to the Council of Ministers

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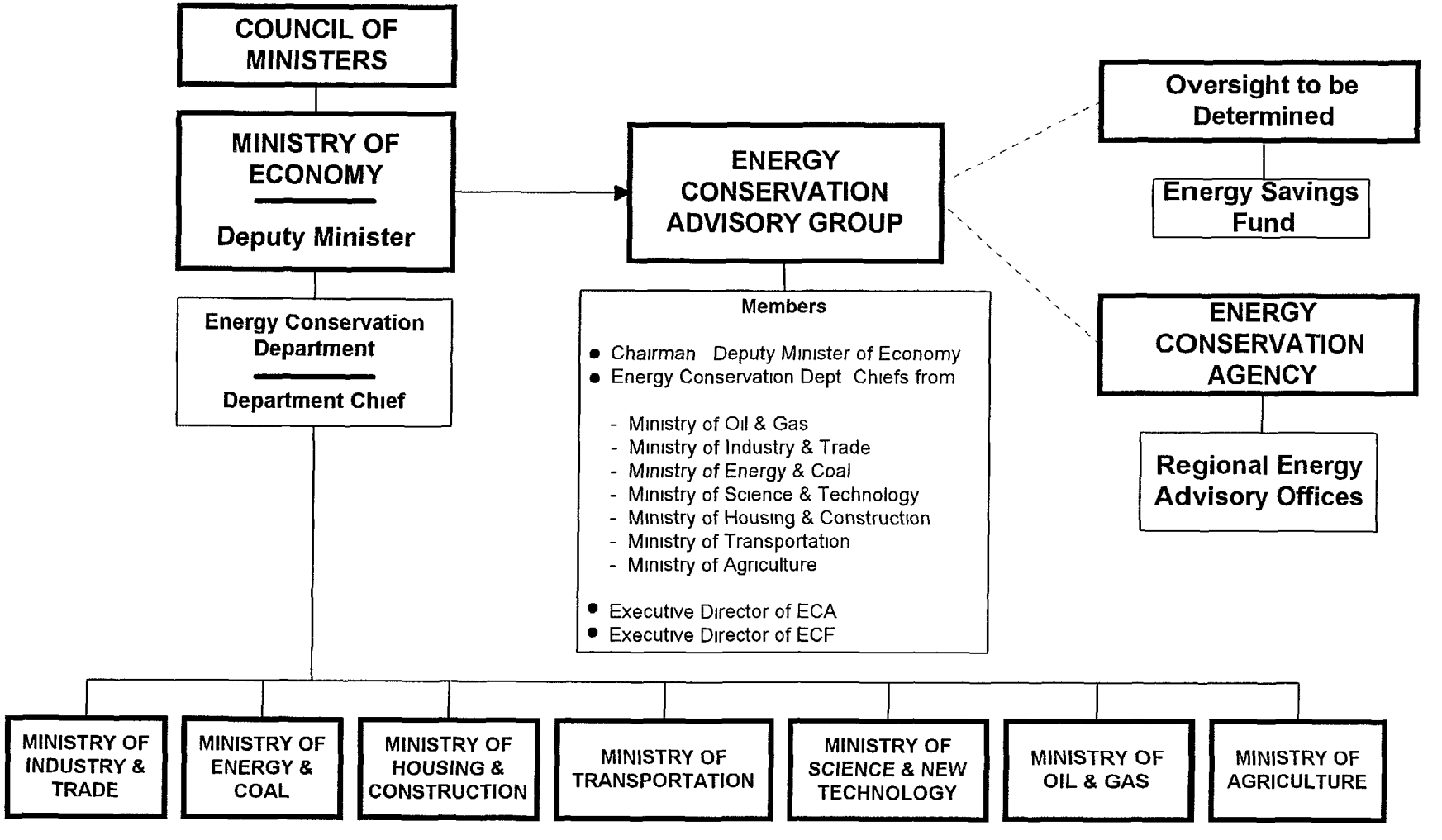
Exhibit 4.12
PROPOSED ORGANIZATIONAL STRUCTURE FOR ENERGY SAVINGS ACTIVITIES IN KAZAKHSTAN



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The ECD has responsibility for planning, developing policy, and establishing energy savings programs to meet the goals and achieve the policy it sets broad guidelines, then establishes specific programs This entity does not have implementation responsibility Since energy savings activities will span many economic subsectors, the Ministry of Economy is well-suited to coordinate energy conservation activities and policies Furthermore, it does not have vested interests in the energy sector, nor is it a supply-oriented or technical/operational organization These characteristics make the Ministry of Economy the best existing government body to undertake the responsibility for coordinating national energy savings policy

Although the ECD of the Ministry of Economy should be the principle group within the Government responsible for energy conservation policy-making, it should establish clear linkages with other Ministries and research institutes which will have input into the development of energy conservation policy The ECD should actively collaborate and consult with other Government organizations in the process of conducting its activities Other relevant Ministries, such as the Ministries of Industry and Trade, Energy and Coal, Science and New Technology, and Housing and Construction should also establish small Departments of Energy Conservation which would serve as the in-house expertise on national energy savings matters in their respective economic subsectors, as well as the contact point for the ECD However, it is vital that these other Government agencies recognize that the ECD is the final authority on developing policy and setting broad guidelines

Research institutes in Kazakhstan also have a critical role to play in concert with the ECD These entities should be utilized by the Government in developing and refining new and stricter standards in the industrial, commercial and residential, and transportation sectors, as well as undertaking research and development (R&D) on energy efficient technologies Although policy will be decided in the ECD, the expertise of the various institutes should be consulted in the areas of R&D and standards development to achieve broader energy savings goals Finally, an important role of the ECD will be to work with regional and local governments in developing appropriate policies

The ECD in the Ministry of Economy would be responsible for the following types of activities (this list is not comprehensive, but rather an example of responsibilities)

- Prepare a National Energy Savings Strategy or Plan

- Work with the power generation and district heating companies to identify conservation and demand-side management (DSM) programs (eg off-peak electricity tariff pricing incentives, load management schemes) which encourage the companies to promote energy conservation among their consumers, have the greatest potential to reduce energy intensity and consumption, and that are economically and technically feasible Establish priorities and allocation of resources

- Develop demand forecasts and periodically review national energy demand in the residential, commercial and industrial sectors to identify short-term and long-term trends in consumption patterns

- Maintain an awareness of conservation technology being developed in the world of particular use in Kazakhstan, e g cogeneration technologies, advanced lighting and refrigeration technology, automotive standards, etc

- Monitor conservation programs (once established) to determine the degree to which they have achieved the results expected and if not, why not?

- Identify what component of total electricity production can be met through co-generation (peak load supplements, stand-by capacity, etc), and tariffs that will be required to make cogeneration economically feasible to large-scale industry

- Coordinate with the Ministry of Transportation in developing long-term program (non-fuel based) for reducing mobile source emissions (i e car and truck)

- Work with other government entities and research institutes to identify renewable energy (e g wind, solar) programs that have the highest probability for successful application in Kazakhstan and that are economically and technically feasible

- Coordinate activities with the Energy Savings Fund

In order to conduct these and other activities, the ECD will require staff capabilities in various disciplines

Energy Conservation Department: Disciplines Required

Educational Background	*Skills Required*
Finance	Investment requirements analysis, payback analysis, market analysis
Economics	Project feasibility analysis, statistics, pricing
Engineering[16]	Industrial, electrical, mechanical, transportation, process auditing and engineering, DSM, environmental auditing, cogeneration, state-of-the-art combustion equipment

b) *A separate Energy Conservation Agency to be established to implement the national energy savings programs* This Agency would report to the ECD in the Ministry of Economy since the Agency is to implement the policies and programs developed by this Ministry and since it will receive funding from the Government However, the Agency should operate on a daily basis relatively independently of the ECD A senior individual commanding respect within the energy sector should be appointed Executive Director of the Agency The Agency will be governed by a Council composed of representatives from various government organizations, research institutes, and private enterprises

The Agency would carry out the Government's energy savings objectives and programs These activities will, of course, depend on the policies to be included in the *National Program for Energy Savings*, however, a sample list of activities is provided below

- Training programs
- Auditing
- Demonstration projects
- Assist in developing energy efficiency standards and labeling
- Information, education and publicity programs
- Market surveys of potential for energy savings in various sectors

16 Although the Ministry of Economy should have personnel with these engineering skills, it is important to emphasize that this Ministry will not have implementation or operational responsibilities regarding energy savings activities Rather, it will be a policy-making and coordination body

- Policy and legislation input to the Government (principally to the ECD but also to other Ministries as needed)
- Working with regional and local (municipal) governments
- Promoting the development and assisting in the formation of Energy Service Companies (ESCOs) and joint manufacturing ventures

This Agency will initially be funded by the Government and/or international donors but ultimately could become self-financing This could be achieved by eventually allowing the Agency to charge for the services it offers (for example, technology demonstrations, audits, training seminars) thus reducing the funding burden on the Government The Korean Energy Management Corporation operates in this fashion However, the Kazakh Energy Conservation Agency should not have the responsibility of operating and administering a Fund

The Energy Conservation Agency should assume a leading role in promoting the development of private sector activity in energy efficiency Specifically, the Agency can assist domestic and foreign private firms in their efforts to establish joint ventures by providing market information, advice on government regulations, and facilitating the application process to obtain financing from the Energy Savings Fund This assistance also can be provided to ESCOs, which carry out energy efficiency services such as plant audits or technology demonstrations in exchange for compensation based on a percentage of the energy saved as a result of these services (Performance contracting and ESCOs are discussed more in depth in Chapter 5)

While the Ministry of Economy will coordinate national energy savings policy with local and regional governments, the Agency should be granted the authority to operate Regional Energy Efficiency Advisory Offices designed to implement energy conservation programs and activities country-wide (e g on-site audits, presentations made to industry groups, and targeted written materials and other information) These Offices will work with consumers, retail enterprises, and industry to promote energy saving awareness and, through public information campaigns, stress conservation through savings and the use of more energy efficient machines, appliances, insulation, off-peak production, etc

In order to ensure effective coordination in the formulation of energy savings policy, the Government should establish an Energy Conservation Advisory Group This Group would be directed by the Deputy Minister who oversees energy savings activities in the Ministry of Economy, and consist of the Energy Conservation Department Chiefs from the relevant line ministries In addition, the Group's representation should include the Executive Directors of the Energy Conservation Agency and Energy Conservation Fund The Group is to be responsible for integrating technical input from the line ministries and to oversee the activities of the Agency and Fund This latter role is not to be implemented on a day-to-day basis, but rather to monitor periodically these entities' programs to guarantee that they are commensurate with broad, national policy and goals, as well as to ensure that they are enacted efficiently

The European Community is currently sponsoring the Kazakhstan-EC Energy Centre, based in Almaty The Centre was opened in 1994 and is equipped with a modern range of energy measuring instruments and a technical library Local experts have been recruited to staff the Centre, which will focus on activities in training, statistics, information dissemination and audits/surveys The Kazakh government should assess the mission, current roles, and effectiveness of this Centre to ensure that the Agency will not duplicate its activities If it is determined that each organization can provide complimentary activities, then the benefits of expanding/fostering this ***independent,*** energy efficiency Kazakhstan-EC Centre center, to operate similar to those that have been developed in Poland, the Czech Republic, and Russia, should be considered These centers have been established with international donor funds and are staffed by local

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engineers, economists, and scientists The Centers are designed to become financially self-sufficient over time from revenues generated from services they provide

An independent center would operate separately from the Energy Conservation Agency and the Ministry of Economy An independent center would offer a non-government alternative to energy conservation programs Broadly, this center could carry out some of the following functions which supplement and/or compliment Government activities

- Provide high level policy support to the Government
- Training and demonstration
- Public education
- Assisting firms in financial arrangements
- Assisting in JV development
- Conducting market analyses for energy conservation in various sectors
- Assisting in the development of standards (especially for residential appliances)

4 ***Establish voluntary energy efficiency targets and regulations for large energy consuming facilities and power and district heating companies.***

The Government should consider establishing certain voluntary targets for facilities whose energy consumption is above a fixed threshold In order to alleviate the high energy intensity and wasteful consumption practices of enterprises in the industrial sector, the government should propose that these facilities voluntarily

- *Set energy efficiency and consumption targets and periodically report progress to the government* (e g once per year, or every two years)
- *Periodically conduct a complete a complete energy audit* (initially, once every two years)
- *Develop an energy conservation plan for the plant*

Because this type of energy efficiency program can become burdensome not only for the Government to operate, but also for the industries regulated, it should be implemented initially on a voluntary basis, especially during the difficult economic transition period The Government of Kazakhstan should review these efforts carefully and frequently after implementation As discussed, enterprises will, over time, routinely incorporate many of the regulations established by the Government, thus making the program unnecessary

Preliminary DSM Requirements It is too soon for the Government to consider mandating most of the DSM activities common in the US, such as rebate or information programs, and rate incentives These sophisticated efforts require technical and informational links between the consumer and the supplier of energy that currently do not exist The first step in developing DSM activities, therefore, is improving the technical monitoring and control of supplying and consuming energy, which will provide information on energy use both to the utility and the consumer Once this is established, specific and appropriate mechanisms can be implemented

Thus, in the initial energy savings legislation drafted by the Government, special consideration should be given to the energy supply companies, particularly power and district heating, to incorporate requirements for the incremental upgrade and installation of controls and instrumentation Although this requirement will apply to production and delivery facilities, regulations should also focus on end-use This latter requirement will compliment Recommendation #1, which emphasizes increasing the energy efficiency of the residential and commercial buildings sector

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The benefits of such a program will yield immediate and significant benefits For example, a residential energy efficiency demonstration project in Poland involved the installation of controls (such as regulated heat exchangers and thermostats) and weatherization (such as weather stripping of windows and doors, insulation, and window caulking) at a block of apartment buildings Preliminary results have yielded energy savings of over 20 percent What is most interesting about these results, is that the cost of the controls and weatherization is about commensurate with the annual per apartment subsidy the government was spending to provide district heat in 1992-1993

Thus, the Government should consider establishing a program which requires the energy supply utilities to incrementally improve energy metering at the production and end-use levels Indeed, owing to the positive cost-benefit results of the program in Poland, the Government of Kazakhstan should consider providing financial assistance to the utilities to undertake such a program initially

5. ***Establish a dedicated energy conservation fund.***

The fund should operate by providing loans for energy conservation projects and investments, and initially should be focussed on the industrial sector The success of such dedicated funds depends on properly promoting its existence, avoiding complicated application procedures, conducting evaluations of project proposals in a timely fashion, and providing loans at interest rates which recover the fund's cost of money and administrative expenses The Government should begin discussions with donor agencies, such as the IBRD and EBRD, on their programs and resources to finance such funds Additional financing for the fund could be furnished by fines or end-use energy taxes

The Fund will provide loans to enterprises seeking to make energy conservation improvement investments The Fund should establish an application process and specific criteria for obtaining financing At a minimum these criteria should include (a) demonstrated energy savings estimates above a minimum threshold as a result of the investment, and (b) an estimated short-term payback period, i e , 1-3 years

Overall day-to-day control of the Fund should be provided by a Board composed of representatives primarily from the Ministries of Finance and Economy, as well as selected financial institutions such as the National Bank of Kazakhstan and the newly-created National Development Bank As discussed, broad oversight of the Fund will be provided by the Energy Conservation Advisory Group, but the Board will ultimately report to whichever organization it is attached, e g the National Development Bank As discussed in Chapter 5, several countries manage similar funds through a national bank (Also, see Annex E for a discussion of the Russian Energy Savings Fund)

The fund will be particularly effective during the first phases of the economic transition when access to private sector financing will be especially limited However, once the private sector emerges to provide financing for similar investments, the utility of the fund will be diminished Thus, the Government should closely and periodically monitor the need to continue the operation of the fund

It should be noted that potential private sector financing includes funding programs implemented by utilities and ESCOs For example, power or district heating utilities can loan money to customers to assist in implementing energy conservation investments (such as installation of new efficient technologies) with customer repayment incorporated as part of the periodic utility bill

6 Establish tax incentives as part of the general tax code.

During the country's initial period of economic transition, the Government should establish tax incentives for enterprises making energy conservation investments or for manufacturers producing energy efficiency equipment These incentives can include

Tax credits An enterprise would be able to claim a certain percentage of a qualifying energy savings investment and reduce the enterprise's overall tax liability by this amount The percentages should vary according to the complexity of the investment, for example, 10 percent for process improvements and 25 percent for cogeneration

Lower taxes on corporate profits This incentive is applied to firms implementing energy conservation programs

Tax holidays For an enterprise implementing energy conservation projects, a certain period of time would be granted during which it would not be required to pay taxes, either all or a fixed percentage

Accelerated depreciation Allow an enterprise to accelerate the writing-off of investments in energy conservation projects, including cogeneration, thus reducing tax liability

This type of incentive should be considered owing to the critical importance of the energy sector as the engine for future economic growth However, the government of Kazakhstan should only consider these tax incentives as part of the initial energy savings legislation of the country and then periodically review the effectiveness of the program to judge if it should continue or what changes could be made

7. Grant priority access to foreign exchange for energy conservation investments.

Allowing enterprises easier access to foreign exchange, or loosening foreign exchange controls, will provide greater ability to obtain imported foreign energy efficiency equipment The Government should consider relaxing the controls and regulations associated with transactions in foreign exchange for those enterprises making energy savings investments

Chapter 5
FUNDING OPTIONS

5 1 POTENTIAL SOURCES

There are several potential sources, including domestic markets, foreign investors and donor agencies and multilateral financial institutions The domestic market will be quite limited over the medium term, with the exception of Government funding The development of a private market for medium term and long term capital will take several years Bank financing will be limited to short term loans The internal funds of public and private enterprises will be constrained until the economy begins to grow again Consequently, the primary sources of funding for energy efficiency investments over the next few years will have to be from the Government budget, donor agencies or financial institutions, and perhaps foreign funding backed by the Government in the short term[1] or some combination of these primary sources

There are many donor agencies in many of the OECD countries and multilateral financial institutions which administer various programs and initiatives supporting energy savings Some of these include the United States Agency for International Development (USAID), European Bank for Reconstruction and Development (EBRD), and the World Bank In October 1994, the EBRD established a special unit to focus on projects promoting energy efficiency in the former Soviet Union The new unit is headed by an executive with wide experience in managing energy savings in the transport and power sectors Since 1979 the World Bank has funded more than forty projects devoted to energy efficiency Many of these projects have instituted technical changes, rehabilitated power and industrial facilities, promoted conservation measures in all sectors, and promoted demand side management A majority of these projects have also helped to establish or strengthen energy efficiency/savings institutions and economic and financial infrastructure Annex M describes the Russian Gas Distribution Rehabilitation and Energy Efficiency Project (RGDREEP), one of the current World Bank energy efficiency projects

5.2 ENERGY SAVINGS FUNDS

5.2.1 Examples

Financing support for energy savings investments in Kazakhstan over the next several years must be underwritten by the government, whose main source of money is from foreign institutions, in the form of grants, transfers and loan forgiveness schemes Examples of some of the fund mechanisms utilized to promote energy savings investments in other countries are described below

Hungary Industrial Conservation Loan Program National Bank of Hungary provides funds to commercial banks for a 12-year loan period with a 2-3 year moratorium before payments begin Commercial banks provide loans on the same terms to industrial borrowers Each commercial bank provides its own financial review of loan applications The program involves about $60 million in foreign exchange Using loan funds, companies can purchase imported equipment only for energy efficiency improvements The program is World Bank financed

1 Foreign investors will require Government guarantees until the overall economic and business environment improves Key signposts the foreigners will nook for include a stable government, expanding economy, sound legal structure and enforcement, non-onerous fiscal structure, and convertible currency and access to foreign exchange markets

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Hungary Central Environmental Protection Fund Despite its name, the CEPF's charter states that funds can be used to support a project that "results in the saving of material and energy " Each year the fund collects approximately HUF 2 4 billion ($21 8 million) from gas taxes, voluntary payments from multi-lateral institutions, and a variety of user fees and fines for pollution Application of funds are through a) grants (75%), b) loan guarantees up to 70% of the value of the credit (10%), c) and the balance on expenses and a variety of other public educational activities Total support cannot exceed 60 percent of the total estimated project cost, and within this overall limitation, grants cannot exceed 30 percent of estimated project costs Loans can be arranged as

- Interest free for a two year grace period with repayment commencing from the completion of the project and taking one to five years, or
- a soft loan with the same terms as in a) above, except that interest will be subsidized from 60-120 % of the Central Bank base rate, or
- longer term loans of from 5-15 years may be granted in cases having national significance

German Coal Fund of the Hungarian Credit Bank Bank lends money at a rate of 50% of the floating rate charged by the Hungarian Central Bank (30% as of Sept 1994), plus a 3 5% spread. The maximum lending limit is HUF 50 million ($454,000), ad the Bank will allow a 85/15 debt equity ratio Money can be lent for a maximum of 8 years on a term loan basis, with a two year grace period A one-half percent commitment/facility fee is charged To qualify, a prospective borrower needs to demonstrate to the Bank that its project would save 500 gigajoules per each HUF 1 million lent, and that at least one half of the funds' application will be employed in pursuit of energy savings As a matter of preference, the Bank will request three year audited financials, and wants 200% asset coverage Over the last two years, the Bank has lent out HUF 1 7 billion ($15 5 million) under this credit facility

The most significant aspect of the lending criteria is that the savings have to be demonstrated in the form of lower energy usage There is no concession made to the notion of increased production efficiency as measured by the cost of inputs per unit divided by unit revenue

Poland's National Agency for Energy Conservation Agency operates nationwide as a joint stock company with the State as a shareholder the Agency is owned by the Polish Industrial Agency, the National Economy Bank, and the National Fund for Environmental Protection (all in turn are owned by the Polish Treasury) It will have an expected budget of $75 million and be able to borrow in its own name, while carrying the risk equivalent of a Government of Poland obligation The Agency will work in elaboration and supervision of an energy conservation program, information/education/training, standards, promotion of manufacturing and use of energy saving appliances, energy audits in industrial facilities, demo projects

The Agency's agenda also includes the collection of funds from domestic and foreign sources for the support of investment connected with the "rationalization of energy consumption" and the "construction of financial support system for effective energy consumption "

The Agency will be able to provide financing to energy conservation projects at subsidized rates of interest running from 20% to 70% of the then prevailing National Bank of Poland refinancing rate

The Agency will not function as a profit making enterprise, and thus the director has indicated he will only initially support projects with a payback of less than 1 5 years

Poland's National Fund for Environmental Protection This is a government-owned financial institution which will fund energy efficiency projects It currently offers loans with subsidized interest rates (20%-

80% of the NBP refinancing rate), extended grace periods and advantageous repayment schedules The current budget call for some $255 million to be provided as loans in 1994 The fund may provide up to 50% of the total value of a project Financial operations of the fund are carried out for the most part through the ECO-Bank The Fund does hold shares directly in companies working in the environmental area Working with the fund are a host of regional organizations There are 49 Provincial Environmental Funds which accounted for 31% of the monies that went into the 1992 environmental protection expenditures of the country vs 27% from the National Fund (another 10% came from local governments)

Polish Development Bank The Polish Development Bank was established in 1991 as a "wholesale" bank basically to channel medium and long term funds through other banks operating in Poland (including foreign subsidiaries) to finance investments One of the strategic goals of the Bank is its role to provide financing, construct financing schemes and lending procedures for projects undertaken in the field of energy saving and environmental protection The PDB will act as fund manager distributing loans through a network of retail banks

Reasonable lending procedures should consist of two steps i) a general credit evaluation of the potential borrower, performed by the bank and ii) provided the prospective borrower is found credit-worthy, assessment of energy savings potentials by an energy consultant, followed by lending towards those savings investments which are financially feasible under reasonable assumptions about future energy price developments

Korea's Energy Management Corporation (KEMCO) Established by the National Assembly in 1980, KEMCO currently employs 600 staff with a budget of about $20 million The corporation is entirely government-owned, but receives only 30 percent of its budget from the national government The remainder is provided by revenues from its services to residential, commercial, and industrial customers Portfolio includes energy audits, promotion of cogeneration and district heating projects, support of energy conservation R&D, provision of general information, education, and outreach programs, inspection and approval of energy using equipment, promotion and utilization of new and renewable energy sources KEMCO also provides financial assistance from monies in the dedicated National Energy Rationalization Fund (generated from taxes on imported energy)

Brazil's National Development Bank The National Development Bank started a financing program for conservation projects by industrial, commercial, and public sector enterprises in 1986 The real interest rate (after inflation) was 6-8 5%/year, considerably less than market interest rates However, there was little promotion of the program, complicated application procedures, substantial delays in evaluating project proposals, and low electricity prices during much of this period As result, few loans were made

India's National Development Banks India has several different programs offered by its national development banks These programs generally combine subsidized energy audits (provided by private engineering firms) with concessional rate loans (interest rates generally range from 1-4 points below conventional development bank rates) As of March 1990, the largest of the three programs had provided financing for 122 energy audits and had committed approximately $13 million in loans for energy saving equipment In 1991, India's development banks will start a $750 million energy conservation loan program, using $250 million from the World Bank, and $550 million of their own funds

China's Energy Conservation Company The Energy Conservation Company (ECC) of the State Energy Investment Corporation provides grants which normally cover one-third of a project's cost Some additional funds come from federal ministries or local and provincial governments, but the bulk of the funds come from the individual companies making the energy saving improvements The ECC has an

annual budget of about $300 million, of which some goes to proven technologies and some to demonstrating new technologies

Oslo's Revolving Credit Fund The city of Oslo in Norway has established a revolving credit fund for energy efficiency based entirely on a small surcharge of 0 16 cents per kWh (equal to 2 9 percent of average electricity rates) The fund currently has a balance of about $100 million

5.2.2 Russian Energy Savings Fund[2]

The mandate of the RESF is to assist in implementing the government's policies on energy conservation Its envisioned activities include (a) financing scientific studies, drafting or norms and regulations, and work on standardization of energy consumption, (b) providing equity financing to assist in implementation of energy conservation measures, (c) providing financial support to the development of the manufacture of energy saving and energy efficient equipment and materials, and (d) providing preferred credit to small and medium energy saving projects which meet specified technical and economic criteria

The organization of the RESF is shown in Annex E The management group includes the chairman, two vice-presidents (of technology and economics) and four department heads (of projects and appraisals, regional programs, loans and finance, and external relations) There are also 11 sector branches which focus on the needs of specific sectors or functions Total staff complement is about 35, of whom 25 are full time and the remainder perform their functions on a part time basis along with regular jobs in the various ministries There are also approximately 30 consultants or "experts" working under contract In addition, 12 regional centers have been established, consistent with the concept of regional funds The latter are independent of the RESF, but have a representative on the RESF Board The Board of Directors also consists of the chairman of the RESF, the vice-presidents and the department heads

Overall control and direction is provided by a Council of Observers, which is composed of representatives from the Ministries of Economy, Finance, Science and Fuels and Energy The Council is intended to endorse basic strategy and policy, and audit one or two major projects per year to ensure that the RESF meets its objectives

Originally, the RESF was to be financially independent of the budget, with the funding coming from a number of sources including special taxes, fines and other assessments The legislation to implement the various funding mechanisms for the agency was introduced in the legislature, but was left outstanding when Parliament was dissolved in late September 1993 At present, the future of the legislation is in doubt In the interim, funding has come mainly from the Ministry of Fuel and Energy and other ministries

2 Annex E discusses the general provisions, resources, guidelines for utilization of the Fund's resources, and the supervision of the RESF The materials in section 5 2 2, Annex E and Annex M are taken directly from the World Bank's staff appraisal report, No 13046-7RU, "Russian Federation, Gas Distribution Rehabilitation and Energy Efficiency Project "

5.2.3 Russian Energy Efficiency Demonstration Zones[3]

In April 1993 a Technical Cooperation Agreement was signed between Russia and the United Kingdom This Agreement, which was negotiated with the assistance of the United Nations/Economic Commission for Europe (UN/ECE) Energy Efficiency 2000 Project secretariat, authorizes the repayment of western investments in energy efficient, environmentally sound technologies by the export of up to half of the oil and natural gas recuperated by energy saving measures Annex F outlines the EBRD's proposed contractual relationships, performance guarantees, legal structure and monetary flows for financing energy efficiency demonstration zones in the Russian Federation

5.3 USA DEFENSE ENTERPRISE FUND[4]

The Defense Enterprise Fund ("the Fund") is a venture capital fund capitalized by the US Government in order to make equity or debt investments in joint ventures between Russian, Ukrainian, Kazakh, or Belarussian companies and Western companies that will assist in defense conversion (preferably of plants that had been involved in weapons of mass destruction)

The Defense Enterprise Fund's primary focus is on the conversion of industrial resources from defense production to civilian production It does this by funding joint ventures between organizations in the above four countries and Western partners The Fund has a preference, though not a requirement, for investing in joint business initiatives involving US firms or a US subsidiary of a foreign-owned firm

The Fund will require a commitment of resources from both the Western partner and the partners in the former Soviet republics The form and level of commitment that is acceptable (capital, equipment, personnel, technology, etc) is determined by the Fund

The Fund may provide financial assistance or make investments in qualified joint venture initiatives which include personnel and/or facilities currently or formerly involved in research, development, production or operation and support of the defense sector of the aforementioned Republics of the Former Soviet Union, with a focus on the conversion of facilities which previously produced weapons of mass destruction, components of such weapons, and delivery or support systems for such weapons In the context of Fund activities, these include nuclear, biological and chemical weapons, guided missiles, and aircraft Also eligible are firms associated with the production of command, control, and communications equipment for military forces associated with such weapons as well as with the production of strategic defense systems such as ABMs and systems to counter strategic bombers Fund investments may also be made in facilities and with personnel associated currently or formerly with other segments of the defense sector which are converting to civilian activities

The Fund seeks to encourage private sector participation in the ownership and management of the entities in which the Fund invests Toward this end, the Fund will make investments only in initiatives involving privatized enterprises or involving enterprises, or spin-off enterprises that commit, in writing, to

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3 An energy efficiency demonstration enterprise zone is a town, district or limited area, in which favorable conditions in every sphere are established to stimulate enterprise and initiative in market approaches to energy efficiency Such urban or regional economic development zones have already been successfully established in western countries On a city-wide scale, the combined effect of energy-efficient technology, energy pricing policy, favorable tariff structures, advisory services, information campaigns, metering, monitoring and controls, energy audits, tax incentives, grants and government-guaranteed loan schemes, international assistance and trade development programs are demonstrated The intention is to replicate successful measures at a national level, once proven on a limited scale

4 The information in this section was taken directly from a *DOC/Bisnis* bulletin

privatization An enterprise is considered to be privatized when greater than 50% of the ownership and control is in the private sector

Project descriptions and inquiries should be directed to the following address and telephone number

Michael Lehner
Vice President and Investment Manager
Defense Enterprise Fund
104 Crofton Road
Waban, MA 02168
(617) 527-3307 Phone, (617) 527-2722 Fax

5.4 PROJECT FINANCE

5.4.1 Private Sector Project Developers

With the trend towards privatization occurring throughout the world, many governments expect that they will no longer be unconditionally responsible for the financing of capital projects In many of these capital projects, a private sector developer will be the catalyst for the realization of the project, taking the project from concept to commercial operation The developer organizes the many elements associated with a capital project, including sales contracts for the output, fuel supply contracts, selection of the appropriate technology, signing construction contracts, procuring the equipment, arranging for operation and maintenance, and lining up insurance The development process is complex, requiring many skills and the ability to integrate all of the elements Often developers resort to what is called project financing, where the banks and investors are repaid by project revenues only, without recourse to the developer

There are two perspectives on project financing The developer's perspective is that he wants to maximize the upside profitability of the project, whereas the financier wants to minimize the downside risk, making sure that even in the worst case he will get his money back In project financing, the banks have the money so developers follow their rules Thus, to successfully finance a project, the developer must minimize the risk To make a project work, the risk must be reduced below some threshold level, and the lower the risk can become, the lower will be the financing payments On an international level, there are many projects worldwide competing for such capital financing It is no wonder that the financing party has the right to choose the project which represents the best return with the least risk

There are many types of risk in capital projects During the construction phase of the project, there are a variety of risks Included here are cost overruns with the worst possible result being that the project becomes uneconomical because of too high a capital cost or the cost of the project exceeding the bank's credit limit Also, in this phase there is the risk of delays, which can result in cost overruns and the postponement of tax benefits into the following year There is also a risk that the completed plant will fail to meet the performance specifications established for it Once the plant is placed into commercial operation, there is a new set of risks The efficiency of the plant may be less than design, resulting in higher than expected operating costs Or, the maintenance costs may be higher than expected

There are also price risks, especially for energy projects This risk has a very high probability in today's wild energy markets, where fuel costs especially can go up or down The fuel cost could be higher than expected, resulting in higher operating costs There is the risk of a fuel supply interruption, which can result from an interruptible gas contract, a coal mine strike, or a rail strike The result of this is that the plant cannot operate because it has no fuel to burn, resulting in a loss of revenue

There are a variety of other risks, such as fluctuations in interest rates which can result in higher than expected financing costs There is the risk of tax law changes, which seems to happen about every year or two any more, which in the worst case could result in the unavailability of financing There also are the more traditional types of risks such as acts of God, like fire, flood, etc

Without ways to minimize these many risks, project financing would be impossible So how do you go about minimizing risk in a capital project? The best way is to secure long term contracts which transfer the risk to another party For example, the risk of construction cost overruns can be minimized through fixed price construction contracts The risk of poor equipment vendor and the risk of fire, flood, and so on can be addressed with insurance The principle here is to transfer the risk to the party that has the most control over it The equipment vendor has the most control over equipment performance, so he provides performance warranties The insurance company has an insurance market to spread out the risk of acts of God over many projects

An ideal low risk project would incorporate the following

- The construction contract should be fixed price clump sum turnkey contract with guaranteed completion by a specific date
- Equipment vendors would provide commercially proven technology at a fixed price with performance guarantees on efficiency, reliability, emissions, maintenance costs, and so on
- It would include some type of take-or-pay provisions where certain minimum payments to the project are guaranteed
- The fuel supply contract should be for a guaranteed supply, if an economical back-up source is not available, the price should be fixed in advance as much as possible
- The operating and maintenance contracts should be for fixed prices during the term of the financing
- Insurance should be used to cover risks that can't be addressed elsewhere, including traditional programs such as workers' compensation Also included should be such non-traditional coverages required for third-party financed projects such as expanded builder's risk, force majeure and systems performance insurance

The principle here is to try to fix as many things as possible in advance and eliminate as much uncertainty as possible Where things can't be fixed, floor prices should be established, in which the worst case still makes it possible to meet the debt service for the project No project will ever completely meet these low risk criteria, but the closer that it comes, the more likely it is to be financed, and the lower the financing cost

5.4.2 Sources of Funding

The state of uncertainty in the world financial markets is such that many commercial banks and traditional sources of private capital for long term lending or investment are wary of aggressively pursuing new business in NIS lending Home-country regulators of many of the major international banks require far greater balance sheet offsets for international loans than for domestic, single-country loans There is little room in the commercial banks for major new initiatives in committing long-term capital to provide sector infrastructure projects in most of the NIS Combinations of multilateral development institutions, bilateral

development arms of industrialized governments, export credit agencies, and newly evolving capital markets in host countries, are available to complement commercial bank credit

Various sources of funding exist for private sector project developers for various stages of project development Exhibit 5 1 presents a list of several institutions which provide various services It indicates which of the three services, shown at the top of each column, a particular institution provides The "project feasibility study assistance" programs (Column 1 of Exhibit 5 1) are focused on the early development states and feasibility study activities of a project Some of the programs are geared to assisting the foreign buyer or project sponsor, without necessarily supporting any specific potential supplier Funding assistance in such programs generally runs directly to the foreign sponsor, who then selects the firm to execute Other programs are designed to provide assistance directly to the applicant US business entity to assist with the costs of project development or project feasibility analysis

The institutions with a • in Column 2 of Exhibit 5 1 are the principal sources of financing or guarantees for the actual project realization, not the feasibility or development studies leading up to the project The US Government and multilateral institutions are listed that would be most amenable to approaches from a US firm and most able to help that firm with financing suitable to that firm's project development plan

The institutions with a • in Column 3 of Exhibit 5 1 are the primary sources for investment insurance and political risk coverage These are the vehicles of protection for both debt and equity flows into projects, and may be viewed as credit enhancement mechanisms, as contrasted, with sources of capital per se Their role is vital in the financing package and the attraction of capital to projects in developing countries

Exhibit 5.1

	Project Feasibility Study Assistance	Project Financing Sources/Institution	Investment Insurance and Guarantee
Asian Development Bank (ADB)	●	●	
Commonwealth Development Corporation (CDC)		●	
Department of Energy (DOE)	●		
Environment Enterprises Assistance Fund		●	
Export Credit Agencies		●	
Exim Bank/Japan Exim Bank Cofinancing Arrangement		●	
Exim Bank of the US Engineering Multiplier Program	●	●	●
Global Environment Facility (GEF)		●	
International Finance Corporation (IFC)		●	
International Fund for Renewable Energy and Renewable Energy and Efficiency (IFREE)	●		

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	Project Feasibility Study Assistance	Project Financing Sources/Institution	Investment Insurance and Guarantee
Japan Industrial Cooperation Agency (JICA)	●		
Multilateral Investment Guarantee Authority (MIGA)			●
Non-OECD Export Credit Agencies		●	
Overseas Private Investment Corporation (OPIC)		●	●
Overseas Private Investment Corporation Special Funds (Asia, Environment)		●	
Private Export Funding Corporation (PEFCO)		●	
Private Insurance			●
Small Business Administration (SBA) Export Finance		●	
United Nations Technology Transfer Programs	●		
US Agency for International Development (USAID) Bureau for Private Enterprise (PRE)	●	●	
USAID Private Biomass Energy Systems and Technology (BEST) Project	●		
USAID Private Sector Energy Development Program (PSED)	●		
US Trade and Development Agency	●		
The World Bank		●	
The World Bank ECO		●	●

5.5 PERFORMANCE CONTRACTING AND ENERGY SERVICE COMPANIES (ESCOs)[5]

Performance contracting enables a country to enhance its economy and its environment and to do so out of funds now being spent on wasted energy In the process, performance contracting offers exciting business opportunities for the in-country energy service industry, increased employment and clear advantages for a customer that chooses to cut operating costs through private sector energy financing and services

5 The material presented in this section was taken from a draft report entitled "The Feasibility of Performance Contracting in Poland," prepared for USAID

Performance contracting allows the customer, e g a school, hospital, state agency, commercial business or an industry to use *future* energy savings to upgrade facilities and cut operating costs *now* The energy service company (ESCO) identifies energy saving opportunities in the customer's building, equipment and/or industrial processes The ESCO then implements those measures approved by the owner at no initial cost to the owner, maintains the measures for the life of the contract and *guarantees* the energy savings

5.5.1 Performance Contracting in Retrospect

In the late 1970s, Scallup Thermal, a division of Royal Dutch Shell, introduced the concept in North America of using third party financing to improve energy efficiency and cut operating costs As energy prices continued to climb, the idea of using future energy savings to upgrade facilities and cut operating costs became even more attractive In its embryonic stages, the energy financing agreements generally turned on each party receiving a percentage of the energy cost-savings The ESCO received a share to cover its costs and make a profit The owner also received a share (as well as capital improvements) as an inducement to participate Since each party received a share of the energy cost savings, this procurement procedure became known as "shared savings " During the life of the contract, the ESCO expected its percentage of the cost savings to cover all the costs it had incurred, plus a profit This concept worked quite well as long as energy prices stayed the same or increased

In the mid-1980s, energy prices began to drop With lower prices, it took longer than predicted for the firm to recover its costs Some firms could not meet their payments to their suppliers or financial backers Companies closed their doors, and in the process, defaulted on their commitments to their shared savings customers Some suppliers tried to recover costs from the building owners Lawsuits were filed and "shared savings" was in trouble

From this tenuous thread, the "shared savings" industry survived, but its character changed dramatically Perhaps to respond to earlier "shared savings" fears and uncertainties within the industry, the ESCO industry's focus turned to *guaranteed performance* And "performance contracting" emerged as the favored name Different financing mechanisms also emerged, but nearly all of them offered energy savings guarantees Shared savings as a financing mechanism still existed, but its appeal was limited Instead, the guarantee centered on the reduction in the *amount* of energy consumed and the dollar savings calculated at current billing rates To avoid the risks associated with falling energy prices, ESCOs began setting an energy floor price below which money guarantees would not apply

The performance contracting industry has matured from this shaky beginning Those who remain have track records that clearly demonstrate they can reliably meet the energy and financing needs of their customers When an ESCO guarantees savings, it does not get paid unless those savings are achieved, i e , unless the ESCO performs as predicted That is the essence of *performance* contracting The agreement favors the customers Typically, the only cost to the customer is the money that would otherwise have gone to the utility for wasted energy

Today, performance contracting has matured into a viable and reliable way of doing business in North American and many countries throughout the world In the United States and Canada, federal law allows, even encourages, federal agencies to use performance contracting to cut operating costs Over 3,000 school districts have some type of performance contract Major manufacturers have ESCO services and divisions, utilities have developed or acquired ESCOs, and many regional ESCOs have grown from engineering firms and distributorships It is conservative to say that there are at least ten major national ESCOs and another 30-35 operating on broad regional bases

In 1994, the International Energy Agency went on record at the Conference on Energy Efficiency in Latin America to support and encourage the ESCO industry Some version of guaranteed energy savings is now being practiced in France, Germany Sweden, Spain, Italy, etc Some ESCO activity is reported in Hungary and the Czech Republic has two projects underway The multi-national banks are increasingly supportive of the energy service company industry The World Bank scheduled a roundtable for September, 1994 to explore the possibility of creating a position paper as well as criteria that would foster an ESCO industry as a condition of loaning money to a country

5.5.2 Typical ESCO Services

Through the years, ESCOs have become a customer-driven industry, and the customer typically has a wide range of ESCO services from which it can select exactly what it needs Services offered by an ESCO usually include

- Energy audit to identify energy and operational savings opportunities
- Financing arrangements
- Purchase, installation and maintenance of the installed energy efficient equipment, possibly maintenance on all energy consuming equipment
- New equipment training of operations and maintenance (O&M) personnel
- Training of O&M personnel in energy efficient practices
- Monitoring of the operations and energy savings, so reduced energy consumption and operating costs persist
- Guarantee of the energy savings to be achieved

5.5.3 Benefits Associated with ESCOs

The popularity of performance contracting rests on the broad range of benefits it delivers It offers benefits not only to the country, but to the business offering the service and the customer as well

Country Benefits

The benefits which accrue to the country in which ESCOs operate include

- Reduce the country's reliance on external energy resources, and reduce the associated negative impact on balance of trade

- Offer all market sectors an opportunity to upgrade facilities using current and future monies now spent on wasted energy

- Improve the economy by cutting operating/production costs and increasing the country's economic competitiveness

- Allow increased industrialization without concomitant increases in utility generating capacity

- Increase employment while reducing the needed capitalization for the same quantity of energy, i e a recent study of Russian conditions showed that making available the same amount of energy through energy efficiency creates five times as many jobs as producing this energy with only one-eighth the capital investment

- Improve the environment without incurring the costs usually associated with such efforts In fact, energy efficiency through performance contracting can significantly reduce pollution emissions, such as CO_2, SO_x and NO_x while it "makes money "

- Help create a local energy service industry Using successful ESCOs in prime/sub or joint venture in-country partners has already proved to be an excellent means of technology transfer while creating additional businesses and employment opportunities in the developing country

In-country Business

An in-country partner as a joint venture or subcontractor is critical to an effective project for an external energy service company (ESCO) The in-country partner brings to the effort the essential knowledge of the culture and how to do business in that culture

The ideal in-country partner is a design/build "mechanical contractor," who has heating, ventilation, air conditioning (HVAC), electrical and other related turnkey capabilities, along with experienced project managers to manage the implementation of the projects on a national basis It is also important that such a partner has good political connections to enhance marketing efforts and to expedite contract negotiations with large institutional and commercial customers Such a partner should also have experience in the procurement of equipment on an import basis in order to access the current technologies available for energy conservation outside of the country

The benefits to such a partner are substantial from a short-term financial perspective and long-term growth Offering performance contracting services to its existing customers would allow the partner to provide improved customer relations and expanded services, which include installing major capital improvements in the customer's facilities at no initial cost Pursuing performance contracting would allow the partner to posture itself into a long-term leadership role by providing its customers with new innovative services, which neither the company nor its competition have previously provided

From a financial perspective, performance contracting provides a significant positive cash flow benefit to the partner's existing company by creating a substantial amount of incremental business to such a company without requiring any additional overhead This incremental business not only comes from "old" customers, but comes from a "new" customer base, which has a primary need for performance-based contract services

A third major benefit to the partner, which translates to a financial benefit, is the fact that no additional fixed resources will have to be obtained in order to implement the performance contracting program An existing external ESCO will provide all support and resources necessary including technical personnel, legal contracts, marketing and performance contracting procedures and methodology to ensure that the program is properly implemented and that project performance risks are mitigated

Whether an organization chooses to develop its own business or become a JV partner, the popularity is largely due to the opportunities it offers a firm to

- Sell to customers who have no money
- Serve existing customers better
- Increase business, at low incremental cost
- Make more money selling savings and service (reduce production costs, increase profit)
- Keep personnel employed
- Demonstrate confidence in products and service

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- Hold down energy costs
- Increase the company's competitiveness

It also offers businesses an opportunity to serve the country's environmental needs The process of energy efficiency is essentially environmentally benign It is a very cost-effective way to reduce air pollution

Customer Benefits

The in-country recipient of ESCO services can achieve many business/organizational benefits, including

- An immediate upgrade of facilities and reduced operating costs -- without any initial investment by the owner

- Access to the ESCO's energy efficiency expertise Through savings guarantees, ESCOs have learned from experience just how effective specific energy conservation measures are under certain conditions and how soon they can pay for themselves

- Positive cash flow (The measures usually generate savings that exceed the guarantee)

- The opportunity to use the money that would have been used for upgrades to meet other needs

- Improved and more energy-efficient operations and maintenance

- Risks normally incurred by customer are absorbed by the ESCO, including the guaranteed performance of the new equipment for the life of the contract (not just through a warranty period)

- A more comfortable, productive environment

- All the services are paid for with the money the customer would have paid the utilities for wasted energy

Performance contracting is probably the best and quickest way to be sure an organization is operating as efficiently as possible It offers the customer a risk-shedding opportunity The only true risk the customer incurs is finding the right ESCO partner and obtaining a contract that best meets the customer's needs

Chapter 6
FACILITY-LEVEL ENERGY MANAGEMENT

One of the most important benefits of energy management is that is makes a firm more profitable By practicing good energy management through a well-structured and organized plan, a company can become more aware of how energy is being used, the actual costs of energy, and the methods and equipment that can be used to control and reduce energy waste

Energy management does not mean reducing production levels or lowering product quality, safety or environmental standards The underlying principle is cost effectiveness energy management measures must be justified in normal commercial and financial terms, like any other activity or investment A systematic and structured approach to energy management, including both technical and financial evaluations, is required to identify and realize full potential savings

Many companies and plants do not identify even simple energy conservation measures with short payback periods, and many who have identified such opportunities fail to implement them The main barriers to action are typically

- Management attitudes concerning energy efficiency
- Lack of knowledge of what is technically possible
- Inappropriate financial and economic analysis methods

The greatest successes generally occur at companies where management supports an integrated energy management program and is seen to support it

What are the specific benefits achievable through energy management? There are often benefits both to the national economy and to the plant itself At the national level, for example, benefits include

Immediate results Most conservation projects can be implemented within a year or so, offering faster benefits than most supply side activities

Reduced load shedding Energy conservation measures can reduce the rate of demand growth, reducing load shedding in electricity and gas supply systems

Lower energy imports

Lower foreign exchange needs These follow directly from lower energy imports

Use of local equipment Often much of the equipment needed to implement conservation projects is made locally, thus encouraging local manufacturers

Job creation Through the increased use of local equipment and a demand for energy-efficiency related services, conservation can contribute to job creation and to increasing the skills of the local workforce

Lower inflation If firms are able to cut product prices or to moderate the rate of price increases, this will contribute to keeping inflation lower

At the plant level, benefits include

Lower production costs and higher profits Energy costs can represent a significant proportion of manufacturing costs, energy cost savings are thus a direct contribution to company profits and can be significant for energy intensive industries

Better competitive position Firms achieving savings in energy costs are in a position to cut product costs and thus improve their competitive position against other domestic firms or in export markets

Improved ability to withstand future energy cost increases or curtailments

Improvements in productivity Energy management programs can identify productivity improvement and cost reduction opportunities in areas other than energy Because energy management incorporates many disciplines (e g engineering, human relations), programs often result in improved use of other resources such as raw materials and manpower

Environmental benefits Saving energy almost always leads to lower emissions from manufacturing plants (e g less smoke, less production of sulphur dioxide, lower NOx emissions)

The potential benefits of good energy management are of course entirely dependent on the nature of the plant concerned Energy intensities, the amount of energy consumed per unit of output, vary widely depending on the product in question, the type of manufacturing process, the type of fuel, age of equipment, size of the plant and operating practices However, savings for a plant which is starting an energy management program are often 20 to 80 percent of present energy consumption, and even more in many cases For most firms, energy conservation makes very good business sense

6.1. THE ENERGY MANAGEMENT APPROACH

6.1.1 Where To Start

How does a company begin to address the problem of controlling energy consumption and costs? The answer will depend to some extent on the company concerned, for example, its organization and management philosophy Two points are extremely important

- Top management must be fully committed to controlling energy costs
- The appropriate in-house department must be established to implement, and be accountable for, the energy management program

Other factors that should be examined at an early stage include the following

- The value of energy consumed
- Energy cost as a percentage of total production costs
- Who in the company currently looks at, records, or evaluates energy consumption and costs
- The size of the company (number of employees, departments, site area)
- How many different products are made
- How diverse is the energy consuming equipment
- With the existing company organization, how best can energy consumption be monitored in different areas or departments
- Costs of additional meters

- What are the potential savings
- How do potential savings compare with current profits

The overall approach is illustrated in Exhibit 6 1

6.1.2 Top Management Commitment

The decision of company management to control energy costs is a vital first step This must be clearly stated and understood by all within the company An important part of top management commitment is to set up the responsible department for implementing the energy management program This typically involves appointing an Energy Manager and establishing an Energy Committee Evidence of top management commitment will be demonstrated in the level of support given to the Manager and the Committee, especially the resources authorized and allocated for their function

6.1.3 The Plant Energy Committee

Because energy concerns different departments within an enterprise, an effective energy management program will involve many people In some companies, a committee is formed to include representatives of key departments While unnecessary bureaucracy must be avoided, there are advantages to having an active Energy Committee at the plant

- It can encourage communications and the sharing of ideas among various departments (and other plants) throughout the company
- It can serve to obtain agreements on energy saving projects which affect more than one department
- It can provide a stronger voice to top management that a single manager normally could

Membership will depend on existing management structures and the type and quantity of energy used

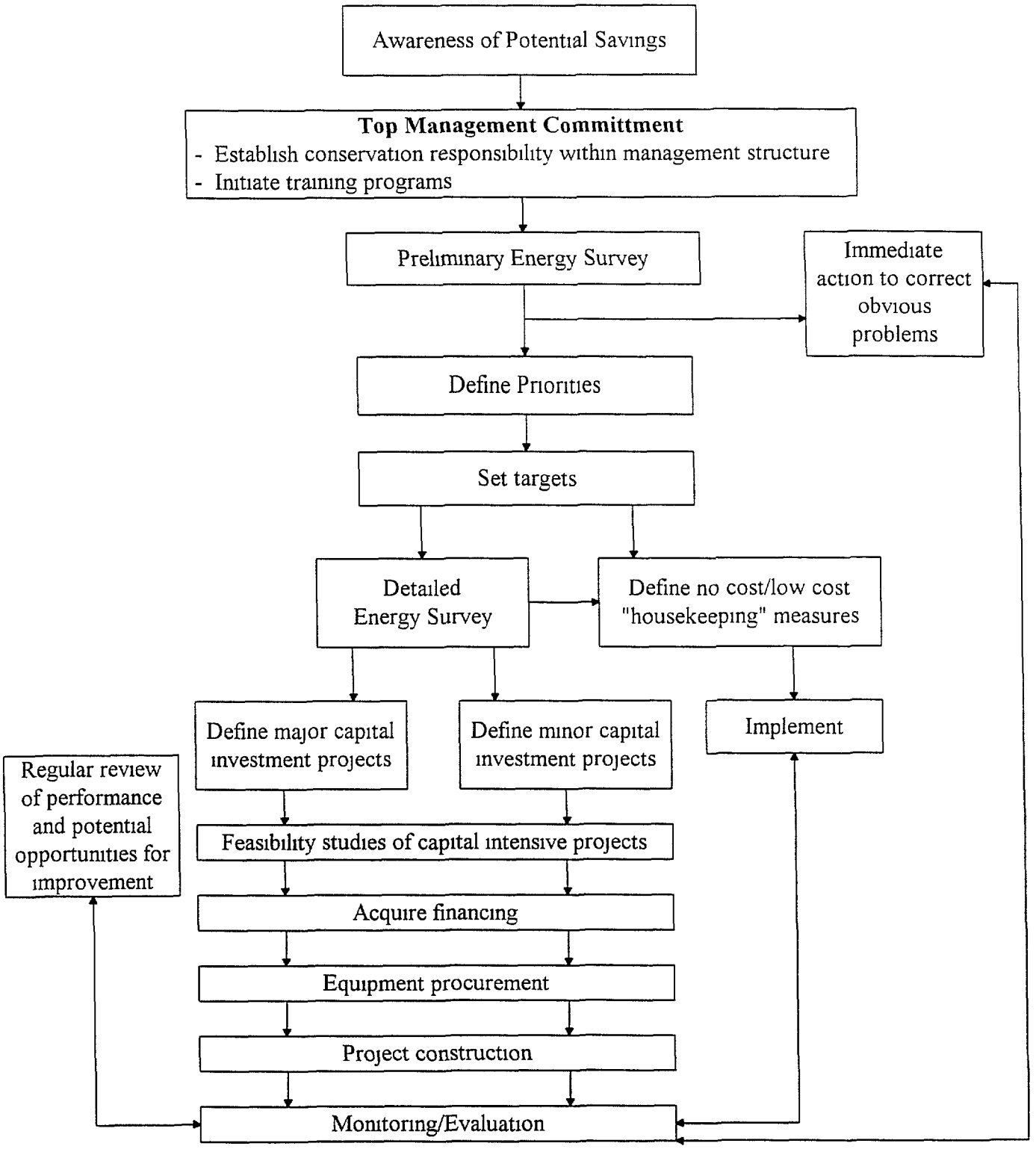
When should the Committee meet? Normally a monthly meeting is usual so that monthly production and energy consumption may be reviewed regularly by the Committee This review would include a comparison of actual performance against previously set targets and budget figures, as well as against previous months Other items for the agenda would be a review of the status of energy conservation investments, in progress or planned

6.1.4 The Energy Manager

Forming an Energy Committee is not enough, someone is needed to implement the policies and directives of the Committee, and to provide the data needed by the Committee to make decisions Appointing an Energy Manager is therefore an essential step in implementing an energy management program in most companies The role of the Energy Manager will vary from company to company but he will normally be concerned with the following tasks

- Collecting and analyzing energy related data regularly
- Monitoring energy purchases
- Identifying energy saving opportunities
- Developing projects to save energy, including the necessary technical and economic evaluations
- Implementing energy saving projects
- Maintaining employee communications and public relations

Exhibit 6.1
The Total Energy Management Process



A typical job description for an Energy Manager is provided in Annex G In some companies, particularly smaller firms, the Energy Manager may report directly to the General Manager or Plant Manager In small companies, the Energy Manager may be part-time Larger companies may appoint a full-time Energy Manager and give him one or more technical assistants, thus forming an "Energy Conservation Group" Wherever possible, the Energy Manager or Group should be independent of the main operating departments reporting to the highest level, such as the Plant Manager, can often give the needed independence and authority

The skills and experience of the Energy Manager need careful consideration Technical competence is usually regarded as the primary qualification, although this may not be as important as often thought In smaller companies, good technical skills may be helpful because the Energy Manager will probably carry out much of the work himself In a larger company, where technical skills are more readily available, the Energy Manager may well be someone with experience in accounting or general management

Most Energy Managers are appointed from within the firm This is primarily done because the position requires a good practical knowledge of all aspects of company operations, both technical and administrative

An Energy Manager must have excellent administrative and communication skills Most Energy Managers need to spend much of their time convincing their colleagues and top management to take a specific line of action The following qualifications are of course ideal and in practice are rarely seen in one individual However, a good Energy Manager should have many of the following abilities, some of which he will bring to the job and some of which he can learn

- Familiarity with the plant and its production processes and quality requirements
- Ability to collect and analyze data, and to interpret data in a form suitable for review by top management
- Knowledge of energy-consuming equipment and factors affecting its efficiency (e g boilers, furnaces, heat exchangers, steam systems, lighting, refrigeration)
- Engineering skills, to size and select equipment, supervise installation and ensure correct maintenance
- Ability to communicate and interact well with both plant management and with line operators and maintenance workers, providing a bridge to promote implementation of management directives and the company energy efficiency policy
- Good judgement to know when to call upon outside help such as consultants or equipment vendors to assist problem solving
- Proper perspective of the role played by energy in the company, in relation to other elements such as raw materials, capital and labor
- Ability to use initiative to develop solutions to problems, and to relate his plant problems to those encountered by others elsewhere or in different industries and to adapt solutions to his own circumstances

Above all, the Energy Manager needs an open mind to view problems from different perspectives and the skill to convince others that savings are both possible and worthwhile if the right measures are taken

6.2 MEASURING ENERGY AND ITS COST

6.2.1 Introduction

Energy management is primarily concerned with the efficient transfer of the energy in fuels and electricity into useful work or heat To check that such transfers are being performed efficiently, it is essential to measure energy inputs and outputs This requires the use of various types of meters and instruments, either fixed in the plant or, in some cases, portable It also requires knowledge of fuel, steam and electricity characteristics to enable comparisons to be made on a common basis

6.2.2 The Heating Values of Fuels

An important characteristic of an energy source is the energy contained per unit of mass or volume (the heating value, heat of combustion or calorific value) This is routinely measured to establish the price of the fuel There are two values associated with fossil fuels a higher (or gross) heating value and a lower (or net) heating value All fossil fuels produce water vapor as a by-product of the combustion process The higher heating value includes the latent heat of the water as it condenses back to a liquid state The heating value generally determined in the laboratory is the higher value

In practice, most combustion processes occur at temperatures at which the water vapor remains in the gaseous state and is discharged with the combustion cases The lower heating value therefore represents the amount of energy in a fuel which is normally released upon combustion in a typical industrial boiler or furnace The difference between the higher and lower heating values for a fuel is a function of the hydrogen content of the fuel, as this determines the amount of water formed Some typical ratios of lower to higher heating values are

	Ratio LHV/HHV
Natural gas	0 90
Fuel oil	0 94
Coal	0 98
Electricity	1 00

In carrying out energy-related calculations, it generally makes little difference which heating value is used Boiler efficiencies based on higher heating values are often calculated in the United States while the lower heating value is more commonly used in Europe, for example The essential principle is to be consistent and use the same basis for all fuels The convention used should always be stated clearly

6.2.3 Unit Energy Costs

An important step to controlling energy costs in a plant is to determine the unit costs of the different energy forms For example, the cost may be constant, irrespective of the level of consumption (e g 150 USD per ton of a specified fuel oil) Some fuels and electricity may have a tariff which varies in accordance with the quantity consumed in a set period of time (e g 4 5 US cents per kWh of electricity up to 100 kWh per month, 2 5 cents per kWh thereafter) There may also be other complicating factors, such as a "demand charge" for electricity or gas, which is a cost element set by the highest actual level of demand in the period (e g 25USD per kW maximum demand) or even by the maximum contract or

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maximum allowable connected load Some forms of energy are also subject to a surcharge for peak period Electricity consumption may be subject to a "power factor penalty" through which the plant is penalized if it consumes too much reactive power

In any month, it may therefore be necessary to compare the registered consumption with the actual utility bill in order to calculate the average cost per unit consumed this unit cost can of course vary from month to month, in line with changes in the demand pattern and not just the total consumption For practical reasons, it may be more meaningful for energy savings calculations for the Energy Manager to compute the marginal cost of energy, that is, the cost incurred for consuming one more unit of the particular form of energy (or conversely, the amount saved by consuming one unit less of the particular energy form)

The unit costs referred to above are usually expressed as a cost per ton, per liter or per kilowatt-hour, as appropriate Other forms of unit cost which can prove useful are the costs per unit of energy equivalence, e g the cost per kcal or kilojoule of energy delivered to the plant Such costs can be adjusted by the efficiency of energy use to give estimated costs per unit of useful energy obtained in the plant This last type of unit cost is mostly used to compare the costs of different fuels or electricity where fuel substitution is being considered and where the different energy forms are used in the processes with different efficiencies

A cost-conscious manager will know the unit cost of his energy consumptions and will think in terms of cost savings when he observes operations that are perhaps not optimum or when he suggests priority for a particular maintenance job

6.2.4 The Cost of Steam

This is a special case of the unit costs mentioned above The plant Energy Manager should calculate the cost of steam and advise plant managers The basic calculation requires the cost of boiler fuel, fuel heating value, water costs, condensate boiler and steam operation, maintenance costs and the cost of capital investment Strictly speaking, these other factors can be incorporated but this is not usually done For most practical purposes, the marginal cost is sufficient for making decisions on energy saving actions or investments This is because decisions are usually based on differences between costs and savings for various options, and the "excluded" costs are typically the same for all options

6.2.5 Energy Accounting

Establishing the cost of steam and the unit costs of fuels are part of a wider activity we can call "energy accounting " Accounting for energy, in its simplest terms, means keeping accounts of energy consumption and energy purchases for the plant At a more detailed level, it may mean assigning energy costs to different departments

The term "monitoring" is used for maintaining a careful check of energy consumption and, usually, to analyzing energy use By monitoring energy use on a regular basis, trends toward higher or lower energy efficiency can often be detected at an early stage and appropriate action taken

The term "targeting" is used to refer to the setting of energy efficiency improvement goals, which can be derived from the analysis of historical data or by an engineering analysis of equipment performance, or indeed a combination of such methods "Monitoring and Targeting" is used to describe an organized approach to measuring energy consumption, analyzing the data and using the results to develop energy-saving procedures as part of the plant energy management program

Exhibit 6 2 illustrates various steps involved in energy accounting, including the elements known as "Monitoring" and "Targeting" which are the key to continued improvement in energy efficiency

6.2.6 Basic Data Collection

Monitoring and Targeting depends on the collection of data in which to judge current performance and to plan for future improvements The simplest data may be needed to bring energy consumption figures into line with production figures, as the time periods for the data must be identical for proper comparisons to be made

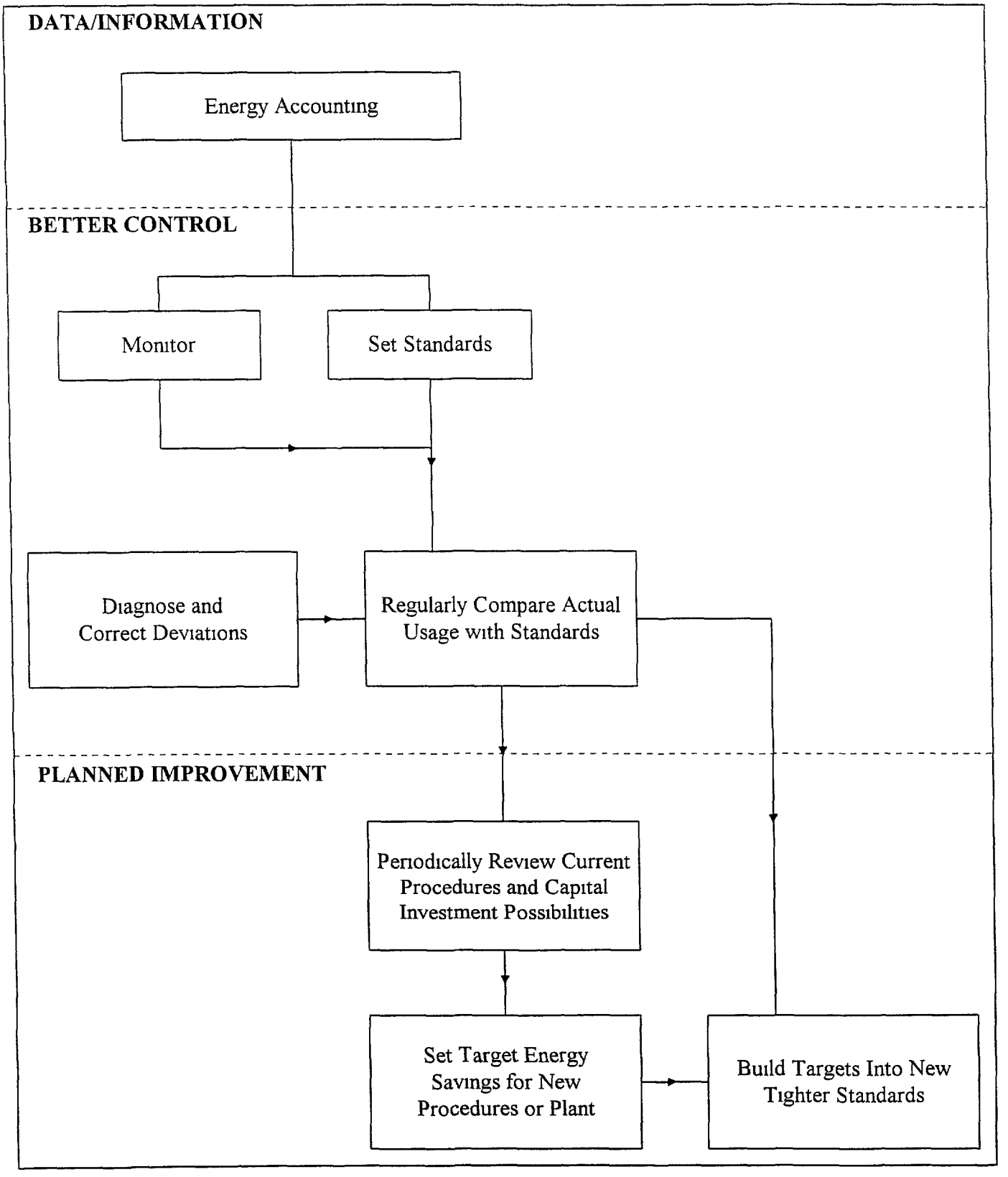
The first step is to gather historical data from previous fuel and utility bills and to establish a procedure for collecting data in the future Relating energy consumption to production levels is important and production should be expressed in appropriate units (e g tons of steel ingots, meters of cloth, square meters of ceramic tiles) In general, the data should be collected monthly so that seasonal changes may be monitored

For most plants, data for the entire plant will be available, together with the corresponding production figures Data on energy use by different departments are often more difficult to obtain, although an analysis of sections of a plant may be desirable to identify major opportunities for energy and cost saving An energy management program should divide the plant into "cost centers " whose energy consumption can be metered and whose production (or "activity") can be defined and measured Targets for the cost centers can be developed and an individual made responsible for improving energy efficiency (e g a workshop supervisor or department manager) Unless energy consumption can be measured, it is difficult to monitor the energy efficiency of a part of the plant, and thus it is not practical to assign responsibility for an unquantified energy performance

In addition to energy and production data, it is often useful to record key parameters which affect production rates, product quality and energy efficiency For example, the particle size distribution and fineness of cement should be recorded Where a significant proportion of energy consumption is concerned with heating or cooling buildings, it is important to record the main climate related variable such as outside temperature and humidity, and solar insulation (and of course internal temperatures and humidity levels) This will allow the Energy Manager to examine the data and adjust energy consumption for changes in such variables

The exact nature of the data to be collected must be decided by the Energy Manager with the help of the energy Committee, based on experience of the manufacturing processes used At many plants, comprehensive data are collected routinely but never analyzed The Energy Manager should analyze the data and recommend improvements, such as the collection of new parameters and the discontinuance of other parameters Only by analyzing the actual data is it possible to judge if parameters are missing The Energy Manager must be prepared to make mistakes and to spend some time experimenting with data collection systems until an appropriate system is found for that particular plant

Exhibit 6.2



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6.3 ENERGY AUDIT PROCEDURES

6.3.1 Introduction

Various approaches have been developed to help a company evaluate energy efficiency, identify energy saving opportunities, and establish a plan for implementing projects to save energy One of these approaches is the "energy audit" (also known as the "energy survey") Audits are generally done at two levels The ***Preliminary Energy Audit*** and the ***Detailed Energy Audit*** Practical audit work requires a flexible approach, in which procedures are adapted to meet the needs of a particular plant

Below is a brief presentation of the procedures involved

6.3.2 The Preliminary Energy Audit

The ***Preliminary Energy Audit*** (PEA) is an initial data gathering exercise Typically, the PEA can be completed without sophisticated instrumentation and uses only data that are already available Data from plant records are collected and supplemented by a "walk through" of the plant in which the audit team observes the general condition of equipment, the standard of maintenance and the level of operations control exercised by management Other than stack gas analyses on boilers and furnaces, few measurements are usually made, improving combustion efficiency is probably the most common opportunity for saving energy

For a small to medium-size plant, a PEA will typically take one week in-plant and up to one week to write the report For a large industrial facility, such as a refinery or steel plant, the PEA may take two to three weeks to complete The typical output of a PEA will include a series of low cost "housekeeping" measures, as well as lists of obvious sources of energy waste, such as poor combustion control, missing insulation, steam leaks and broken instrumentation Most importantly, the PEA identifies the need for, and scope of, a Detailed Energy Audit

6.3.3 The Detailed Energy Audit

The ***Detailed Energy Audit*** (DEA) is an instrumental survey of energy consuming equipment and processes in a plant, followed by a detailed analysis of the different systems It is normally conducted after a PEA, although it could of course be performed independently

Portable instruments are used to quantify energy use and establish the operating efficiency of key equipment and processes Such instruments are indispensable in plants where fixed instrumentation is lacking (which is often the case) In other plants, the portable equipment can be used to check on fixed instruments The most frequently required plant measurements are

- Temperatures and pressures
- Combustion gas analyses
- Flow rates
- Relative humidity
- Boiler water quality
- Lighting intensity
- Electricity system measurements

For audit work, recording and data logging equipment also is frequently utilized Portable instruments are not intended to be a substitute for properly maintained fixed instruments. which are essential for operations control and optimization

A DEA for a small and simple plant might take as little as 4 person-weeks, while a complex facility might require about 15 to 30 person-weeks of effort These figures are of course rough estimates In general terms, about half of the effort is spent in data collection on site, and the other half in data analysis and report writing

6.3.4 What to Expect From an Energy Audit

Whether an audit is performed by in-house personnel or by outside consultants, the Energy Manager should ensure that three important categories of information are properly covered in the audit work and the final report

Consolidation of energy and production data Energy and production data should be compiled in a systematic way Where possible, a comparison with industry standards should be made

Detailed examination of energy saving opportunities A typical audit report should contain a summary table with all measures listed, their costs, the estimated benefits and the return on the necessary investments A full description of the recommended measures must be given, with justification of each measure The report should address the possible risks in implementing projects

Implementation action plan The report should set out a schedule, or order of priorities, indicating how implementation can proceed and who should be responsible

6.3.5 The Final Report

The exact format of the report will depend to some extent on the specific objectives of the audit and on the nature of the plant However, a typical audit report will generally contain the following items

Executive Summary

In addition to a description of the work performed, this contains a list of all recommended measures that have been justified in both technical and economic terms Measures that appear promising but require further study should be mentioned The summary will also contain a recommended plan of action

Background

This section is factual in nature, providing the context for the audit work and recommendations For example

- Plant description
- Process description
- Major energy supply systems

Findings

This section is descriptive and includes discussion of the plant performance that was observed Various aspects should be covered such as

- Energy management
- Energy accounting procedures
- Energy utilization

Recommendations

Recommendations will be made in various areas, such as

- **Energy Management** Including improved management, programs, better energy accounting procedures, means of increasing energy awareness, and long term monitoring requirements, and

- **Energy Utilization** With recommendations divided into no cost-low cost items, minor investments, and major investments Measures may also be divided into those with simple payback times under 1 year and those with longer paybacks Much will depend on the needs of plant and company management Measures requiring further study should be listed

Annexes

These can include energy tariffs, heat and material balance calculations, and samples of plant records Completed audit data sheets should also be included

6.4 CONSERVATION MEASURES

To assist Energy Managers to identify energy conservation opportunities, Appendix B contains checklists of measures in various categories These lists are not exhaustive but do provide a starting point The technical suitability of a measure will of course depend on the specific conditions at the plant, which will be defined during an energy audit The economic viability of a measure always requires careful consideration

6.5 PERFORMANCE

6.5.1 Monitoring Performance

The need for monitoring plant performance regularly has already been discussed at length Through proper monitoring, both desirable and undesirable trends can be detected at the earliest possible moment and appropriate action taken In addition to the routine checking of monthly data, however, it is usual for a plant with a well defined energy management program to carry out a plant audit from time to time, in addition to the audit normally done at the beginning of their program Carrying out a comprehensive audit once per year is a reasonable procedure

6.5.2 Checklisting

Between major audits, Energy Managers can keep close track of operating conditions by a process know as "Checklisting " This is a form of the plant walk-through which would have been done as part of an energy audit

"Checklisting" consists of periodically checking the operating departments (and thus the main energy users) against a list of areas in which waste is most likely to occur It is informal, does not call for major resources (unlike the energy audit) and is essentially qualitative The typical energy audit will generate a list of areas deserving regular attention, and thus the audit report is often a good starting point for developing the plant checklist procedure

The essence of success in Checklisting is to keep the process simple and to establish it as a routine which yields results The procedure divides naturally into two parts, a short plant tour and the listing of items requiring rectification The energy Manager should therefore

- Organize a tour of the plant which covers the main operating areas and energy consuming equipment This tour should start and finish near his office, should be set up to cover the necessary items in a logical order, and should be arranged to take perhaps two hours at the most

- For each operating department or major item of equipment, list the key operating parameters which need monitoring The list should include quantitative data only when such data are readily obtainable from existing instruments or log books

- For those items where quantitative data are not easily obtained, a quantitative list should be drawn up Items requiring checking on a daily basis should be noted, while those requiring less frequent checking should be shown accordingly

- Checking of space conditioning systems should be done at the appropriate time, winter or summer, for example

- Equipment that tends to be left on unnecessarily or to idle should be included in the checklist

A record of all faults found on checklist tours should be kept Problems which occur regularly should be examined and a permanent solution sought Items involving maintenance attention should be noted and examined in more detail if they are seen to occur frequently or are not rectified promptly

6.5.3 Training

Employee motivation can often be helped by providing training in energy efficiency matters which helps the employee understand his responsibilities better and gives him the knowledge or skills to conduct job better The type of training needed will vary from plant to plant, and will depend on the existing skills of employees The Energy Manager should develop short training courses for different levels of the operating personnel, from shift workers to members of the management team Training can be arranged to take perhaps a half day each month, although there may be an initial need for one or two days of concentrated courses to raise energy awareness and energy-related skills urgently at the beginning of the plant energy management program

Part of the training activities should include review of energy efficiency improvement targets and the progress made towards achieving them Feedback on successes, and on failures, should be used to increase energy awareness, to improve employee understanding of the need for energy efficiency, and to seek the active cooperation and participation of all employees

In all such activities, the commitment and interest of top management can provide a strong motivating factor If it is perceived that management lacks interest, there is little hope that the energy management program will be successful It should be clear to all that reports are read, that data collected for management are actually used and studied, and that ideas for improving energy efficiency are appreciated and listened to Effective energy management is a team effort, in which communication is a key element

Chapter 7
POWER SECTOR

This chapter presents the overall considerations necessary for the development of a National Energy Savings Program for Kazakhstan Specifically, it discusses the present status of the Kazakhstan power industry, including an overview of the active power plants and a detailed review of a specific plant (Thermal Power Plant TES-2 in Almaty) Many statistics and data dealing with electricity production, generation and distribution are also provided On a few specific topics, comparative statistical data between Kazakhstan power industry and other countries are presented Subsequently, general discussions on energy savings in Kazakhstan's power industry are presented Included in these are discussions on fuel, electricity generation and distribution savings, in terms of both fuel and dollar savings A methodology for assessing energy savings is presented and recommended measures, in terms of time-related phases, are discussed in detail Overall energy savings potentials for Kazakhstan's power industry are identified and quantified, both in terms of physical quantities (fuel) and money (US dollars or Kazakhstani Tenge)

7.1 INDUSTRY OVERVIEW

7.1.1 Kazakhstan Power Industry

Most power and thermal plants in Kazakhstan are over 20 years old and are operating with obsolete equipment or with components requiring considerable renovation The electricity produced in such a relative inefficient matter is then transmitted, also inefficiently, to the ultimate consumers In addition, many plants are compelled to fire non-design fuel (e g coal with ash content exceeding the maximum design specification) It is estimated that these problems result in an overall decrease in the production of electrical power and energy heat in the neighborhood of 30-40% relative to the optimum electricity production levels The impact of the reduced power production has been moderated in the past few years by a decrease in demand due to industrial recession Reduced electricity production (an annual average of 2 55 million Kwh decrease between 1990 and 1994) often results in domestic heating black-outs

By Western standards, Kazakhstan's power plants are poorly operated and maintained, in addition to being overstaffed Plant operation is plagued by the use of poor quality coal, the handling of large volumes of ash, the lack of pollution control equipment, and outdated instrumentation and control technology Another very serious problem is the lack of availability of spare parts, since most of the equipment is imported, and suppliers find it difficult to supply parts in the current political environment

As Kazakhstan grows into a market-led economy, the demand will accelerate and lack of available energy will possibly become a limiting factor in the economic development of the country Increasing the efficiency of existing plants, extending their life and implementing Demand Side Management programs are the most cost-effective means for improving the power industry situation The necessary renovation and maintenance costs are large and potential domestic or foreign investors will require detailed plans and cost estimates in order to evaluate their participation

Projections of primary energy consumption have been prepared by Kazakhstani agencies and are shown in Exhibit 7 1 below This exhibit shows that Kazakhstan's overall energy demand (including electricity) is expected to fall during the economic restructuring process Initially, this will be driven by falling industrial output and economic retrenchment, as the initial stages of the reform are undertaken In the medium term, reduced energy demand will result from higher relative energy prices, restructuring of enterprises, and an increase in energy efficiency Energy and electricity demand is expected to be primarily affected by the declines in industrial output in the mid 1990s

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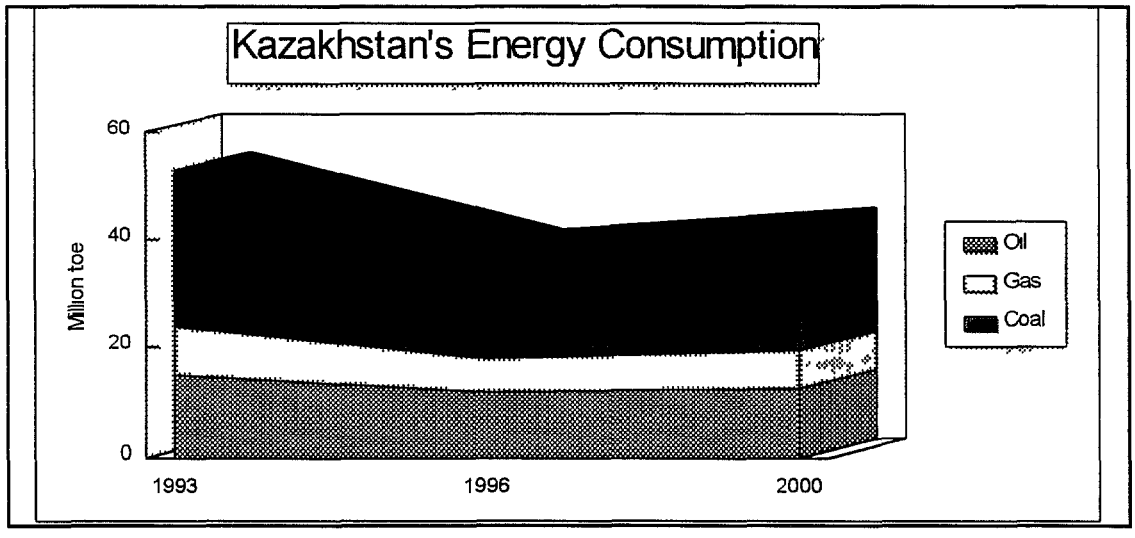
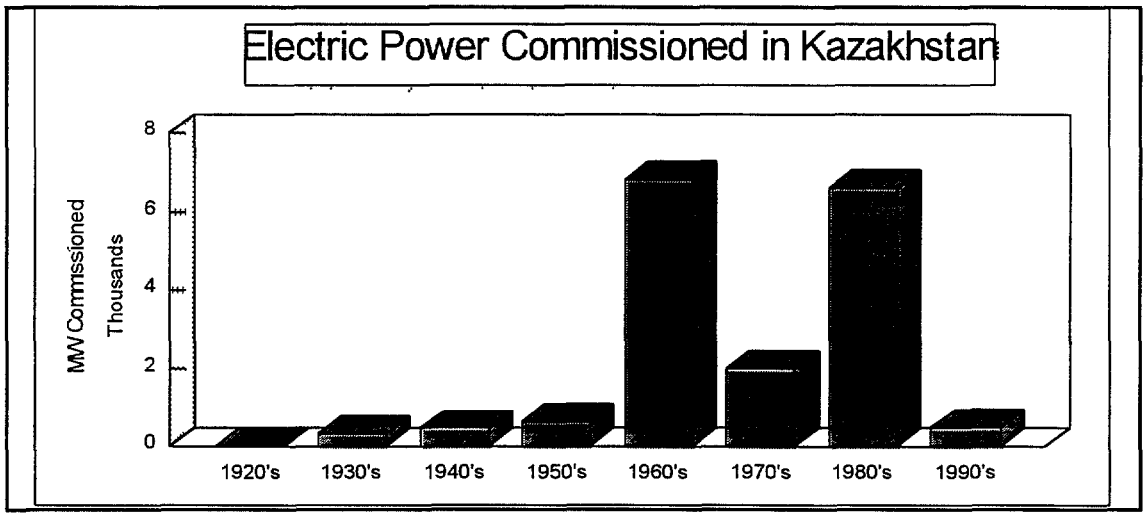
Exhibit 7.1
KAZAKHSTAN ENERGY CONSUMPTION



The total electric power commissioned in Kazakhstan, identified as a function of the decade in which such capacity was commissioned, is depicted in Exhibit 7 2 below

Exhibit 7.2
ELECTRIC POWER COMMISSIONED IN KAZAKHSTAN



As can be seen from the graph, a significant portion of Kazakhstan's installed electrical capacity has been commissioned in the 1960-1980 decades, utilizing the technology available in Russia in that period

Kazakhstan power plants (including the hydro plants) with the reported year in which the plants were commissioned, their MW rating and the type of fuel consumed are listed below

Year Commissioned	*Name of Station*	*MW*	*Fuel*
1928	LENINOGORSK HARIUZOV GE	5 6	H
1934	SEMIPALATINSK TES	6	C
1934	SHIMKENT TES-2	12	C.G,M
1935	ALMATY TES-1	145	C.G,M
1935	ALMATY CASCADE GES-1	15 6	H
1935	KENTAY TES-5	18	C
1937	LENINOGORSK ULBINSK GES	27 6	H
1937	BALHASH TES	120	C
1942	KARAGANDA ES-1	109	C
1943	ALMATY CASCADE GES-8	2 5	H
1943	TENGIS GAS TURBINE	57	C,G.M
1943	ALMATY CASCADE GES-5	3 8	H
1944	SHIMKENT TES-1	30	C,G,M
1947	UST KAMENOGORSK TES	241	C
1948	ALMATY CASCADE GES-10	0 8	H
1948	ALMATY CASCADE GES-6	2 5	H
1948	ALMATY CASCADE GES-7	2 5	H
1948	ALMATY CASCADE GES-9	0 8	H
1948	ALMATY CASCADE GES-11	0 8	H
1949	TISHINSK GES	6 1	H
1949	LENINOGORSK URDAYSKAYA	0 2	H
1951	LENINOGORSK GEORGIEVSK	1 4	H
1952	JESKAZGAN TES	177	C
1952	UST-KAMENOGORSK	331 2	H
1953	KARATAL GES	10 1	H
1955	ALMATY CASCADE GES-8a	0 8	H
1956	LENINOGORSK TES	57	C
1956	EKIBASTUZ TES	12	C
1957	KOSTANAY TES	12	C,M
1959	TALGAR ES	3 2	H
1959	TEKELY TES-2	24	C
1960	KARAGANDA TES-1	32	C
1960	BUHTARMINSK ES	675	H
1960	URALSK TES	28	G,M
1960	ANTONOV ES	1 6	H
1961	RUDNEV TES	123	C,G,M
1961	PETROPAVLOVSK TES-2	380	C
1961	SOGRINSKAYA TES	50	C
1961	PAVLODAR TES-2	110	C
1961	AKMOLINSK TES-1	26	C
1962	ATYRAY TES	144	G,M
1962	ATYRAY TES	227	G,M
1962	ALMATY GYDROSTATION	173	C
1962	GARAGANDA ES-2	648	C

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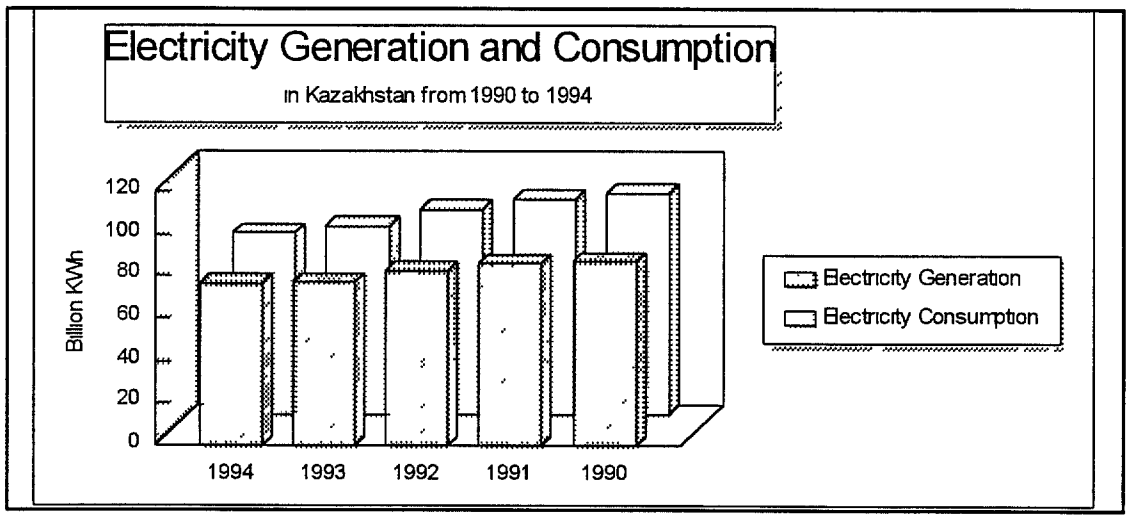
1963	ALMATY CASCADE GES-2	14 4	H
1963	JAMBUL TES-4	60	G,M
1963	ARKALYK TES	6 5	M
1963	USPENSK ES	1 9	H
1964	TENTEKSKAYA TES	18	C
1964	PAVLODAR TES-1	350	C
1964	KZIL-ORDA TES-6	146	C
1965	LENINOGORSK ZAYSANSKAY	2	H
1967	JAMBYL ES	1230	G,M
1968	ERMAKOVSK ES	2400	C
1970	KAPCHAGAY GES	434	H
1972	PAVLODAR TES-3	440	C
1973	KARAGANDA TES-2	435	C
1977	KARAGANDA TES-3	440	C
1979	AKMOLINSK TES-2	240	C
1980	EKIBASTUZ ES-1	4000	C
1980	ALMATY TES-2	510	C
1981	SHIMKENT TES-3	160	G,M
1987	SHULBIN GES	585	H
1990	EKIBASTUZ ES-2	500	C

Total MW Power Commissioned= 14,076 90

(**C**=Coal, **G**=Gas, **M**=Mazut, **H**=Hydro)

Of the total installed generating capacity, about 87% is thermal, 12% is hydro, and insignificant portion is nuclear All major thermal stations in Kazakhstan are coal-fired with the exception of a few gas or fuel oil fired stations in the city areas The electricity balance for Kazakhstan for the years 1990-1994 is shown in Exhibit 7 3 below

Exhibit 7.3
ELECTRICITY GENERATION AND CONSUMPTION IN KAZAKHSTAN FROM 1990 TO 1994



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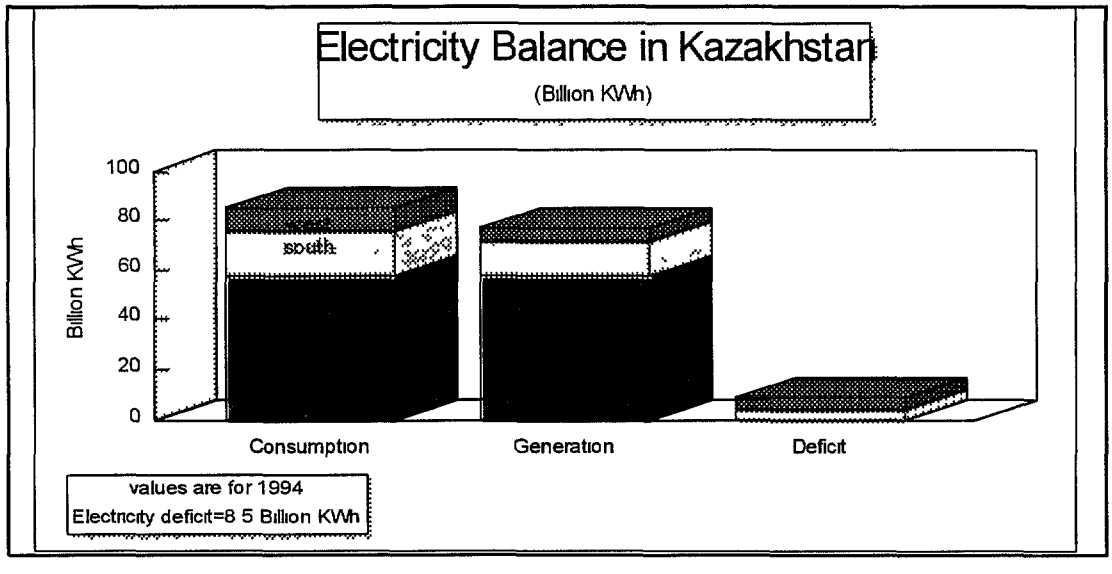
In view of the size of Kazakhstan, the power system is subdivided into three regional power grids in the North, in the South connected to the Central Asian System, and in the West connected to the Russian system While the domestic supply of electricity has expanded rapidly during the last decade, Kazakhstan still imports a considerable amount of electricity from Russia and Central Asia In terms of Kazakhstan's activities in trading energy it must be noted that, although Kazakhstan is self sufficient in energy on a fuel equivalent basis, its sheer size and geographical imbalance of production and consumption centers, result in a significant percentage of its domestic energy supplies being met through energy imports from neighboring Republics A substantial proportion of energy trade is within the Newly Independent States, with the Russian Federation being the most prominent trading partner There is a large flow of electricity from Siberia through northern Kazakhstan to the Urals region The western and southern grids rely heavily upon imports from Russia and Central Asia, especially Kyrgyzstan Regional energy trade is expected to continue, and possibly increase as a result of the economic restructuring process

The current Kazakhstan electric power deficit, that is the difference between power consumption and production, is calculated to be approximately 15%

Exhibit 7 4 below, depicts the electricity deficit in Kazakhstan for 1994, such deficit amounted to 8 5 billion kWh, which, assuming a cost of electricity of $ 03/kWh, resulted in a loss for Kazakhstan of 255 million dollars

Exhibit 7.4
ELECTRICITY BALANCE IN KAZAKHSTAN



A significant problem in Kazakhstan is represented by the considerable portion of equipment which is either functionally obsolete, or very close to the end of its useful life Such equipment inefficiency is considered to make up about 1300 MW of power plant capacity, or about 10% of overall Kazakhstani installed capacity The problem of aging power plants is not unique to Kazakhstan As shown in Exhibit 7 5 below, the US is facing the same situation with aging power plants , and the American utilities are successfully solving the problem by developing modernization and life extension programs to old fossil plants to obtain acceptable unit performance, within the utility's budget constraints

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Exhibit 7.5
AGE DISTRIBUTION OF US AND KAZAKHSTAN COAL-FUELED POWER PLANTS

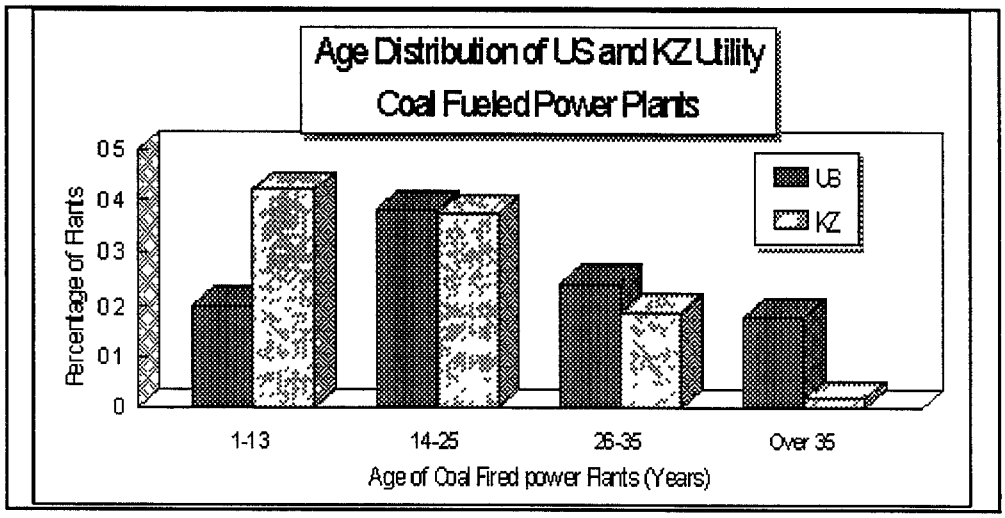
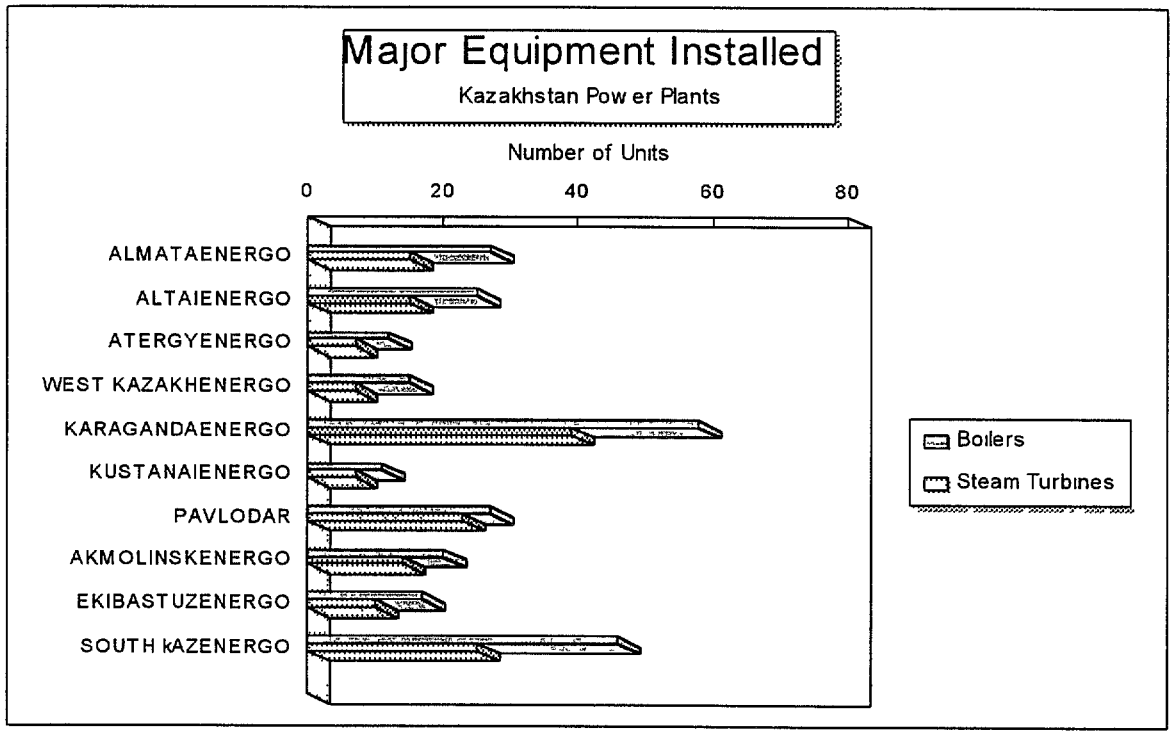


Exhibit 7 6 below provides some statistics on the power boilers and power turbines which are installed in Kazakhstan's power plants

Exhibit 7.6
MAJOR EQUIPMENT INSTALLED IN KAZAKHSTAN POWER PLANTS



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The number of operating power boilers installed in the power plants in all regions of Kazakhstan, and their total operating hours, is depicted in Exhibit 7 7 below Exhibit 7 8 provide similar data for steam turbines

Exhibit 7.7
OPERATING BOILERS IN KAZAKHSTAN POWER INDUSTRY

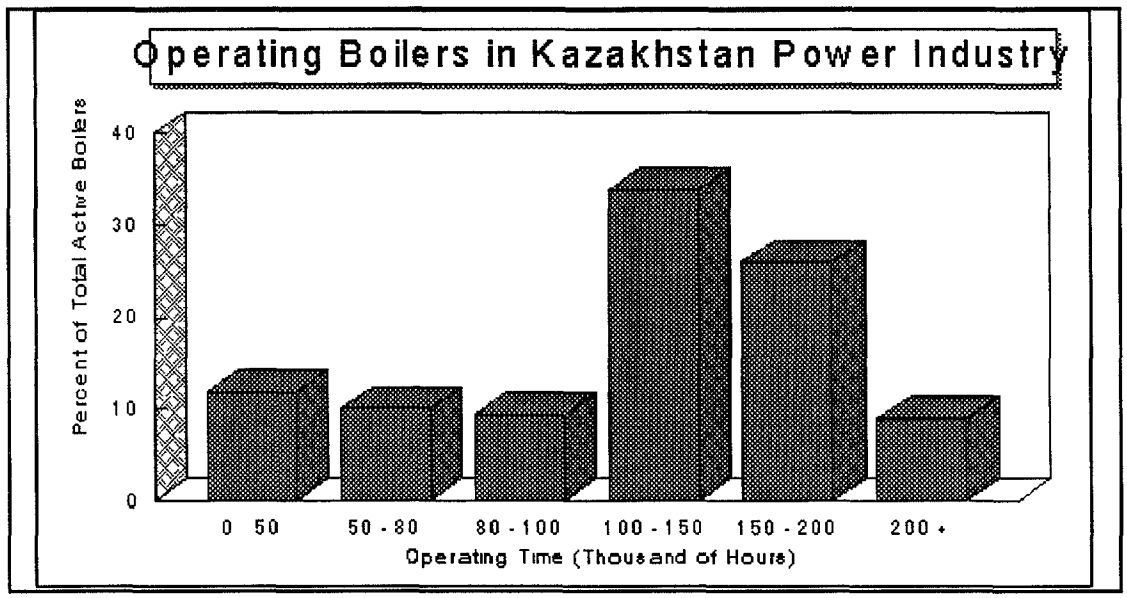
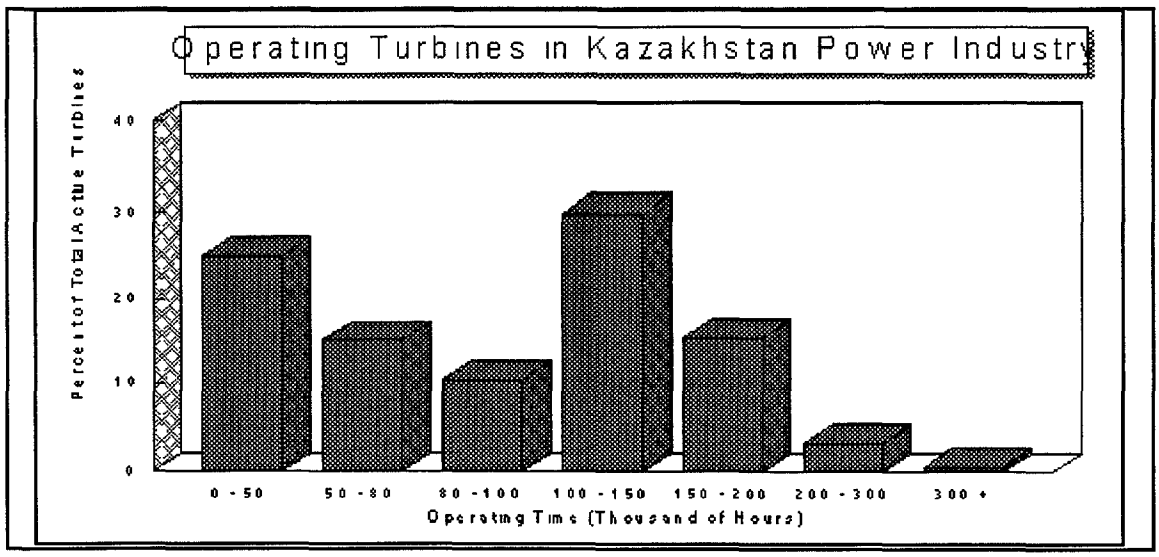


Exhibit 7.8
OPERATING TURBINES IN KAZAKHSTAN POWER INDUSTRY



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Both exhibits (7 7 and 7 8) highlight the fact that a considerable portion of Kazakhstan major equipment such as boilers and turbines, has been operational for a relatively long period of time In fact, over 45% of power plants' turbines, and 60% of power boilers (supercritical, high, and intermediate pressure) have been operated (on the average) for over 150,000 hours

The distribution of electricity in the various regions of Kazakhstan, as a function of the sector in which such energy is consumed, is shown in Exhibit 7 9 below (both as a function of each Region total consumed electricity, and as a function of the Sector's percentage of the total electricity consumed in that Region)

Various forecasts have been developed by various Kazakhstani organizations on electric power demand and production, all of which are inconsistent with each other, both in values and trends The inconsistencies are due to the assumptions made on Kazakhstan's future economic, political, and social conditions, as well as on which (if any) reconstruction program is to be implemented for the power industry The "average" values of forecasted electricity production and consumption are shown below as well as the minimum and maximum values are shown in parenthesis

	1995	2000	2005	2010
Production (B kWh)	73 8 (61 5-85 0)	81 4 (44 7-110 0)	115 0 (95 0-135 0)	135 0 (110 0-160 0)
Consumption (B kWh)	85 0 (76 0-95 0)	88 3 (60 0-110 0)	125 0	140 0

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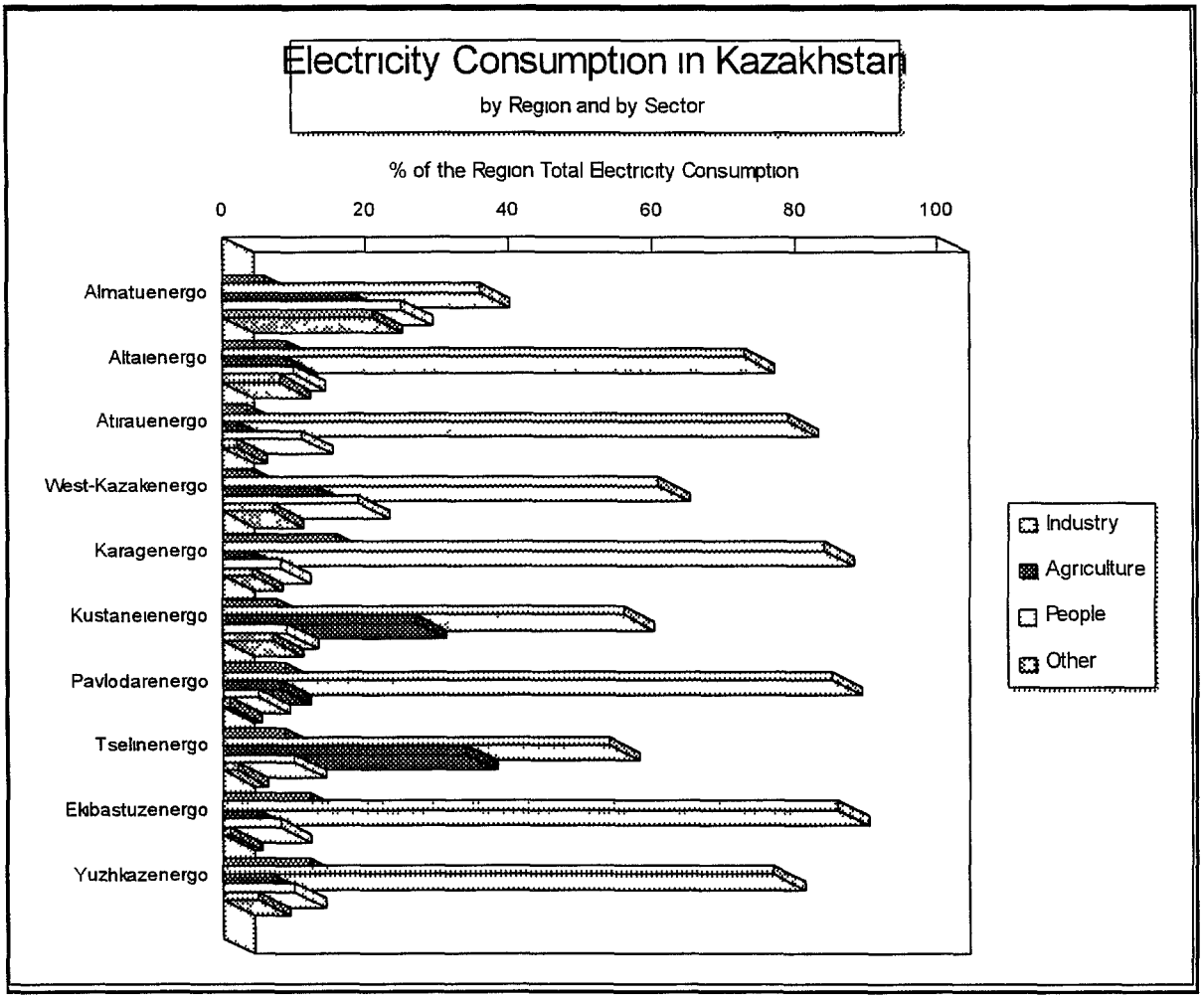
Exhibit 7.9
ELECTRICITY CONSUMPTION IN KAZAKHSTAN BY SECTOR AND BY REGION



"Average" Forecast of Kazakhstan's Electricity Production and Consumption

It shall be recognized that over 10% of Kazakhstan total installed capacity, or approximately 1300 MW, is produced by equipment whose useful productive life is completed or close to completion, the cost of production for such power output per kWh is considered to be significantly greater than the potential revenues realized from the sale of such energy

From the above considerations, it can be deduced that the useful capacity of electricity available in Kazakhstan is estimated at approximately 8500 MW and that the electric power deficit is estimated to be as much as 32 billion kWh or 34% of Kazakhstan's overall demand This result in a total replacement cost of hundreds of millions of US dollars a year

If a comprehensive program for the upgrading and modernization of Kazakhstan's power industry is developed and implemented, the resulting balance of electric power consumption and production can be represented by Exhibit 7 10 below

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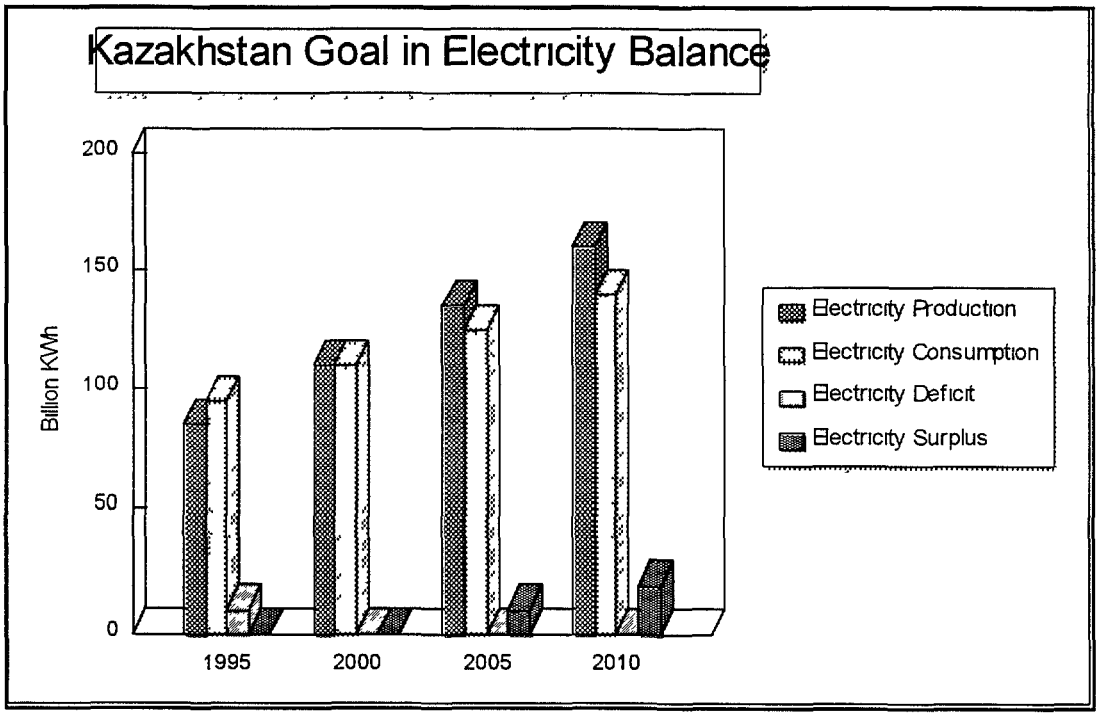
Exhibit 7.10
ELECTRICITY CONSUMPTION AND PRODUCTION TO 2010



Programs have been proposed by Kazakhstan's power agencies, including "Kazakhstanenergo" and the Ministry of Energy and Coal, for planned addition and retirement of MW capacity to the Kazakhstan power industry Exhibit 7 11 below depicts the anticipated power balance of Kazakhstan to the year 2010 in terms of (turbine power) MW retirement and replacement

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Exhibit 7.11
ELECTRIC POWER CAPACITY ADDITION AND RETIREMENT IN KAZAKHSTAN TO 2010

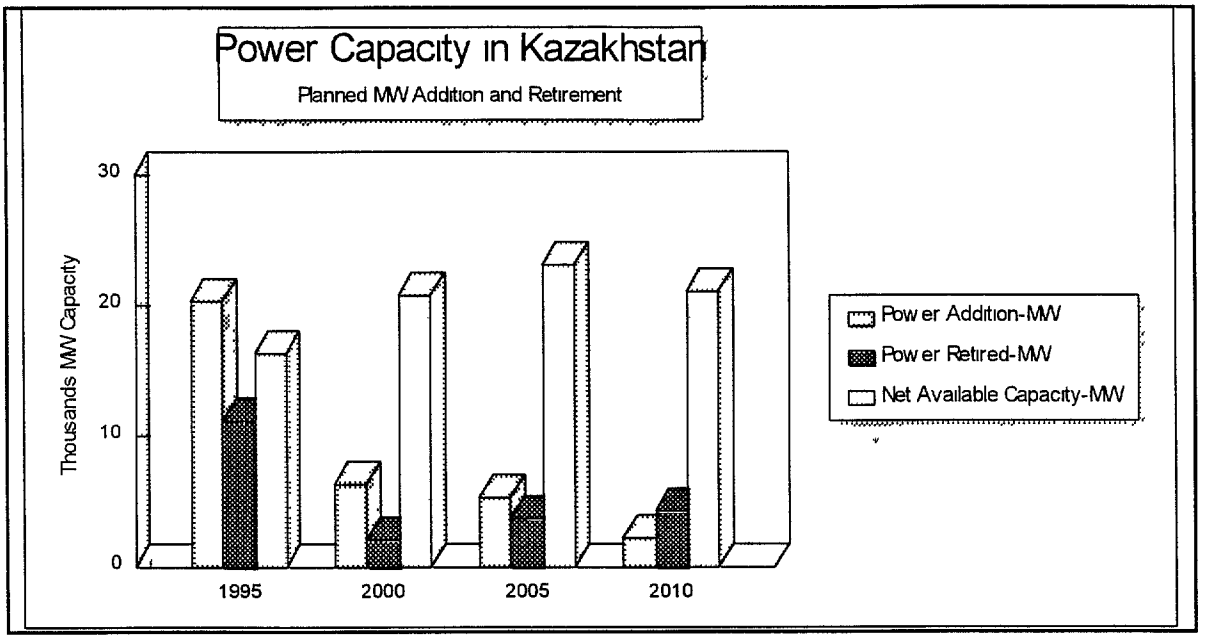

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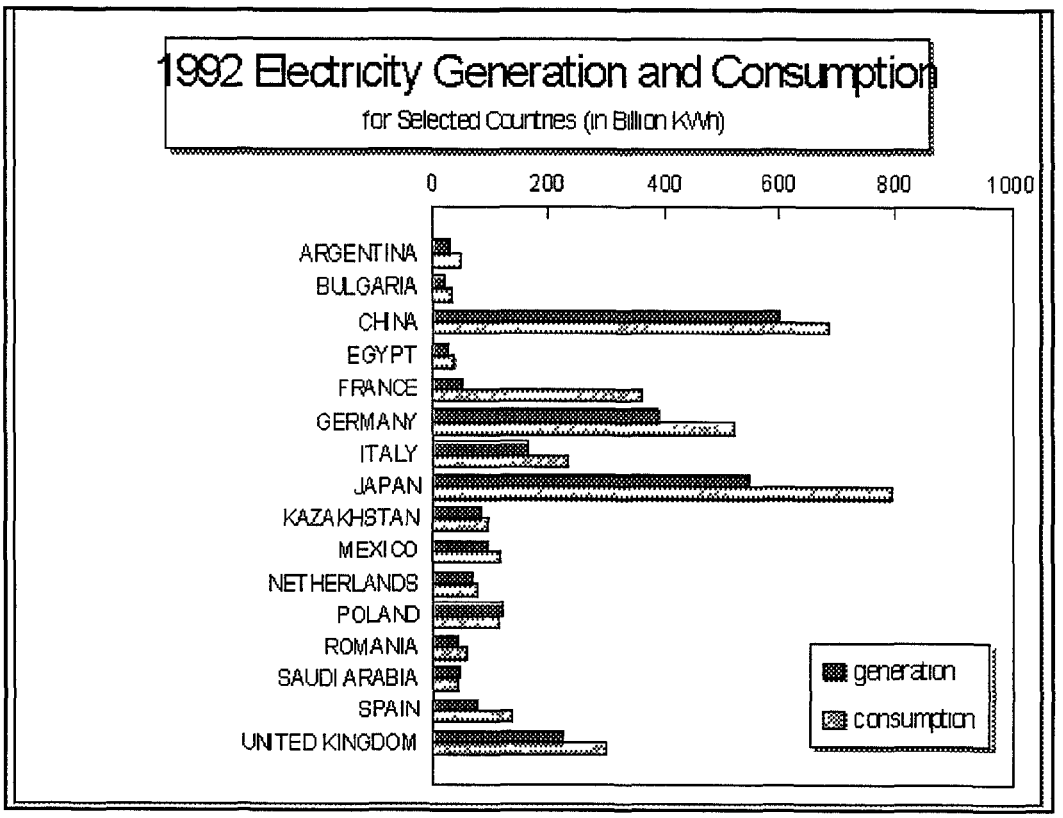
Exhibit 7.12
1992 ELECTRICITY GENERATION AND CONSUMPTION FOR SELECTED COUNTRIES



Current per capita consumption of electricity in Kazakhstan is high in comparison to countries with similar GNP per capita This reflects the over consumption and inefficient use of energy, particularly in the industrial sector, in response to the low relative price of electricity

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Exhibit 7.13
ELECTRICITY EFFICIENCY FACTORS FOR SELECTED COUNTRIES

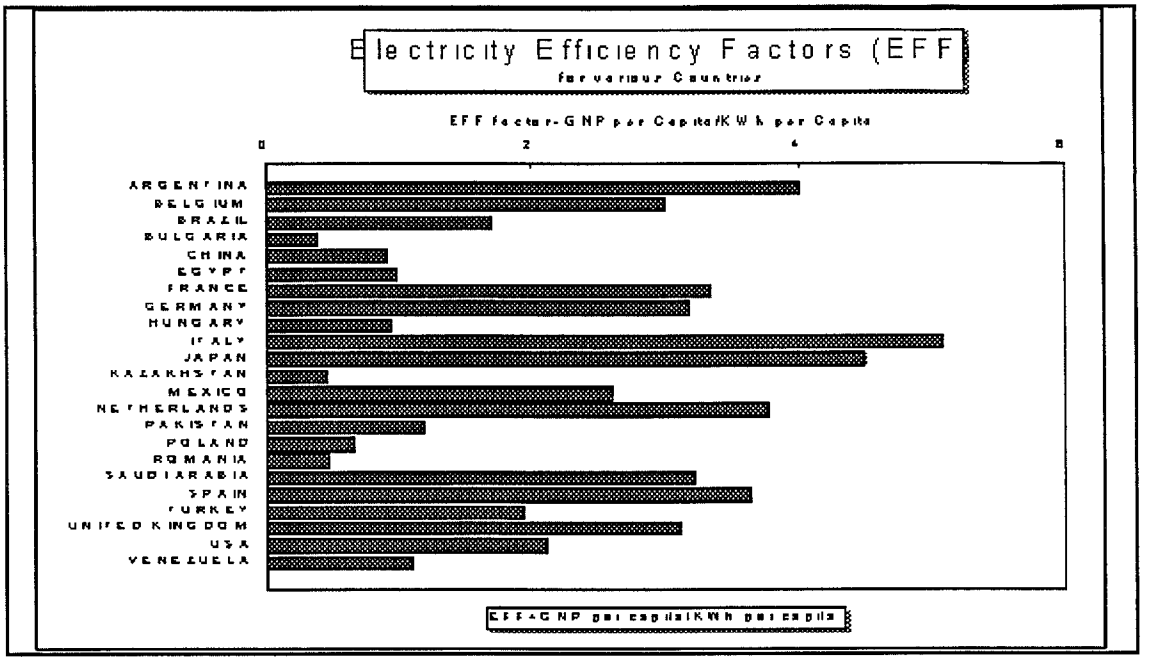
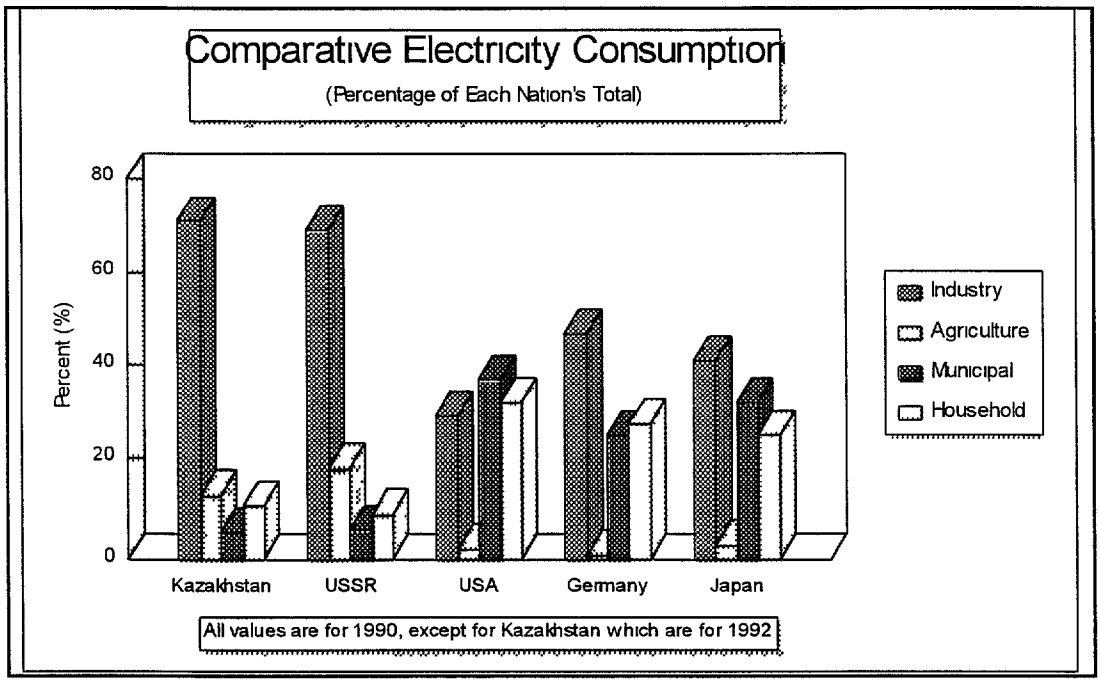


Exhibit 7 13 documents that Kazakhstan electricity efficiency level (defined as the ratio of the per-capita Gross National Product to the per-capita electricity consumption) is relatively low, when compared with the most industrialized countries

The relative allocation of electric energy to various industrial segments in Kazakhstan and in some highly industrialized countries is indicated in Exhibit 7 14 below

Exhibit 7.14
COMPARATIVE ELECTRICITY CONSUMPTION



In the Exhibit above, all countries' values are in percentage of their total electricity consumption (76 5 billion kWh for 1992 for Kazakhstan) From the chart it can be seen that in Kazakstan, over 70% of the electricity is consumed by the industrial sector, compared with 29% for the USA, 47% for Germany, and 41% for Japan This leads to the conclusion that a program aimed at improving the consumption of electricity in Kazakhstan's industrial sector will contribute considerably to overall electricity savings in the country

A typical comparison between Kazakhstan and some industrialized countries, in terms of level of electricity consumption for the production of metals (i e alumina), is depicted in Exhibit 7 15

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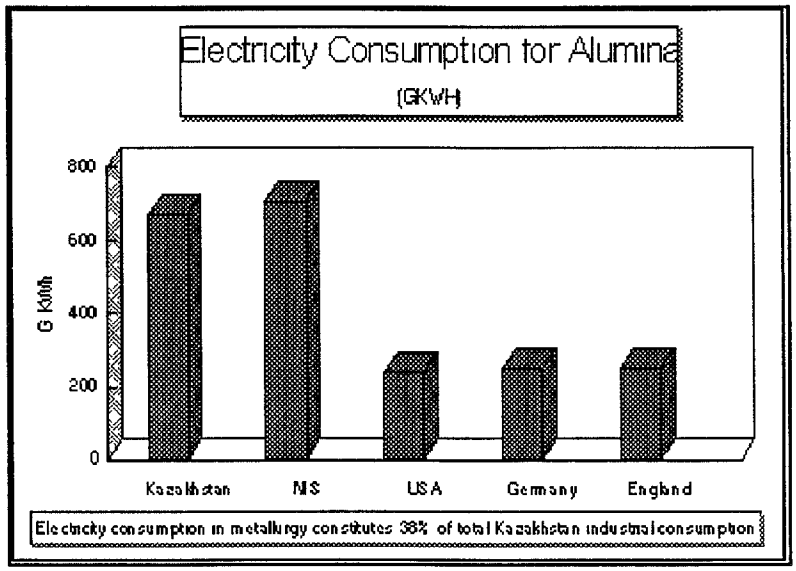
Exhibit 7.15
ELECTRICITY CONSUMPTION FOR PRODUCTION OF ALUMINA



7.2 ENERGY SAVINGS IN THE POWER INDUSTRY

7.2.1 Definitional Discussion

Energy savings is defined as the process of minimizing or eliminating energy-waste in processes, methodologies or equipment In the generation and production of electricity and heat, in conventional power plants and district heating facilities, energy can be saved in each phase of the overall process Specifically, savings can be realized in the following areas

- **Fuel** Proper utilization of fuel (coal, gas, mazut)
- **Energy Generation** Utilize efficient equipment and processes, use proper controls and process monitoring devices, standardize the equipment to minimize operation and maintenance activities, minimize equipment and system energy of fluid losses
- **Output Distribution** Assure that the output (electricity and/or heat) is properly transmitted and distributed to the ultimate user, minimize the potential losses incurred in such distribution process, inculcate in the end-users the notion and culture of "energy-saving "

It is very difficult to estimate precisely the amount of savings which could be realized in a future Energy-Savings program in Kazakhstan, due to the significant number of unknowns, some of which are non-technical in nature and of socio-political connotations, but a rational estimate indicates that approximately 30-40% of the total electric energy could be saved if a comprehensive Electric Energy-Savings program is implemented This represents about 28-38 billion kWh

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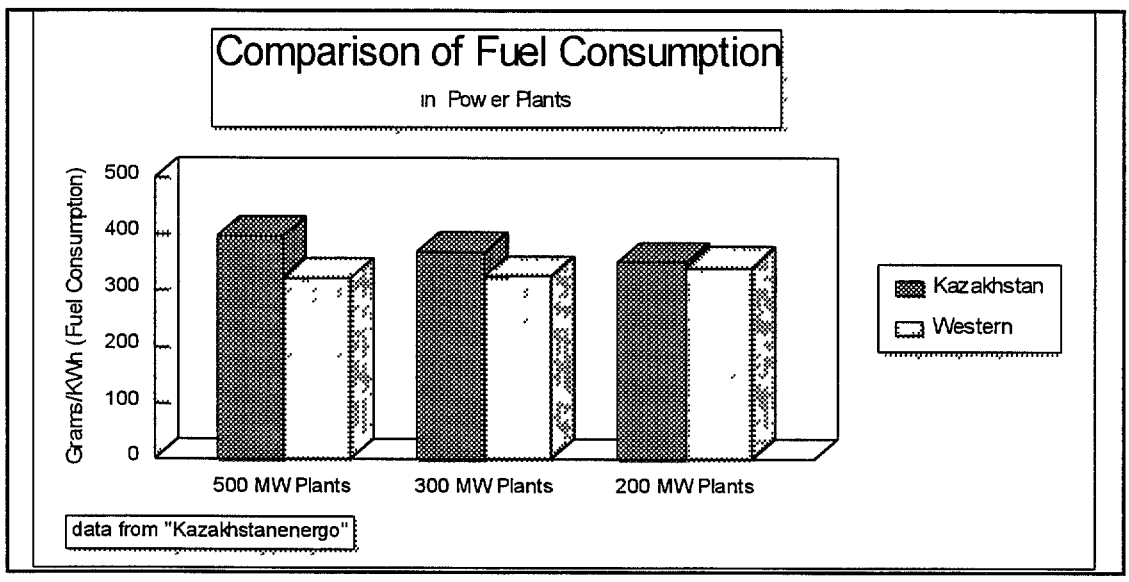
7.2.2 Fuel

Kazakhstan's coal industry is closely integrated with the electricity sector in Russia and with the Urals metallurgy industry Cooking and steam coals from Karaganda are exported by rail to the main industrial cities in the Urals The demand for cooking coal is likely to fall substantially in the near future because total Russian demand for iron and steel will decline The Urals steel industry, which uses outdated technology and is a major source of environmental damage, may bear the brunt of the resulting contraction of supply The low-quality coals produced at Ekibastuz (with high ash content and low calorific value) are primarily suitable for use in power station for generation of electricity and heat energy About 30% of the mines' output is exported Most of the remaining Ekibastuz coal is used for power generation locally, with a substantial fraction of that power output being exported to Russia, as part of a system of power wheeling from Siberia to cities in the Urals

In the production of energy, Kazakhstan's State Energy organization "Kazakhstanenergo" is the largest consumer of primary fuel resources-coal, mazut, and gas The volume of such fuel consumption in 1993 was 35 56 million tons, of which 22 71 million tons were consumed for the generation of electrical energy, and 12 71 million tons for the production of heat energy (essentially hot water for district heating services) In terms of relative consumption, the following statistics (for 1993) have been reported by Kazakhstan's Ministry of Energy and Coal 359 grams/kWh for the generation of electricity and 181 Kg/GCal for the production of heat energy

Specifically, the statistics contained in Exhibit 7 16 illustrate the relative difference between Kazakhstan unit fuel consumption per kWh output against the average "Western" power plant

Exhibit 7.16
COMPARISON OF FUEL CONSUMPTION
BETWEEN KAZAKHSTAN AND "WESTERN" POWER PLANTS

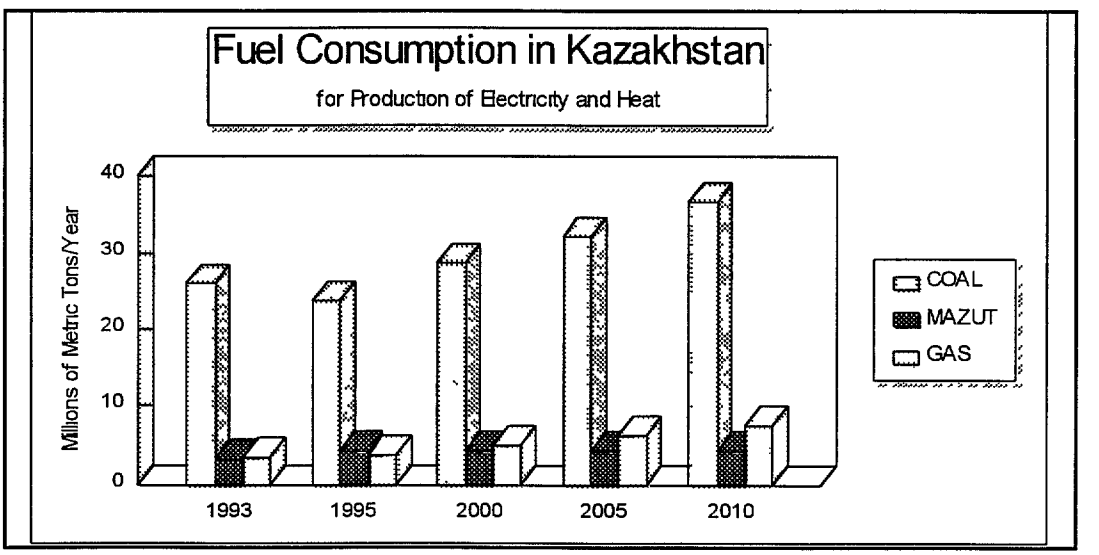


The statistics reported in the above exhibit indicate that, in terms of unit fuel consumption per unit output, Kazakhstan fuel consumption is about 13% higher compared with similar plants in the "West" This translates in a fuel overconsumption of over 4 million tons of fuel per year, or approximately 100 million US dollars a year, assuming a fuel cost of $25/ton

Data and statistics reported by the State Energy Company "Kazakhstanenergo" indicate that thermal power plants have overconsumed in 1993 over 1 7 million tons of fuel for the production of electricity This can be considered to be, in part, due to the poor performance of the equipment available in the plants, mainly boilers and turbines in the 300-500 MW power plant capacity category (which make up about 50% of the overall Kazakhstani capacity and electrical output) It was reported that the State Energy Company "Kazakhstanenergo," in generating electricity and heat energy, utilizes equipment and methodologies which need significant improvement for their optimum efficiency The largest over-consumption is shown in the 300-500 Mw energy block, and in the electric power production from facilities with pressure of 90-130 Kg/cm^2 Comparing Kazakhstan's values with those of highly industrialized countries (i e USA, Germany, Japan), Kazakhstan fuel consumption is estimated to be about 10% higher

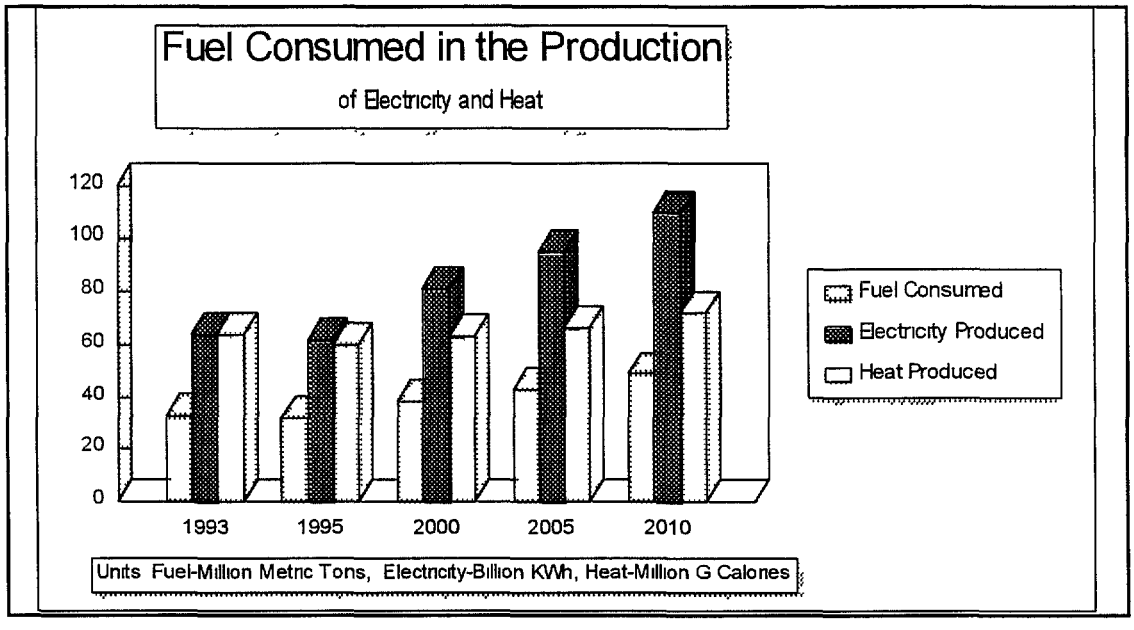
Fuel cost calculations indicate that, despite the relatively small quantity of mazut used (10%), its cost equals that of the main fuel (coal) Assuming a $10/ton price of coal (including transportation expenses), the total cost of the 26 million tons of coal burned in 1993 equals that of the reported 3 4 million tons of mazut burned at $75 per ton Mazut used for power generation, district heating and industrial uses accounts for over one third of the total petroleum consumption in Kazakhstan In the power sector, mazut is used to co-fire with coal which is of low quality having relatively high ash content As new coal facilities come on stream, and with increased co-firing needs for older power stations with declining efficiencies, more (rather than less) mazut will be needed in the immediate future, even though there are, presently, programs under study to minimize the use of mazut for power generation purposes The relative consumption of coal, mazut and gas in the production of electrical and heat energy in Kazakhstan's power and heat production facilities is shown in the Exhibit 7 17 below

Exhibit 7.17
FUEL CONSUMPTION IN KAZAKHSTAN FOR PRODUCTION OF ELECTRICITY AND HEAT



The relationship between consumption of fuel and production of electricity and heat in Kazakhstan is depicted in Exhibit 7 18 below

Exhibit 7.18
RELATIONSHIP BETWEEN FUEL CONSUMPTION AND ELECTRICITY AND HEAT PRODUCED



The exhibit above indicates that, when present Kazakhstan's values of quantity of fuel consumed per unit output of electricity and heat are compared with those of developed countries, it is evident that Kazakhstan efficiency levels are lower, especially as far as the production of energy heat is concerned In essence, in Kazakhstan the power and heat industry uses much more energy per unit of electricity or heat output, than industrialized countries The exhibit, developed with data furnished by Kazakhstan Ministry of Energy and Coal, also indicates that the level of efficiency of fuel utilization is expected to improve in the future starting at about the year 2000

7.2.3 Energy Generation

In assessing the energy efficiency of the Kazakhstan power industry, as a whole, it is of special interest to compare the current energy use (i e BTU of fuel consumed) per unit of output (i e kWh of electrical power), called *specific energy consumption*, with that of a well-operated plant using modern energy-efficient technology (for example, in the USA) The efficiency of the modern technology is identified as the "standard " The gap between the specific energy consumption and the energy standard is, for the purpose of this report, the indication of the degree of obsolescence of the power plants' equipment and/or the inefficiency of the plants' operation (which is defined, herein, to include the energy transmission, distribution and metering to the ultimate users)

An initial step to a rational and meaningful energy saving process is the measurement of all the energy that enters and leaves the power plants or district heating facilities This process provides the needed incentive to chase the sources of energy waste and to eliminate such wastes from the equipment, process

or methodology adopted Moreover, such energy waste can also be associated with the management of the plant generating the electric or heat energy, or of the one which distributes it

Exhibit 7.19
ASSESSMENT OF KAZAKHSTAN POWER INDUSTRY

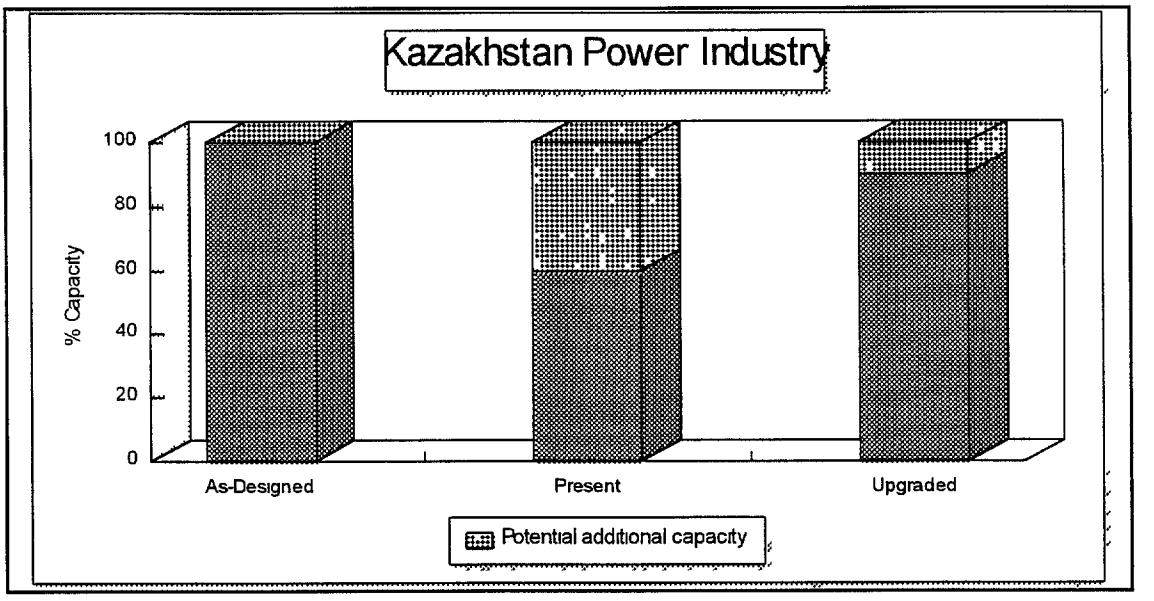


Exhibit 7 19 provides a graphic assessment of the status of Kazakhstan power industry The "As-designed" bar represents the rated original (100%) power capacity The "Present" bar constitutes the current level of power capacity, which is estimated to be about 65% of its original capacity Such decrease is due, mostly, to the "inefficiency" factors identified below If such deficiencies are corrected, Kazakhstan power plant capacity can reach a level very close to its original "As-designed" capacity In terms of actual numbers, an "upgraded" power industry in Kazakhstan can produce an additional 26 6 billion kWh of electricity Inefficiency factors include

- Plant Aging
- Equipment Deterioration
- Poor Coal Quality
- Lack of Proper Instrumentation
- Lack of Spare Parts
- Poor or Missing Insulation
- Corrosion/Erosion Problems
- Lack of Preventive Maintenance

Based on visits to some of Kazakhstan's power plants, such as Almaty TES-2 plant (see Annex L) and at the Dzhezkazgan and the Dzambul facilities, it seems that there are 3 levels of plant measurements and controls

- those associated with atmospheric steam and air pollution
- those internal to the various equipment and systems
- those associated with the production of electric power and heat energy (steam, hot water)

Of these three, the instrumentation associated with monitoring the production of electricity and heat energy appear to be somewhat in line with those existing in similar power plant facilities in the West, even though the efficiency and precision of Kazakhstan's instruments could be improved considerably In fact, typically in Kazakhstan, the electric energy is measured, in the control room, by station meters at the end of each shift, 2 times a day The heat energy is measured by measuring water flow and associated heating value, by utilizing instrumentation calibrated in units of energy flow

Considerable improvements are needed, on the other hand, on the other two categories of plant instrumentation and controls Of special concerns are also the lack of, or malfunction of, existing instrumentation on rotating equipment, particularly to monitor vibration on turbine generators It is of great concern that excessive vibration may result in decreased operating efficiency, inaccurate measurements and, eventually, in damaged equipment

The Kazakh Energy Resource Institute (KERI) has provided recommendations on energy savings devices to be adopted in an effort to improve the performance of Kazakhstan's energy-producing facilities These recommendations are described below

- Coal-dust precombustion chamber is being developed Such chamber will allow a non-mazut boiler to properly start-up and attain its designed performance even if poor coal quality fuel is utilized
- A compact air heater is being developed, to be installed in gas and mazut boilers, which will allow to reduce heat losses by 1-2%
- Special heat-resistant materials, able to reduce by 8-10% the power input, are being investigated
- Special devises designed to convert solar and wind energy to electric power are being studied and designed
- Studies for the preliminary design and for the construction of small hydroelectric plants are being made

7.2.4 Output Distribution

It was also reported that, in 1993, the energy losses in the transmission and distribution of electric energy in Kazakhstan was estimated at 9 26 billion kWh, or approximately 10 3% of the total power generated To replace such losses, 3 3 million tons of fuel have been consumed For comparison purposes, the amount of electric energy transmission and distribution losses in Canada are approximately 8% of the power generated It is estimated that, in Kazakhstan, the electrical power transmission and distribution losses can be reduced by about 4 percentage points (or, for 1993, 3 5 billions kWh, equivalent to 1 million tons of fuel), and that of the heat energy for district heating by 0 5% (or for 1993, 0 36 million Gcal, equivalent to 65 2 thousand tons of fuel)

The Gosenergonadzor State Energy Inspection Office reported that, in 1991, in Kazakhstan, the inefficient power consumption made up 11% of the total energy consumption, or about 9 billion kWh It was felt that such inefficiency could be minimalized, if not totally eliminated, by a more responsible and effective management

7.2.5 Potential Energy Savings

The table below provides a summary of the improvements and savings that can be realized in each area of the Kazakhstan power industry, if a comprehensive energy savings program, as outlined in this chapter, is implemented

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Potential Area of Improvement	Considerations	Estimated $Savings
Fuel	Present 5-7% higher Fuel Consumption	30 M$/year
Power Production[1]	5-15% improvement possible	400 M$/year
Transmission & Distribution	Present loss (11%) can be cut down by 4% minimum	95 M$/year
Consumption	Present inefficiency in power consumption is 11%	30 M$/year

From the above table it can be concluded that, if the identified inefficiencies existing in the fuel utilization, energy production, transmission, distribution, and consumption are eliminated or significantly minimized, in Kazakhstan's power industry, an approximate saving value of over 500 Million dollar a year can be realized

7.3 RECOMMENDED ENERGY SAVINGS MEASURES

Energy savings measures for the power sector are listed and described in this section according to three phases ***Phase 1*** (Short Term) the first 3 years from the start of the Energy Savings Program, ***Phase 2*** (Medium Term) the fourth year to the sixth year of the Program, ***Phase 3*** (Long Term) the next 12 years following the end of Phase 2

7.3.1 Phase 1: Short-Term Measures

The list of quick-payback measures below should be undertaken during Phase 1 for typical power plants in the Republic of Kazakhstan

- Install low NOx burners to control the mixing of the fuel and air and reduce NOx emission
- Change poorly operating valves on water, steam, and condensate systems to eliminate leaks from these systems Replace poorly designed/selected valves (type, capacity) with more functional ones to improve system performance
- Change/modify present instrumentation on various plant equipment to properly control/monitor boiler operation and systems performance
- Install oxygen analyzers

1 It is estimated that the potential savings of fuel *in the production phase only* of Kazakhstan (Kazakhstaenergo) Thermal Electric Stations (TES) is from 1 8 to 2 1 million tons/year, and in the heat energy producing facilities (for District Heating) is from 0 3 to 0 5 million tons/year Assuming an average fuel cost of $25 per ton, such savings is calculated at over $65 million per year

- Repair/replace poorly attached or missing insulation on piping systems Launch an extensive equipment and piping insulation program to repair and replace existing insulation in poor condition, and supplement existing insulation in good condition (as necessary)

- Replace/repair malfunctioning fans on cooling towers

- Install steam traps Develop and implement a steam trap selection and maintenance program

7.3.2 Phase 2: Medium-Term Measures

The medium term measures recommended to be undertaken during Phase 2 include

- Replace obsolete equipment, utilize gas turbines, HRSG (heat recovery steam generators), and more efficient heat cycles (such as cogeneration, combined cycle)

- Repower degraded plants to increase their power output and efficiency, reliability and service life ***Repowering will result in increased power output and efficiency, reliability and service life of an existing power plant.*** Repowering shall be considered one of the most important elements in upgrading and restructuring Kazakhstan's power industry, for the following reasons

  - Need for new capacity
  - Age distribution of existing units
  - Relatively high cost of building new plants comparing to repowering an existing one
  - Repowering has shorter lead time for construction than a new plant
  - Efficiency of existing capacity can be improved substantially
  - Repowering delivers competitive capacity at a fraction of its replacement cost

  Various repowering options are possible, among which the following are the most important

  Option A ***Partial repowering*** Combining existing plant systems and infrastructure and new equipment

  Option B ***Station repowering.*** Reusing of existing infrastructure such as buildings, water treatment systems, and fuel handling equipment, but not the original steam cycle

  Option C ***Site repowering.*** Reusing an existing site, but none of the existing equipment, with the possible reuse of infrastructure supporting the plant, such as power lines or water and fuel delivery systems

- Develop domestic capability to assure availability of spare parts

- Provide the necessary training and information to power industry personnel For technical personnel assigned to the operation of the plants, invest in a comprehensive training program to include the special topics such as impact of poor quality coal on overall boiler efficiency, burner operations, and maintenance and equipment maintenance practices

- Develop and implement a comprehensive Demand Side Management program Demand Side Management shall be concerned with the planning, implementation and monitoring of power and heat plants activities in Kazakhstan, to encourage consumers to modify their patterns of electricity and heat usage

- Improve and stabilize the quality and efficiency of the fuel utilized for power plants and district heating stations

7.3.3 Phase 3: Long-Term Measures

Long term measures are focused on upgrading and reconstructing Kazakhstan's power industry and reducing the dependence on imported electricity These measures include

- Replace the original boilers/steam generators with
  - Gas-turbine generators and heat-recovery steam generators (HRSG)
  - Atmospheric fluidized-bed boilers (AFB)
  - Coal-gasification combined cycle (CGCC) process
  - Pressurized fluidized-bed combined cycle (PFBCC) system

- Develop power industry equipment manufacturing and repair capability

- Adopt power industry related engineering and management codes, standards and regulations accredited by the ISO (International Standardization Organization)
  - Building Codes
  - Manufacturing, Design, Construction Standards
  - Standards and Codes which shall provide economic incentives to achieve the power sector's goals
  - Government, Producers, Consumers to agree on acceptable standards

- Proceed with development and construction projects that provide the highest return to Kazakhstan These projects might include the following

  - Put into operation two plants at Ekibastuz SES-2
  - Continue the reconstruction of South-Kazakstan SRES
  - Provide additional power capacity at Ust-Kamenogorsk, Atyrau, Akmola, Karaganda and Aktau
  - Construct a new plant at Aktubinsk HES
  - Complete the construction of Turgaisk SRES and heat electric stations in Taldykorgan, Semipalatinsk, Uralsk, Karachagansk, Kostanay, and Ust-Kamenogorsk
  - Install power transmission lines to southern and western regions of Kazakhstan
  - Install required 1150 and 500 Kv transmission lines for Ekibastuz, Agadyr, South Sres, Zhambul, Uralsk, Karachagansk, Aktubinsk, Almaty, Taldykorgan, Kokchetau, Petropavlosk, Akmola, Zheskazgan and others

- Maximize hydropower capabilities where possible

- Develop non-fossil sources of energy, such as wind and solar power

7.4 ESTIMATED ENERGY SAVINGS

The estimated level of investments and anticipated savings for each of the three Phases discussed in the previous section are presented in Exhibit 7 20

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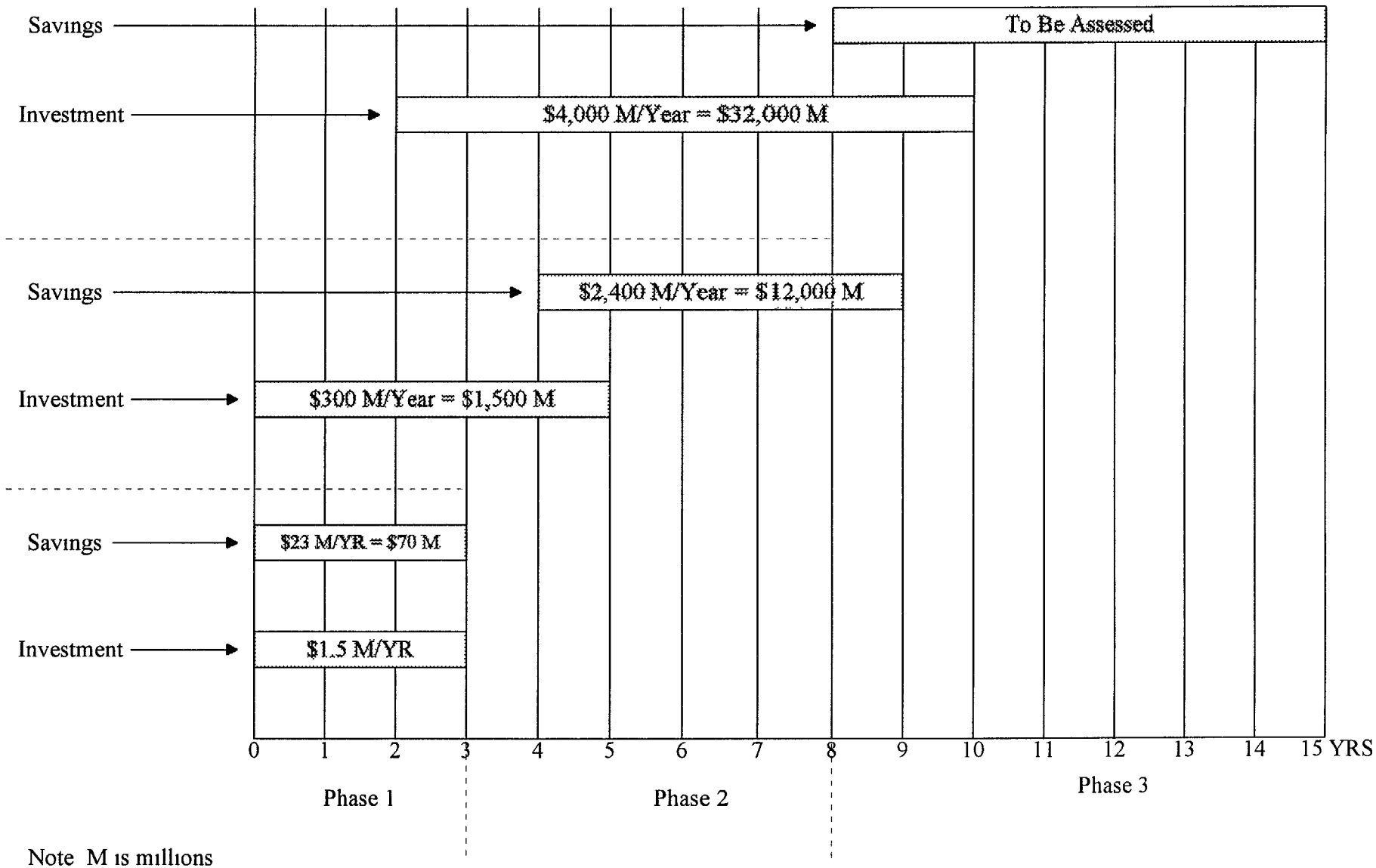
Exhibit 7.20
RECOMMENDED INVESTMENTS AND POTENTIAL SAVINGS IN KAZAKHSTAN POWER INDUSTRY



Note M is millions

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Phase 1: In this phase, small investments made to improve the generation of electricity can result in appreciable return on the investment An investment of $5 million (US dollars) is recommended to procure and install NOx burners and oxygen analyzers, to replace small mechanical equipment, (such as valves, strainers and steam traps), and selected plant instrumentation Such plant improvements are expected to result in an annual savings of $23 million per year throughout the Kazakhstan power industry, or a total savings of $70 million over the three year period

Phase 2: In this phase, improvements are recommended in three major areas (1) quality and efficiency of the fuel (mainly coal) utilized for power generation, (2) replacing major plant equipment (repowering programs), and (3) Demand Side Management program An aggregate total investment of $1,500 million is recommended, spread over a 5-year period, or a $300 million per year levelized effort Improvements in fuel utilization, power generation and distribution, and better control of electricity use from the consumer's side, are anticipated to result in an annual savings for the power industry, of about $2,400 million a year, or, $12,000 million over the 5 years

Phase 3: In this last phase, major improvements are recommended in all sectors of the power industry, including the infrastructures needed to support the construction, operation, and maintenance of all types of (non-nuclear) electric power-producing plants Of significant importance are the following components of the improvement effort (1) capability to manufacture most components of the plants, including gas-turbines, (2) institutional strengthening to include regulatory agencies, government, codes and standards organizations, and financial institutions, and (3) comprehensive power plants' reconstruction program, including building new plants and transmission lines, and the development of wind, solar and other non-traditional power generation concepts An aggregate total investment of $32,000 million is recommended, spread over an 8 to 10 year period, or a $4,000 million per year levelized effort Improvements in overall power generation and distribution are anticipated to result in electric power self-sufficiency for Kazakhstan However a dollar saving value, in terms of currency, has not been estimated, due to the numerous unknowns

The Kazakhstan Ministry of Energy and Coal has developed the following preliminary program of energy savings for the Kazakhstan power industry This program is similar to the Phase 3 discussed above Anticipated savings are depicted in Exhibit 7 21

Program	*Anticipated Resources Savings* (1,000 Tons of Fuel Equivalent)
Replacement of Old Power Station with New Power Station in 1997	400
Reconstruction of Ekibastuz Ges	1600
Refurbishing Major Equipment at Existing Power Stations in 1995-2010	1348
Replacing Pipelines and Equipment Insulation in 1995-2010	252
Decreasing the Power Losses in Energy Generation, Transmission and Distribution in 1995-2000	1600
Total Anticipated Savings	***5200***

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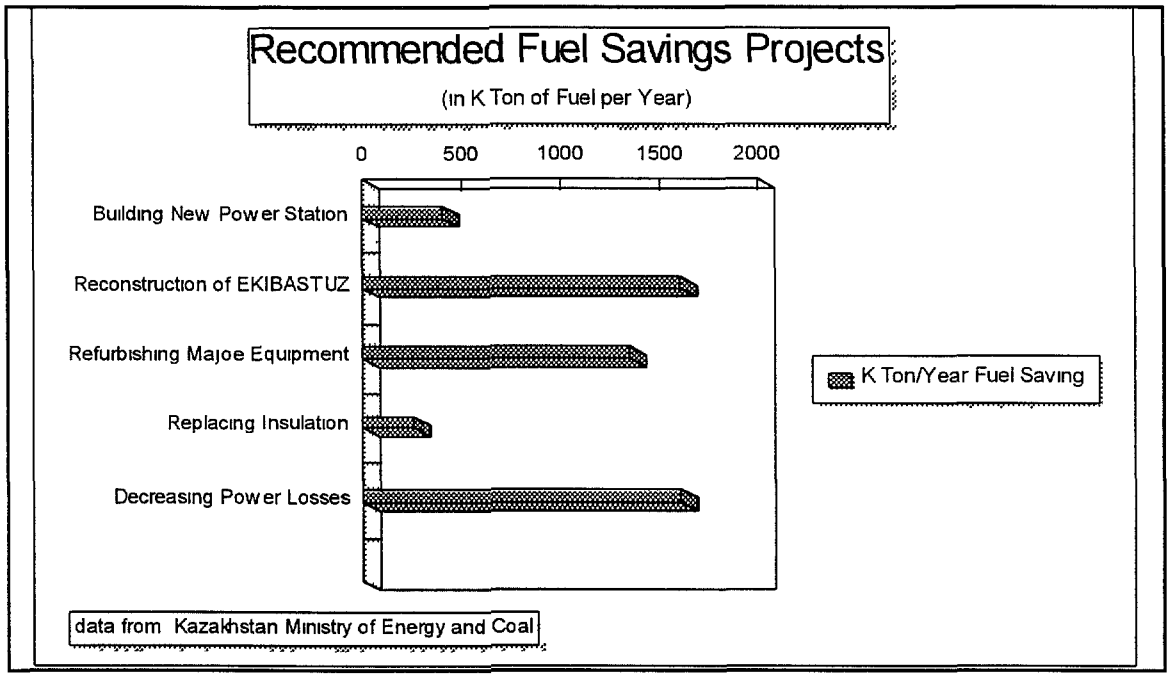
Exhibit 7.21
POWER INDUSTRY FUEL SAVINGS PROJECTS RECOMMENDED BY KAZAKHSTAN MINISTRY OF ENERGY AND COAL



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Chapter 8
DISTRICT HEATING SECTOR

District Heating systems are generally very well developed in Kazakhstan, and particularly so in Almaty As a whole, Kazakstan's district heating systems are relatively inefficient Due to both institutional and technical factors, such as government ownership of the system, energy subsidies, and the legacy of centralized planning, the importance of energy efficiency has long been ignored Similarly, the billing system used by the district heating enterprises throughout the Republic, which is based on estimated average usage within the entire district, has further eliminated incentives for end-users to implement meaningful energy conservation measures Most equipment is relatively outdated There are few measuring devices or instruments for monitoring either supply or demand (end-user) energy On the demand side, little individual metering is installed and operating In general, no metering devices appear to exist presently to measure district heating hot water at users' facilities (houses, stores, buildings, etc), except in very large commercial/industrial facilities This prevents any kind of efficiency savings possibility, because, in order to save energy, one must be able to measure it Automation of the heat distribution is essential for proper management of the whole process Even where monitoring instruments are available, few are utilized on a regular basis On the supply side, monitors and controls for automatic combustion are absent from virtually all facilities, and pollution monitoring and control equipment are also non-existent Another serious problem encountered is the chronic lack of spare parts for plant equipment and the absence of budgetary provisions to upgrade older facilities

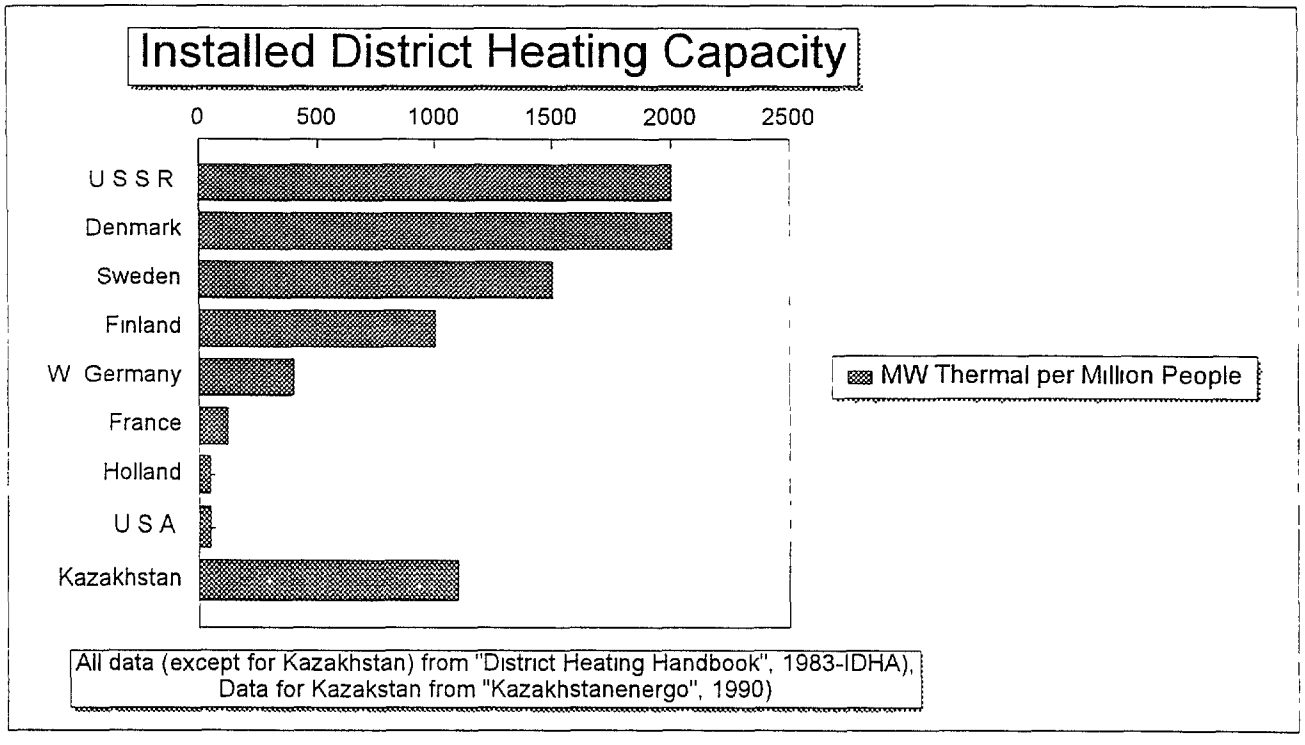
The assessment of the Kazakhstan district heating industry has been done utilizing data and information obtained from the Almaty District Heating System Enterprise (AHSE) and its distributor, the Almaty Municipal Authority (AGTKE-Almaatagorteplokommunenergo) This information represents a reliable cross-sectional view of the overall district heating industry of Kazakhstan (For detailed information on the Almaty District Heating System refer to the "Energy Efficiency Audit Report on Almaty Heating System Enterprise, IRG-Washington, DC, June 1993)

Kazakhstan is considered to be one of the largest users of district heating in the world, as shown in Exhibit 8 1 In Kazakhstan, a considerable portion of the domestic heat is provided by district heating through cogeneration Therefore, many of the considerations presented in Chapter 7 on the power sector are applicable to this Chapter on district heating

8.1 DISTRICT HEATING OVERVIEW

In Almaty, the district heating system is unique in both its supply and end-use configurations The heart of the system is a mixing station which receives hot water from two cogeneration plants The supply configuration then utilizes this heated make-up water from the warmed cooling water of the steam turbine condensers at the cogeneration plants Hot water and industrial steam are provided by several sources Much of the thermal energy used is supplied by two cogeneration stations (TES-1 and TES-2), while three district boiler houses and one independent boiler house provide the balance

Exhibit 8.1
INSTALLED DISTRICT HEATING CAPACITY



For end users of system heat, the circulating hot water serves both space heating and domestic consumption functions Approximately, 23,000 to 27,000 m^3 of hot water are pumped through this loop of the system hourly, and as much as 7,500 m^3 of make-up water is pumped trough the circulating loop each hour More than 70% of this hot water is sold by the Almaty District Heating System Enterprise (AHSE) to one organization, the Almaty Municipal Authority (AGTKE) which, in turn, distributes the hot water to end users through its own networks The entire AHSE system covers a territory spanning 15 km east to west and 10 km north to south, and serves most of the 1 2 million people living in Almaty The AHSE, established in 1960, was constructed in stages as demand grew Consequently, while some pipelines and connected equipment are relatively new, others are more than 25 years old

TES-1 was completed in 1935, and is comprised of six steam boilers each producing 420 gigajoules (GJ) of power and 160 metric tons (MT) of steam per hour The station has a total electric power capacity of 145 megawatts (MW) , and a total thermal capacity of 920 MW There are also 3 turbines which are capable of producing 435 MW of power Base-load boilers at this station, which generates 40 to 60% of the total power capacity, are fueled by pulverized coal from the Karaganda region Conversely, the peaking-load boilers are fired by natural gas and heavy fuel oil (mazut) Approximately 2,500 m^3 of hot water is produced hourly at this station This hot water originates as cooling water from the turbine condensers, which is then reheated using double extracted steam to maintain an average temperature of 150 degrees Celsius The average steam load of this station is 220 MT/hour, with a maximum of 336 MT and a minimum of 105 MT The hot water load has a maximum flow of 2,800 m^3/hour and a minimum of 2,240 m^3/hour

TES-2, constructed in the 1980's, consists of 7 boilers, with individual capacity of 480 GJ per hour Each of these seven boilers produce 420 MT of steam per hour at a pressure of 140 atmosphere and a temperature of 540 degrees Celsius There are six turbines in this facility, 2 with a capacity of 110 MW.

3 with 80 MW, and 1 with 50 MW The total electric power capacity of this station is 510 MW, while its total thermal capacity is 1,000 MW This station produces 5,000 m^3 per hour of hot water at 150 degrees Celsius by reheating cooling water from the condenser Base-load boilers generate 40% to 60% of the total thermal output and also fueled by pulverized coal Mazut and natural gas is burned in the hot water/heating boilers, while natural gas is used in the peaking (hot water) boilers The average steam load at this facility is 385 MT per hour, with a maximum of 700 MT and a minimum of 624 MT The maximum hot water load is 5,600 m^3 per hour

On the average, 3 to 4 km of the older, small-diameter pipelines are reconstructed annually In addition, annual upgrades are made to 2 5 to 3 km of older pipelines in the heating system, and to 3 or 4 boilers, another 4 to 5 boilers are modernized each year The present AHSE maintenance program calls for the replacement of approximately 25 km of pipeline each year to rehabilitate its piping network

In the near future, AHSE plans to construct an additional district boiler house in the northwestern sector of the city to accommodate the increased demand resulting from a number of new residential areas In addition to hot water and/or steam supplied from TES-1 and TES-2, three district boiler houses and one independent boiler house service peak-load needs and major industrial steam customers These boiler houses range in age from 2 to 30 years and are fueled by natural gas and mazut

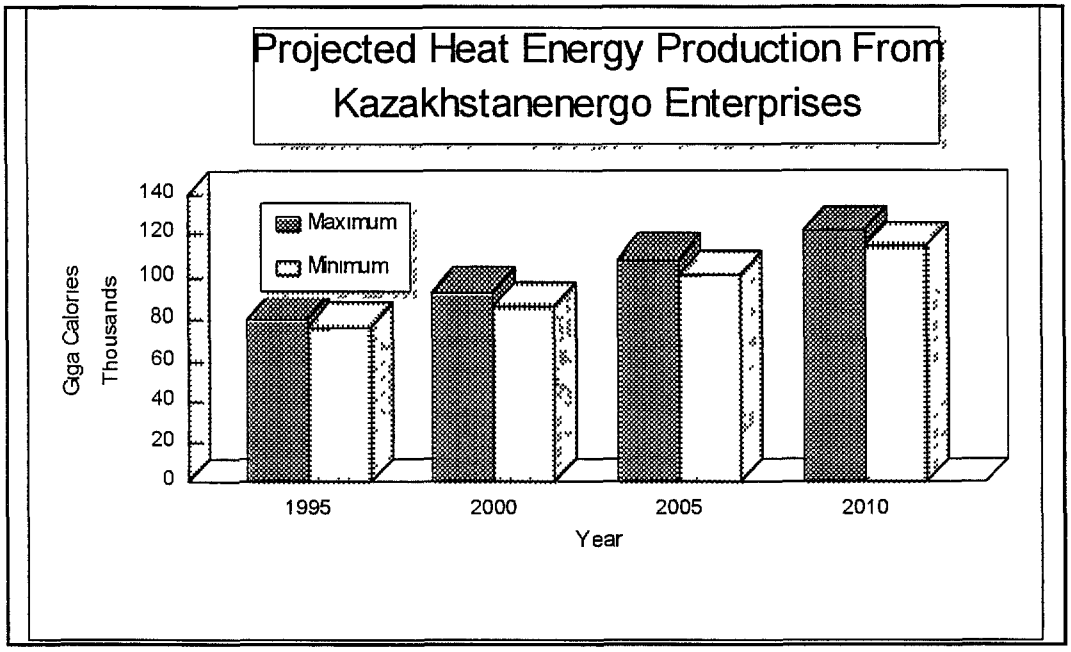
The AHSE has 365 industrial customers which are government-owned enterprises, although, in the near future, some of these enterprises may be privatized The growth rate for energy demand, as currently contracted, is approximately 2% annually Little data are available regarding the characteristics of AHSE industrial customers Most industrial equipment is outdated, and the facilities need varying degrees of repair Hot water and steam usage among industrial customers is metered by the receiving station, but controls placed on their usage are rare To date, few initiatives to improve energy efficiency have been implemented, or even considered, at industrial facilities in Kazakhstan This is partially explained by the history of tariff-subsidies, which did nothing to encourage the conservation of energy, since investments in energy efficiency did not have sufficient economic payback On the demand side, energy conservation is not practiced nor emphasized, due to state ownership and the lack of individual metering On the production side, lack of monitoring instrumentation and other energy-efficient equipment has limited energy efficiency initiatives

AHSE currently has 83 non-industrial commercial enterprises as customers, as well as 706 commercial customers, including schools, offices, and hospitals The growth rate of energy demand within this sector is approximately 3% per year Commercial customers of AHSE generally require utility services for space heating, ventilation, and hot water However, AHSE delivers hot water only to the "gates" of the commercial installation, while the heat-energy monitoring and auditing instruments needed to monitor efficiency levels are installed at the end-use receiving station There are currently 258 residential customers connected to the AHSE system, and 491 residential customers connected to the AGTKE distribution system

As mentioned, the existing energy-pricing system offers little incentive for customers to conserve energy Moreover, since residential end-users are not individually metered, conservation by specific individuals has little effect on the overall cost and consumption of heat Energy efficiency appears to be a completely foreign concept to most residential customers

Based on information and data available from the Kazakhstanenergo Enterprises, the anticipated production and distribution of heat energy for 1995-2010 are shown in Exhibit 8 2 below

Exhibit 8.2
PROJECTED HEAT ENERGY PRODUCTION FROM KAZAKHSTANENERGO ENTERPRISES



In the assessment of Kazakhstan's district heating industry, the following specific problem areas have been identified

- Lack of spare parts for plant equipment
- No budgetary provisions to upgrade older facilities
- Lack of gas analyzers, heat meters flow meters, thermostatic valves, metering and control devices
- Mixer stations produce only hot water
- Coal used to fuel the station is approximately 40% ash content by weight (with heating value of 6,000 Btu/lb)
- Some pipelines in the district heating systems are 25 years old
- Difficulty in localizing damaged or major leakage areas
- Trouble in maintaining the system's hydraulic pressure and temperature levels
- Insulation materials require replacement
- 3 to 5% of total energy inputs could be conserved if automatic control systems were installed to replace manual systems
- Lack of automatic instrumentation and control equipment
- Most visible pipelines have insulation partially or completely exposed, with the covering sheets missing or loosely attached
- Several places have been identified where steam was escaping within the processing and drying shops
- Instruments at both the hot water and steam receiving station (flow rates, temperature and pressure levels) are outdated

Energy losses within the district heating system are primarily caused by

- Water leaks, which are identified by visual inspection, by measuring the ground surface temperature, by monitoring the pressure drops, or by analyzing the flow rates between the sections Since both AHSE and AGTKE are open-loop heating systems, it is difficult to separate those water losses due to leaks from those due to domestic consumption According to AHSE officials, water losses within the system due to leaks are estimated to be approximately 500 m^3 per hour under normal conditions, almost 10% of the total make-up water of 7,500 m^3 per hour

- Failure to meter individual energy usage (industrial, commercial, residential) Approximately 10% of the industrial customers in Kazakhstan have the flow meters necessary to measure hot water/steam flow rates All other customers are unable to measure individual heat consumption Customers are generally charged a flat rate for heat, resulting in no incentive to conserve heat Many regulate the temperature of a room by opening a window, even in the middle of winter It is estimated that as much as 25% of the thermal energy delivered by the district heating system is lost in this manner

- Inadequate insulation Damaged and inadequate insulation around exposed pipeline can be detected using an infrared thermometer Damaged or inadequate insulation around exposed pipelines are a major source of heat loss It is also a problem to securely attach such insulation onto the pipelines

- Throttling of constant-speed pumps for control of flow rates

- Excessive changes in pressure Obstructions in the distribution system (accidental, gradual or due to faulty design, inadequate valves, undersized pipelines, too many fittings or bypasses) can cause excessive changes in pressure and can cause waste of energy

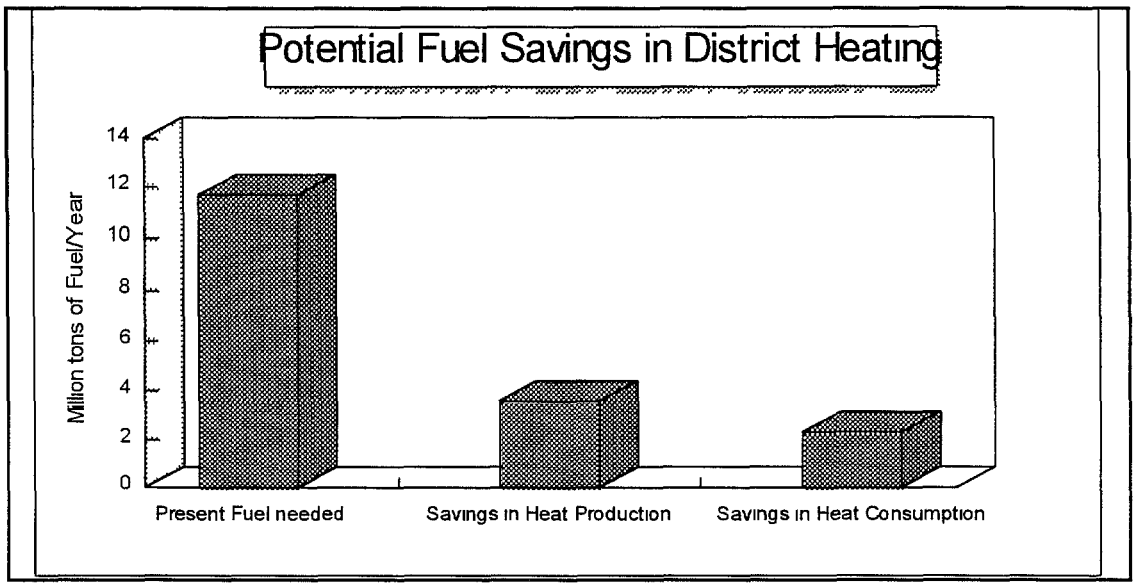
8.2 ENERGY SAVINGS IN DISTRICT HEATING

There is strong evidence that, throughout Kazakhstan district heating systems, a significant potential exists for energy savings in all segments of district heating operation There are also opportunities to satisfy the growth in demand for electric power within the district heating systems through the cogeneration of electricity Further, since most hot water boilers within the systems are fired by natural gas, they would be better suited for gas turbines with combined cycle capabilities

Energy conservation, which can be encouraged through the removal of energy subsidies and the institution of rational, individual billing, has the potential to achieve energy savings of 30% among all end-users On the production and distribution side, improvements in efficiency resulting from the installation of modern instrumentation and controls (and other measures described below) could achieve savings of almost 20% A total reduction of approximately 50% in overall energy use to Kazakhstan district heating systems is possible

Utilizing the values reported by Kazakhstanenergo of 181 Kg/G Calories for the relative fuel consumption for the production of heat (for 1993) and of 63,795,000 G Calories of heat produced in 1993, the savings can be calculated to be approximately 5 8 million tons of fuel per year Therefore, assuming an average fuel cost of $25 per ton, a saving of $145 million a year can be realized Such potential fuel savings are quantified in Exhibit 8 3 below

Exhibit 8.3
POTENTIAL ENERGY (FUEL) SAVINGS IN KAZAKHSTAN DISTRICT HEATING



8.3 RECOMMENDED ENERGY SAVINGS MEASURES

Based on all above described considerations, it is recommended that the following measures be implemented in the National Energy Savings Program for Kazakhstan Such measures can be classified as 1) low-cost, short/medium-term measures, and 2) long-term measures

8.3.1 Low-Cost, Short/Medium-Term Energy Savings

The following low-cost energy savings measures are recommended to be implemented, in the short/medium-term (1 to 5 years), for the District Heating systems of Kazakhstan

- Install microprocessors which will measure and monitor signals of flow and heat rates of thermal production boilers, hot water distribution lines and transportation pumps, and automatic control and manage the supply to, and demand from, mixing stations
- Initiate/continue the program to install flue gas oxygen analyzers to regulate the amount of excess air for optimum combustion efficiency of the hot water boilers
- Install non-contact type water flowmeter, capable of monitoring water flow ranging from 5,000 to 50,000 cubic meters per hour
- Install heat meters to measure and control the quantity of heat used in space heating, ventilation, and utility consumption of individual customers
- Install or replace steam traps in steam lines going to industrial users or in boiler plants
- Repair/replace damaged/missing insulation around pipelines

The above measures will require an overall investment estimated at 12 9 million dollars and will result in an estimated savings of approximately 5 7 million tons of fuel per year

8.3.2 Long-Term Measures

The measures listed below are recommended to be implemented in the long-term range (5 to 10 years) for the District Heating industry of Kazakhstan

- Install a more efficient corrosion protection system for hot water pipelines, since they have a history of failure due to both inside and outside corrosion problems

- Install gas turbines on hot-water boilers for a combined cycle cogeneration process The current, artificially low electricity prices and the uncertainty of future natural gas prices and supplies (now imported from Uzbekistan) appear to make investments in combined cycle gas turbines somewhat difficult in the very short term Nevertheless, the medium and long-term outlook for this option is very attractive, particularly with full development of the Tengiz and other oil/natural gas fields in northwestern Kazakhstan, which promise to yield significant energy resources through newly formed joint ventures with Western companies

The above long-term measures will require an investment of hundreds of millions of dollars However, based on past experience in the United States and other highly industrialized countries, their return on the investments, as well as the resulting savings in fuel utilization and overall efficiency improvements in the overall district heating industry, will be significant

8.4 ESTIMATED ENERGY SAVINGS

The overall recommended level of investments and estimated savings for Kazakhstan District Heating industry are identified in Exhibit 8 4, below

Exhibit 8.4
SAVINGS FOR KAZAKHSTAN DISTRICT HEATING INDUSTRY

Phase	Recommended Measures	Investment	Savings
Short/Medium-Term	See Low-Cost Measures identified in Section 8 3 1	$ 12 9 million	5 7 million tons of fuel per year
Long-Term	See Long-Term Measures identified in Section 8 3 2	(not determined)	(not determined)

Chapter 9
FERTILIZER INDUSTRY

9.1 INTRODUCTION

In November 1994 Vladimir Peer, Energy Conservation Manager at Foster Wheeler USA Corporation, and Nina P Lubchenco, Chief of Organic and Polymer Industries for Kazakhstan's Ministry of Industry and Trade, visited for several days the joint-stock holding company Karatau in Dzambul, Kazakhstan The purpose of the visit was to perform a preliminary energy audit of the plants and to present a seminar on energy savings to the plant technical staff

The Karatau holding company has three joint-stock companies in Dzambul NODFOS, Superphosphate and Hymprom During the visit only the first two plants were in operation, as Hymprom had been shut down for renovation

9.2 DESCRIPTION OF PLANTS

9.2.1 Joint-Stock Company NODFOS

The NODFOS plant produces three main products
- Yellow phosphorus
- Phosphoric acid
- Sodium tripolyphosphate

Yellow Phosphorus

The elemental phosphorus is produced by the Electric Furnace process The phosphate rock is reduced with carbon (coke) using silica as a slagging agent[1] The raw materials are moisturized and then mixed and agglomerated for intimate contact The agglomerates are dried on metallic conveyors at 1,100 - 1,200°C in a natural gas fired furnace

The dried agglomerates are fed to the electric furnace, where the heat of reaction, which is endothermic, is generated by the resistance of the raw materials to the electric current The reaction occurs at about 1,500-1,800°C Phosphorus and carbon monoxide off-gases are cleaned in an electrostatic precipitator to remove the dust and then are cooled with water sprays to condense phosphorus Phosphorus settles in a separate liquid layer below the water and is pumped to storage The carbon monoxide can be burned for its fuel value By-products are recovered as slag and ferrophosphorus (formed from iron impurities in the phosphate rock)

The yellow phosphorus is used in production of red phosphorus, ammunition, pyrotechnics, phosphoric acid and various inorganic and organic phosphoric compounds The slag is used in cement production while the ferrophosphorus is used in the metallurgical industry for special alloys The yellow phosphorus

1 The basic reaction is

$$CaF_2 \bullet 3\ Ca_3\ (PO_4)_2 + 9\ SiO_2 + 15C \rightarrow 9\ (CaO \bullet SiO_2 \bullet 1/9\ CaF_2) + 3\ P_2 + 15$$

molten slag *gas*

is sold mainly on the international markets A relatively small amount is consumed inside the plant for phosphoric acid production The ferrophosphorus is sold also on international markets while the slag is sold on the domestic market

Phosphoric Acid

Elemental phosphorus is burned in air, inside a stainless steel combustion chamber, to yield phosphorus pentoxide Phosphoric acid is then produced by absorbing the pentoxide in water [2] Both reactions are very exothermic, requiring large quantities of cooling water to reduce corrosion and thermal stress in the processing equipment

The principal applications for thermic phosphoric acid are in the production of detergents, food additives, pharmaceuticals, fertilizers and in photography

Sodium Tripolyphosphate

The sodium tripolyphosphate is produced by reacting phosphoric acid with sodium carbonate in aqueous solution and then calcining the product at temperatures above 250°C to eliminate the water [3]

The sodium tripolyphosphate is used in detergents and water treatment It is sold mainly on the domestic market

9.2.2 Joint-Stock Company "Superphosphate"

The Superphosphate plant produces three main products

- Ammophos
- Tricalcium Phosphate
- Sulfocoal

Ammophos

Ammophos is made by reacting phosphoric acid with ammonia in aqueous solution The ammophos solution is injected with compressed air in a high temperature, natural gas fired furnace The product is

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2 The basic reactions are

$$P_4 + 5\ 0_2 \rightarrow 2\ P_2O_5$$

$$2\ P_2O_5 + 6\ H_2O \rightarrow 4\ H_3PO_4$$

3 The basic reaction is

$$6\ H_3PO_4 + 5\ Na_2CO_3 \rightarrow 2\ Na_5P_3O_{10} + 9\ H_2O + 5\ CO_2$$

granulated at about 600°C [4] The phosphoric acid is produced in the plant by decomposition of the phosphate rock with sulfuric acid diluted in a large excess of phosphoric acid [5]

Ammophos is used as fertilizer and sold mainly to China

Tricalcium Phosphate

The tricalcium phosphate is produced directly from phosphate rock which is first moisturized and granulated, and then heated at 1,400-1,500°C in a natural gas fired furnace The reaction proceeds through hydration of the ore and release of hydrogen fluoride which is absorbed in calcium hydroxide producing calcium fluoride as a waste byproduct [6]

Tricalcium phosphate is used as animal feed supplement and as phosphate fertilizer It is sold mainly to the former Soviet Union Republics

Sulfocoal

Sulfocoal is made by treating a special type of coal with sulfuric acid oleum

The sulfocoal is used for water treatment and it is sold to other former Soviet Union Republics

Plant Capacity

Information on plant capacities, recent production rates, and energy consumption were obtained from the plants, Ministry of Industry and Trade, and Ministry of Economy Similar information was received from the above ministries for the joint-stock company "Phosphorus" in Chymkent, which is the only other company in Kazakhstan manufacturing phosphate products

The various unit capacities in each plant are shown in Exhibit 9 1

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4 The basic reaction is

$$H_3PO_4 + NH_3 \rightarrow (NH_4)\ H_2PO_4$$

5 The basic reaction is

$$CaF_2 \bullet 3\ Ca_3\ (PO_4)_2 + 10\ H_2SO_4 + n\ H_3PO_4 \rightarrow 10\ CaSO_4 + (n+6)\ H_3PO_4 + 2\ HF$$

6 The basic reaction is

$$CaF_2 \bullet 3\ Ca_3\ (PO_4)_2 \rightarrow 3\ Ca_3\ (PO_4)_2 + CaF_2$$

Exhibit 9.1
UNIT DESIGN CAPACITIES

Company	Major Products	Year Started	Design Capacity (Tons/Yr)
"NODFOS" Dzambul	Yellow Phosphorus	1978	230,000
	Phosphoric Acid	1978	120,000
	Sodium Tripolyphosphate	1978	120,000
"Superphosphate" Dzambul	Ammophos	1956	83,000
	Tricalcium Phosphate	1956	59,000
	Sulphocoal	1956	18,000
"Hymprom" Dzambul	Phosphoric Acid	1968	600,000
	Diammonium Phosphate	1968	168,000
	Silicium Manganese	1993	25,000
	Ferrous Manganese	1993	25,000
"Phosphorus" Chymkent	Yellow Phosphorus	1966	145,000
	Phosphoric Acid	1966	394,500
	Sodium Tripolyphosphate	1966	360,000

Source Ministry of Industry and Trade

Production Rates

The production rates of recent years are shown in Exhibit 9 2

Exhibit 9.2
PRODUCTION RATES

Company/Product	Annual Production		
	1990 (Tons/Yr)	1993 (Tons/Yr)	1994 (Tons/Yr)
NODFOS			
Yellow Phosphorus	155,500	37,708	27,409
Phosphoric Acid	Not Available	39,676	34,128
Sodium Tripolyphosphate	Not Available	44,319	33,622

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Company/Product	Annual Production		
	1990 (Tons/Yr)	1993 (Tons/Yr)	1994 (Tons/Yr)
Superphosphate			
Ammophos	89,200	38,021	26,900
Tricalcium Phosphate	8,400	29,829	10,700
Sulphocoal	17,200	7,337	4,800
Hymprom			
Diammonium Phosphate	90,100	15,800	6,100
Silicium Manganese	—	80	2,000
Ferrous Manganese	—	2,000	8,900
Phosphorus			
Yellow Phosphorus	157,900	34,700	85,000
Phosphoric Acid	291,600	71,300	170,200
Sodium Tripolyphosphate	318,200	77,600	97,300

Source Ministry of Economy, NODFOS and Superphosphate companies

As shown in Exhibit 9 2, the production of these plants decreased continuously from 1990 (54 to 100% plant utilization) to 1994 (12 to 43% plant utilization) This does not include the diammonium phosphate which was shut down in 1994

The main reason for this decline in production is the decrease in sales due to the following factors

- High cost of energy
- Unreliable power supply
- High cost of transportation (especially to Europe - $40/ton)

These factors resulted in high, noncompetitive production costs for the products on the international markets

Some of the implications of this decline in plant utilization, like the increase in the specific energy consumption, will be discussed in the next sections of this chapter

Energy Prices

The prices of various fuels/energy sources are listed in Exhibit 9 3

Exhibit 9.3
ENERGY PRICES (October 1994)

Fuel/Energy Source	Company	
	NODFOS	Superphosphate
Natural Gas	$100 00/1,000 M^3	$71 77/1,000 M^3 (1)
Fuel Oil	$60 00/Ton	$82 02/Ton (1)
Electricity	$27 70/1,000 KWH	$33 42/1,000 KWH (1)
Steam	$11 07/Gcal (1)	$22 55/Ton (1)

Source NODFOS and Superphosphate companies
(1) Exchange rate basis US $1 00 = 48 77 Tenge

Although the prices are slightly different between the two companies, for consistency of the energy consumption analysis, only the NODFOS prices will be used throughout this report

Energy Consumption

Comparative energy consumptions during 1993 versus 1990 for various plants and products are shown in Exhibit 9 4

Exhibit 9.4
ENERGY CONSUMPTION

Company/Product	Annual Energy Consumption					
	1990			1993		
	Electricity (Mil/kWh)	Natural Gas (Mil/M^3)	Steam (Thous. Gcal)	Electricity (Mil/kWh)	Natural Gas (Mil/M^3)	Steam (Thous Gcal)
NODFOS						
Yellow Phosphorus	2,698	41 7	280 7	800	18 1	262 6
Superphosphate						
Ammophos	80	33 1	124 0	42	13 1	87 1
Tricalcium Phosphate	90	132 7	120 6	60	72 7	74 7
Sulphocoal	—	1 6	10 3	—	0 7	8 4

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Company/Product	Annual Energy Consumption					
	1990			1993		
	Electricity (Mil/kWh)	Natural Gas (Mil/M³)	Steam (Thous Gcal)	Electricity (Mil/kWh)	Natural Gas (Mil/M³)	Steam (Thous Gcal)
Hymprom						
Diammonium Phosphate	—	7 6	—	—	2 4	—
Silicium Manganese	—	—	—	—	0 09	—
Ferrous Manganese	—	—	—	20	0 6	—
Phosphorus						
Yellow Phosphorus	2,584	53 0	364 7	702	18 2	225 2
Phosphoric Acid	66	—	115 7	37	—	107 0
Sodium Tripolyphosphate	75	79 8	124 9	41	21 7	97 3

Source Ministry of Economy

A review of the specific energy consumption (energy per unit product) in yellow phosphorus production is shown in Exhibits 9 5 and 9 6

The typical US energy consumption per tonne of phosphorus, at 90% plant utilization, is 14,157 KWH, 72 5 Kg steam and 6 2 M^3 natural gas, which correspond to a total of 48 82 G cal/tonne

Exhibit 9.5
SPECIFIC ENERGY CONSUMPTION ASSOCIATED WITH YELLOW PHOSPHORUS PRODUCTION

Company	1990				1993			
	Plant Utilization (%)	Electricity (KWH/t)	Fuel [1] (Gcal/t)	Total Energy (Gcal/t)	Plant Utilization (%)	Electricity (KWH/t)	Fuel [1] (Gcal/t)	Total Energy (Gcal/t)
NODFOS	68	17,350	3 98	63 66	16	21,333	10 92	84 31
Phosphorus	109	16,364	5 04	61 33	24	20,231	10 75	80 34

[1] Fuel values include natural gas and steam consumptions

Exhibit 9.6
INCREASED ENERGY CONSUMPTION ASSOCIATED WITH YELLOW PHOSPHORUS PRODUCTION FROM 1990 TO 1993

Company	Decrease in Plant Utilization	Increase in Electricity Consumption	Increase in Fuel Consumption [1]	Increase in Total Energy Consumption		Increase in Energy Cost [2]
	(%)	(KWH/t)	(Gcal/t)	(Gcal/t)	(%)	($/t)
NODFOS	52	3,983	6 94	20 65	32	189 32
Phosphorus	85	3,867	5 71	19 01	31	172 30

[1] Fuel values include natural gas and steam consumptions
[2] Cost premises

$ 27 70/1,000 KWH
$100 00/1,000 M^3 Natural Gas
$11 07/Gcal Steam

As expected, it can be seen in Exhibit 9 6 that the significant decrease in plant utilization (52 to 85%) resulted in major increases in the energy consumption for yellow phosphorus manufacture (31 to 32%)

Even at the maximum plant utilization of 1990, the electrical consumption per tonne for the Phosphorus company is about 16% higher than the typical electrical consumption for USA companies Similarly the total energy consumption per tonne of phosphorus is about 26% higher than for USA companies

A similar trend is shown in Exhibit 9 7 for the phosphate products manufacture

Exhibit 9.7
INCREASED ENERGY CONSUMPTION IN PHOSPHATE PRODUCTS MANUFACTURE FROM 1990 TO 1993

Company	1990		1993		1990 to 1993			
	Plant Utilization	Energy Consumption	Plant Utilization	Energy Consumption	Decrease in Plant Utilization	Increase in Energy Consumption		Increase in Energy Cost [1]
	(%)	(Gcal/t)	(%)	(Gcal/t)	(%)	(Gcal/t)	(%)	($/t)
Superphosphate								
- Ammophos	107	7 50	46	8 89	61	1 39	19	16 18
- Tricalcium Phosphate	99	25 83	51	29 26	48	3 43	13	34 90
Hymprom								
- Diammonium Phosphate	54	0 68	9	1 23	45	0 55	81	6 75
Phosphorus								
- Sodium Tri-polyphosphate	88	3 22	22	5 33	66	2 11	66	20 53
- Phosphoric Acid	74	1 18	18	3 28	56	2 10	178	20 30

[1] Cost premises

$ 27 70/1,000 KWH
$100 00/1,000 M^3 Natural Gas
$11 07/Gcal Steam

The reduction in phosphate products plant utilization (45 to 66%) resulted in even larger increases in the specific energy consumption (13 to 178%) than in phosphorus production
Although several specific energy consumption data provided by NODFOS and Superphosphate companies are 10-15% lower than those obtained from the Ministry of Economy, they show a similar trend in the increased energy consumption

9.3 ENERGY SAVING MEASURES

Based on the energy consumption data in the Dzambul fertilizer companies and typical energy conservation practices in such size plants, a number of recommendations to improve their energy utilization were developed These recommendations were categorized in terms of short, medium, and long term energy savings measures

Short Term Measures Measures include no cost or low cost improvements in plant operation with minimum equipment modifications The maximum cost for these measures should be approximately $100,000 and they should be implemented in general by the plant staff It is expected that the timing for this category of recommendations would be as follows

- Maximum procurement/preparation time 2 5 years
- Average payout 0 5 years
- Total 0 to 3 years

Medium Term Measures Require medium cost investment up to several million dollars for equipment or plant modifications and probably the use of outside engineering/contractor services The estimated timing for these measures is

- Maximum procurement/preparation time 5 0 years
- Average payout 3 0 years
- Total 3 to 8 years

Long Term Measures Include major investments in new or revamped facilities to improve and increase the plant utilization These type of investments would require justification based on significant potential for product sale increases through market analyses and on a comprehensive economic analysis for each measure suggested for implementation The expected timing for this category is

- Maximum procurement/preparation time 9 0 years
- Average payout 6 0 years
- Total 8 to 15 years

A listing of recommended energy saving measures organized in terms of the above three categories is presented as follows

9.3.1 Short Term Measures

Short term measures include

- Improve combustion efficiency of furnaces and boilers by installing flue gas oxygen/combustion analyzers

- Add new steam traps and test/replace existing steam traps based on a rigorous audit of the steam generation and distribution systems

- Add, repair, and replace insulation as necessary based on a comprehensive inspection of heat losses from various equipment and piping

- Improve maintenance program to assure continuous repair or replacement of leaky valves and pipes, damaged insulation, instrumentation, and equipment Develop a detailed maintenance history and data logging program

- Implement an energy saving training program at all levels of plant personnel through seminars, courses, and education programs Special emphasis should be given to overall plant energy efficiency improvement programs, furnace/boiler burner operation, optimum air/fuel ratios, and general maintenance

The estimated cost and energy savings for these short term measures are presented in Exhibit 9 8

The total cost for all these measures is estimated at $120,000 - $190,000, while the potential energy savings are estimated at $250,000 - $400,000, resulting in an average payout of about 0 5 years

These cost and energy saving estimates are providing order of magnitude data for various measures, based on previous energy saving experience in similar size plants These values can be confirmed through detailed energy audits of each specific plant

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Exhibit 9.8
SHORT TERM ENERGY SAVINGS MEASURES

DESCRIPTION	COST	BENEFIT
Install flue gas oxygen/combustion analyzers on furnaces and boiler to improve their operation and combustion efficiency	Estimated cost for 4 to 5 analyzers $75,000-$100,000	Improvement in furnace/boiler efficiency by 5 to 15 percent, in addition to reduction in environmental emissions Fuel savings estimated at $100,000 to $150,000 per year Payout 0 75 years

DESCRIPTION	COST	BENEFIT
Add new steam traps and test/replace existing steam traps following a rigorous audit of the steam generation, distribution, and utilization systems	Estimated cost for 50 to 100 steam traps $25,000-$50,000	Reduction in steam consumption Fuel savings estimated at $75,000 to $100,000 per year Payout 0 50 years

DESCRIPTION	COST	BENEFIT
Add, repair, and replace insulation as required based on a comprehensive inspection of heat losses from various equipment and piping	Approximately $10,000-$20,000	Reduction in heat losses through poor insulation Energy savings estimated at $25,000-$50,000 per year Payout 0 40 years

Exhibit 9.8 (Continued)
SHORT TERM ENERGY SAVINGS MEASURES

DESCRIPTION	COST	BENEFIT
Improve maintenance program to assure continuous repair and/or replacement of leaky valves and pipes, damaged insulation, instrumentation, and equipment Develop a detailed maintenance history and data logging program	Approximately $10,000-$20,000	Improvement in plant operation due to prevention of unscheduled maintenance and shutdown of equipment Improved energy efficiency Estimated operation and energy savings at $50,000-$100,000 per year Payout 0 20 years

DESCRIPTION	COST	BENEFIT
Implement an energy saving training program at all levels of plant personnel through seminars, courses, and education programs The training should emphasize overall plant energy efficiency improvement programs, furnace/boiler burner operation, optimum air/fuel ratios, and general maintenance practices	Minimal	Improvement in energy savings throughout the plant, especially in the furnace/boiler operation and energy consumption

9.3.2 Medium Term Measures

Medium term measures include

- Replace old, inefficient equipment, such as replacement of old burners with high efficiency burners and old instrumentation with modern highly reliable instrumentation
- Install condensate collection and reprocessing systems to improve the utilization of the steam generation system and reduce boiler feed water consumption
- Preheat combustion air to furnaces and boilers using low pressure waste steam to improve the combustion equipment efficiency
- Recover waste heat from stack gases of furnaces and boilers to preheat combustion air, generate steam or preheat boiler feed water The selection of these alternate applications will require a comprehensive investigation of plant steam requirements versus the economics of each application

The estimated cost and energy savings for these medium term measures are presented in Exhibit 9 9

The total cost for all these measures is estimated at $1,900,000 - $4,300,000, while the potential energy savings are estimated at $675,000 - $1,700,000, resulting in an average payout of about 3 years

These cost and energy saving estimates are providing order of magnitude data based on previous energy savings experience in similar size plants These values can be confirmed through detailed energy audits of each plant

Exhibit 9.9
MEDIUM TERM ENERGY SAVINGS MEASURES

DESCRIPTION	COST	BENEFIT
Replace old, inefficient equipment • Replacement of old burners with high efficiency burners • Replacement of old, inefficient instrumentation with modern, highly reliable instrumentation	Approximately $100,000-$150,000	Improved energy efficiency of combustion equipment through reduction in fuel consumption and more reliable operation of the equipment Potential fuel savings estimated at $75,000-$100,000 per year Payout 1 5 years

DESCRIPTION	COST	BENEFIT
Install condensate collection and reprocessing systems to improve the utilization of the steam generation system and reduce boiler feed water consumption This system will include steam traps and piping to collect process and steam tracing condensate, condensate drums, and pumps to return the recovered condensate to the boiler feed water system	Approximately $200,000-$250,000	Reduction in steam and boiler feed water consumption Estimated fuel savings at $100,000-$150,000 per year Payout 2 0 years

Exhibit 9.9 (Continued)
MEDIUM TERM ENERGY SAVINGS MEASURES

DESCRIPTION	COST	BENEFIT
Preheat combustion air to furnaces and boilers using low pressure waste steam to improve the combustion equipment efficiency	Approximately $600,000-$900,000 for 1 -2 furnaces or boilers	Reduction in furnace and boiler fuel consumption Estimated fuel savings at $300,000-$450,000 per year Payout 2 0 years

DESCRIPTION	COST	BENEFIT
Recover waste heat from stack gases of furnaces and boilers, in one of the following options		
1 Combustion Air Preheat	Approximately $2,000,000-$3,000,000 for 1 -2 furnances or boilers	Reduction in furnace and boiler fuel consumption Estimated fuel savings at $700,000-$1,000,000 per year Payout 3 0 years
2 Steam Generation or Boiler Feed Water Preheat	Approximately $1,000,000-$1,500,000 for 1 -2 furnances or boilers	Increased steam generation capabilities without addition of new boilers or reduction in fuel consumption for boiler feed water preheat Potential savings estimated at $200,000-$300,000 Payout 5 0 years

9.3.3 Long Term Measures

Long term measures include

- Install cogeneration facilities to provide more reliable and cheaper electrical power and steam A company like NODFOS seems to be an ideal user of cogeneration facilities based on its high electrical and steam consumption

- Improve manufacturing process Several opportunities to be investigated in this area include

  - Improvement of agglomeration method for raw materials (phosphate rock, coke, and silica) in phosphorus manufacture

  - Higher quality electrodes in phosphorus manufacture

  - Use of the Wet Process in phosphoric acid manufacture for sodium tripolyphosphate production This is a cheaper process which can reduce the product cost

The benefits of these long term measures are presented in Exhibit 9 10

More specific information will be required to estimate the cost of these measures and to quantify their benefits to justify the major investments included in this category of energy saving opportunities

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Exhibit 9.10
LONG TERM ENERGY SAVINGS MEASURES

DESCRIPTION	COST	BENEFIT
Install cogeneration facilities to provide more reliable and cheaper electrical power and steam	To be determined	Improved electrical power reliability and reduction in its cost, as well as steam supply cost

DESCRIPTION	COST	BENEFIT
Improve manufacturing process • Improvement of agglomeration method for raw materials in phosphorus manufacture • Use of higher quality electrodes in phosphorus manufacture • Use of Wet Process in phosphoric acid manufacture for sodium tripolyphosphate production	To be determined	Improvement in plant operation, reduction in energy consumption and product cost

9.4 POTENTIAL FOR FUTURE ENERGY SAVINGS

The potential for energy savings in Kazakhstan's fertilizer industry was estimated based on the energy consumption of the various companies at an assumed future optimum plant utilization of 90 percent

The specific energy consumption shown in Exhibits 9 5 and 9 7 for 1990, when the plants operated at high utilization rates, were used for these energy consumption calculations, as shown in Exhibit 9 11

Exhibit 9.11
POTENTIAL FOR ENERGY SAVINGS IN KAZAKHSTAN'S FERTILIZER INDUSTRY

	Energy Consumption at 90% Plant Utilization				
	Electricity	Natural Gas	Steam	Total Energy	Total Energy Cost [1]
	(Mil/kWh)	(Mil/M³)	(Mil/Gcal)	(Mil/Gcal)	(Mil/$)
NODFOS	3,640	82 6	0 46	13 66	114 17
Superphosphate	149	149 8	0 22	1 94	22 77
Hymprom	120	12 7	0 22	0 75	7 06
Phosphorus	2,298	125 2	0 57	9 51	82 55
Total	**6,207**	**370 3**	**1 47**	**25 86**	**226 55**

[1] Cost premises

$ 27 70/1,000 KWH
$100 00/1,000 M³ Natural Gas
$ 11 07/Gcal steam

The potential future energy savings are estimated as follows

- Short and medium term measures (approximately 5% of energy cost) — $11 million
- Long term measures (approximately 20% of energy cost) — $45 million

These potential future energy savings were estimated based on typical saving experience in such size plants They are providing order of nagnitude information which can be confirmed in detailed energy audits of each plant

9.5 CONCLUSIONS

Based on the preliminary survey of the phosphate fertilizer industry in the State of Kazakhstan it appears that this industry is an important asset for the state economy due to the following factors

- The state has large reserves of phosphate ore
- The fertilizer plants are already built
- The products have good potential for export to the former Soviet Union republics, China and other Asian countries, thus they can be a valuable source of foreign currency

Therefore there is a strong incentive to revitalize this industry by helping the various companies to increase their plant utilization through increased sales of their products This will reduce the energy consumption and all fixed costs (overhead, maintenance, depreciation, sales cost) per tonne of product, which will help this industry to become more competitive on the foreign markets

In achieving this goal, the industry will need help from the government in various areas such as

- Incentives for export
- Assistance in international sales
- Reduction in transportation costs
- Reliable energy supplies
- Financial support in installation of cogeneration facilities, which will provide a more reliable and cheaper source of electricity and steam supply

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Chapter 10
NONFERROUS METALS INDUSTRY

10.1 ENERGY SAVINGS STUDY

The nonferrous mining and smelting industries in Kazakhstan were studied to determine the present levels of energy consumption and how these levels compare to other operations in the world If it were found that Kazakhstan's energy consumption was above this 'standard' level, then suggestions would be made on methods and approaches that would reduce energy consumption

To accomplish this task, literature in the US and Kazakhstan was searched, Kazakhstani specialists were consulted, and the teams own experience was called upon In addition, one major mining/smelting site, Dzhezkazgan, was visited to better understand existing conditions in the country During this visit, copies of a data questionnaire (Annex J) were distributed to obtain more detailed data, however, no responses to the questionnaire were received All data were obtained during site interviews and from our Kazakhstani counterparts in Almaty

10.2 NONFERROUS INDUSTRY OVERVIEW

This chapter will focus primarily on the production of copper, lead, zinc, gold, and silver A large number of byproduct metals and compounds such as sulfuric acid, copper sulfate, silver nitrate, bismuth, tungsten, molybdenum, manganese, etc are produced but do not have the financial significance of the five primary metals

Almost all mines produce ores with multiple mineral components Even most of the 'non copper mines' have ore with 0 1 to 2 0% copper and almost all of the ore carries recoverable silver, 1 to 50 grams per ton plus trace gold These ores require complex concentrating plants or there are large metal losses to the tailings (In fact, many opportunities identified by Western mining companies relate to reprocessing tailings)

As a general rule, the ores produced are of low grade with copper ores being 0 3-1 2% as compared with 0 3-2% in the US and 1-3% in Chile The polymetalic ores are around 0 9-8% combined lead and zinc while in North and South America and Australia 5-20% is more common The geologic conditions also appear more complex with less surface mining and more relatively deep underground mines

While the mines may produce multiple metals within the ore, the smelting complexes have products in which they specialize In Kazakhstan, the primary smelting locations and associated primary output are as follows

Smelting Complex	Typical 1985-90 Production TPY	Comments
Dzehzkargan	200,000 Cu*	2 Primary furnaces electric
Balkhash	150,000 Cu	2 Primary furnaces coal

Smelting Complex	Typical 1985-90 Production TPY	Comments
Chimkent	130,000 Pb	2** Primary furnaces coal
Ust-Kamenogorsk	120,000 Pb	2** Primary furnaces one coal one electric
Leninogorsk	unknown Pb	5** Furnaces primarily handle waste and lead dusts, 2** Units electric
Leninogorsk	95,000 Zn	1** Primary furnace, air blown
Ust-Kamenogorsk	220,000 Zn	2** Primary furnaces, air blown
All Lead/Zinc	1,000 Ag	
All Lead/Zinc	35 Au	

*Recent production at Dzhezkazgan is in the 140-170,000 TPY range
**Noted when there is a question about the number of smelting lines

Source Production data in this listing from Center for International Research " The Mineral Industry of Kazakhstan," by Richard M Levine field trip, or Kazakhstani specialists

Recent production data is considered confidential because of its economic impact on Kazakhstan in the world market We have no specific production data but production at all operations has dropped since the break up of the Soviet Union It is believed that production drops of 20-60% are typical for the 1993-94 time period

Prior to the 1993-94 production drops, Kazakhstan was a major producer of nonferrous metals in the Russian and world markets Copper production was about 3% of world refinery output and 33% of Russian output Lead production was at 5% of world refinery output and 45% of Russian output, much of this refinery output seems to be related to recycling lead scrap because Kazakhstan's mine production was being allowed to fall Zinc production was at 4% of world refinery output and 40% of Russian output Gold and silver accounted for 2% and 10%, respectively, of world output and 15% and 65% respectively of Russian production

The five smelting locations are set up as independent combinats[1], in addition to the smelters there are associated mines and concentrating facilities Besides the smelter combinats, there are nine other mining and concentrating combinats set up within Kazakhstan that are considered to be in the nonferrous industry These are Achisaii, Shalinsk, Zhezkentsky, Zhairensky, Karagailinsky, Zyryanovsky, Akshatau, Teleliysky, and Irtyshsky

1 Translators use the term *Kombinat* when speaking about these organizations It seems to have the same meaning as the words company or corporation

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In the past, markets for the nonferrous industry were primarily outside of Kazakhstan but within the former Soviet Union (FSU) While most of these FSU markets are still potentially available there is a severe problem in being paid for metals shipped to customers within the former Soviet Union, and it has been necessary to seek out customers in Europe and Asia These new customers can buy on the world market and as a result Kazakhstan's nonferrous industry is being forced to discount its products severely so that delivered prices in Europe and Asia are competitive For copper this means loading it on rail cars and shipping it to the Kazakhstan border where the sales transaction takes place at a price about 10% below the London Metals Exchange, LME, price In essence the Kazakhstan metals must pay all of the delivery freight charges for customers in Europe and Asia It appears that shipping costs of about $0 10 per kilometer are being charged, which is rather high for carload lots

The present sales discounts ($200-$300 per ton) are economic for a metal such as copper which is presently selling for about $1 25 per pound on the LME ($2750 per metric ton) For nonferrous metals such as lead, $0 30 per pound ($665 per metric ton), and zinc, $0 52 per pound ($1150 per metric ton) these discounts are a major problem and much of the countries production is only marginally economic or may only be economic if customers with the ability to pay can be found within Kazakhstan or other nearby FSU states Gold and silver can afford freight discounts but most production is as a byproduct of the production of lead and zinc Many of the presently mined ores do not contain enough precious metals to pay for mining and smelting just to recover the precious metal content

As a result of these market factors, copper emerges as one of the most important metals within Kazakhstan Since this industry also has the ability to generate hard currencies, which Kazakhstan needs, copper production also becomes important to the nation Lead and zinc have economic potential but deductions for shipment to European and Asian markets are a problem In the short term Kazakhstan may have to depend heavily on copper These factors also make any cost savings that can be implemented important to the survival of the nonferrous industry and because of recent rises in the cost of energy, energy becomes an important area in which to look for cost savings

10.2.1 Dzhezkazgan Complex

The Dzhezkazgan mining and smelter complex of Zhezkazgantsvemet includes one open pit and four underground copper mines, three ore concentrating plants, a smelter complex, and a Turkish joint venture wire drawing mill[2] The smelter produces 99 99% copper suitable for electrical use, sulfuric acid, copper sulfate, lead dust (lead smelter feed), and gold/silver slimes (precious metal refinery feed) There also appears to be some potential for zinc concentrate production

Production of 'black copper,' an intermediate product produced before casting the anodes used in electrolytic refining to 99 99% copper, is theoretically around 240,000 metric tons per year In actual practice the complex has produced just a little over 200,000 TPY before the formation of the CIS and over the last two years has fallen about 30%

2 This mill is a first step toward upgrading raw copper metal into higher grade products The mill makes large diameter wire but there are apparently plans to add fine wire and insulating capacity as well

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It appears that all the copper produced could be sold at or near world prices (up to 50,000 tons per year can be taken by the on site wire drawing plant), in spite of the favorable economics, production has fallen The production drop that has taken place since the breakup of the FSU has many causes but the primary ones are

- Many experts have left for their original homelands, primarily Germany and Russia, leaving the technical management of the plants to people with less skill

- Supplies of repair parts, chemical reagents, explosives, and other consumables have become less dependable While there are many reasons, the primary one is that many commodities are not made in Kazakhstan, thus, requiring importation across multiple national borders, with all of the purchasing, credit, and shipping problems that are entailed

- Power is in short supply and not dependable The Dzhezkazgan TES is old and well beyond its economic life and power from other supplying stations is contracted to Russia or is otherwise undependable

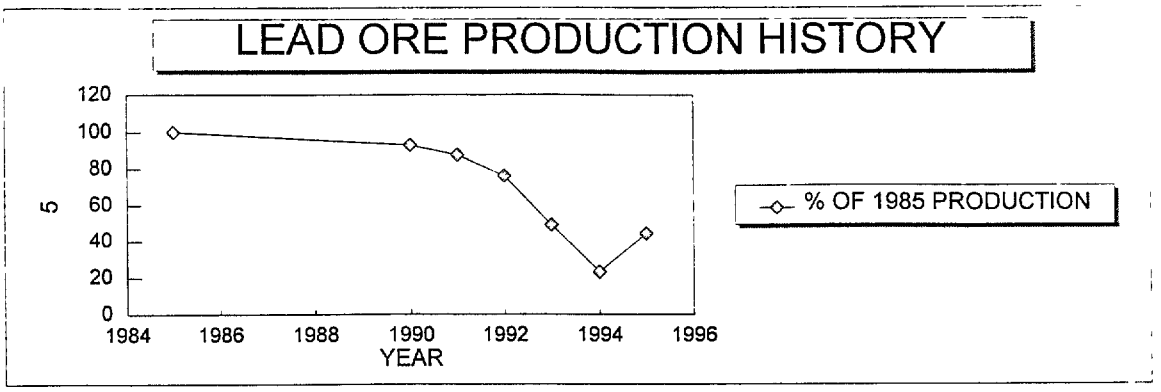
- All sales arrangements are handled by a separate firm We do not understand the reason but insufficient capital is being returned to the plant for improvements, proper maintenance, and wages, even though the mining/smelter complex is clearly producing a large, positive cash flow [3]

In addition small problems are present There is a lack of acid carrying rail tankers Also there is lack of sufficient steam/hot water to keep the electrolytic baths at their ideal operating temperature, etc which causes problems producing cathode copper

While we did not visit other operations in the nonferrous industry, our Kazakhstani counterparts indicate that the conditions are similar at most other producing locations Although, at most other operations, electrical power seems to be more available/dependable, it may have to be imported from other CIS states at a more costly price (approx $0 05/kwh or 50% over Kazakhstani price) This higher tariff could be another factor that is restricting production The lack of adequate capital and other problems noted may stretch back even further than the recent drops in copper production at Dzhezkazgan may indicate Exhibit 10 1 indicates the process may have started at least 10 years ago in the lead industry The drop shown in the exhibit has a number of reasons but it is clear that investments have not been made to maintain production levels

3 How the plant is being stripped of its earnings is not at all clear The Kazakhstani interviewed indicated the Government was responsible but we do not clearly understand the mechanism for allocation of funds resulting from the sales operation

Exhibit 10.1
LEAD ORE PRODUCTION HISTORY

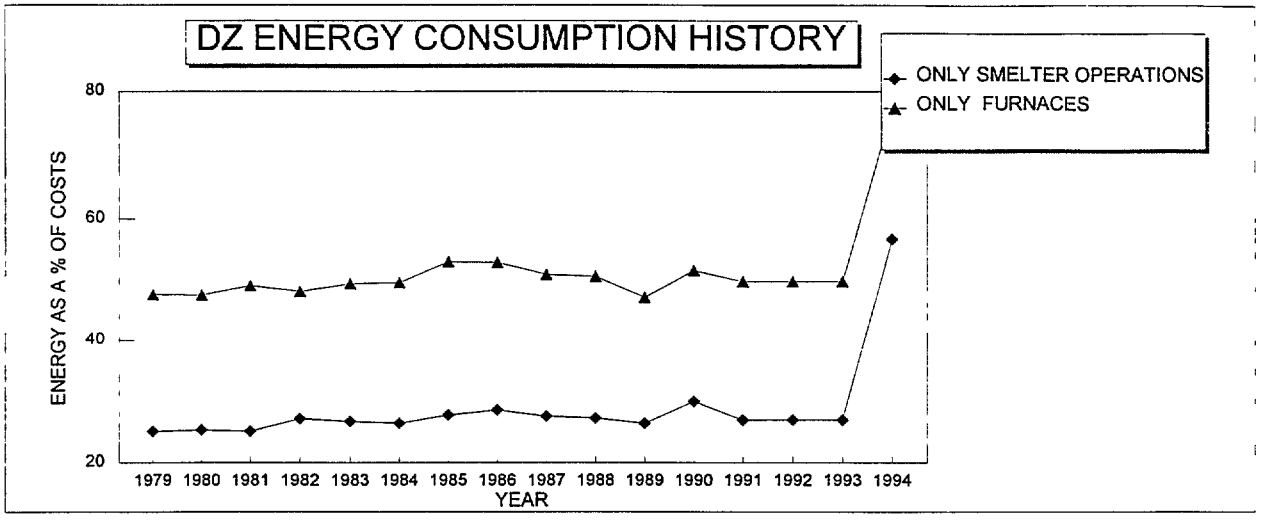


NOTE The 1995 production level is a budget estimate and we do not know how realistic it is

Some of the nonferrous operations/mines in the country are not felt to be economic in the world market Some operations are being maintained for national reasons The Kazakhstani know that something will have to be done about these mines, but, in general, mine closings have not yet begun

While energy has always been a component of prices, energy costs have risen rapidly towards 'world' levels This has caused the percentage of costs associated with energy to rise substantially in the last year as presented in Exhibit 10 2 This, coupled with shortages of supplied electrical energy, have brought energy awareness to the forefront of managerial awareness There already seems to be a branch on the Dzhezkazgan organization chart for energy management

Exhibit 10.2
DZ ENERGY CONSUMPTION HISTORY



Note 1 Exhibit does not include power consumption for the new wire mill

Note 2 This data was presented in a plant seminar to encourage energy savings Some of the data were corrected by the team's Kazakh specialists because it was overstated (probably for demonstration purposes) and while we feel the general trend is correct it may still be exaggerated

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The staff of the combinat are looking at a number of ways to achieve energy savings or general efficiency improvements Projects which seemed to be well underway were

- Rebuild the entire smelter furnace area A Japanese engineering firm is proposing a new smelter technology which would eliminate the electric furnaces, install heat recovery, cogeneration, etc It is expected to take 3 5 years at a minimum to complete and it should save 35% of the energy now used in the furnace area An alternate study was initiated using a comprehensive heat recovery/cogeneration concept for the existing furnace technology, however, this option is not presently being pursued

- Construct a new TES at Dzhezkazgan This unit is intended to supply some power for the smelter, provide reliable heat for the town, and heat the plant process areas Initial proposals for this plant have already been received

- Replace the acid production system with a more energy efficient system and install acid by-product production that will create higher value products that can be more easily shipped than liquid acid

- Install larger flotation cells (16 cubic meters) in the concentrator area These should be more efficient and provide cleaner separation

10.3 INTERNATIONAL COMPARISONS: ENERGY CONSUMPTION

Exhibit 10 3 presents energy consumption costs related to total production costs for many of the metal mining/smelting operations in Kazakhstan for 1993 and the first part of 1994 Energy costs as a share of total expenses has risen from 22 4% in 1993 to 26 3% in the first ten months of 1994[4]

4 Most of this increase is attributed to electricity and steam not fuels Also, this source suggests energy cost share at Dzhezkazgan to be about 33% in 1994 which questions the reliability of data in Exhibit 10 2

Exhibit 10.3
EXPENDITURES - NONFERROUS MINING AND SMELTING INDUSTRIES OF KAZAKHSTAN
(Thousands of Tenge)

Operation or Enterprise	1994 10 Months				1993 Totals			
	Mining & Smelting Expenses	Electrical Steam Etc	Fuel	Other Expenses	Mining & Smelting Expenses	Electrical Steam Etc	Fuel	Other Expenses
ACHIS AII POLYMETALIC COMBINAT & SHALINSK MINE	219,965 =	85,896	1,210	132 859	417,469 =	117,686	15,904	283,879
SHYMKENT LEAD SMELTER	1,553,923 =	381,391	199,776	972,756	2,845,627 =	392,529	179,442	2,273,656
ZHEZKENTSKY MINE	405,066 =	124,016	19,377	261,673	517,942 =	125,342	28,487	364,113
ZHAIRENSKY MINE	358,986 =	78,458	22,420	258,111	204,769 =	15,615	5,476	183,678
KARAGAILINSKY MINE	64,953 =	13,955	3,907	47,091	101,963 =	36,027	18,013	47,923
ZYRYANOVSKY LEAD COMBINAT	961,773 =	294,116	9,804	657,853	941,125 =	313,394	43,292	584,439
ZHEZKAZGAN NON-FERROUS COMBINAT	6,395,496 =	1,899,462	230,238	4,265,796	7,807,523 =	1,992,265	318,762	5,496,496
BALKHASH COPPER SMELTER	6,104,789 =	906,157	168,286	5,030,346	6,769,291 =	892,251	211,143	5,665,897
AKSHATAU MINE	219,965 =	69,685	17,421	132,859	417,469 =	100,193	33,398	283,879
LENINOGORSKY SMELTER	1,871,509 =	515,853	58,700	1,296,956	2,513,317 =	887,415	82,725	1,543,177
TEKELIYSKY Pb-Zn MINE	208,648 =	74,378	7,829	126,441	412,593 =	99,022	8,252	305,319
IRTYSHSKY MINE	107,090 =	35,406	4,539	67,145	213,193 =	52,754	10,991	149,448
UST-KAMENOGORSKY Pb-Zn SMELTER	8,419,059 =	1,605,234	246,959	6,566,866	11,324,026 =	1,449,475	294,425	9,580,126
TOTALS	26,891,222 =	6,084,007	990,466	19,816,752	34,486,307 =	6,473,968	1,250,310	26,762,030

Note This exhibit is reported in Tenge It appears that these costs have been calculated in dollars and then converted to the Tenge assuming 48 77 Tenge/US dollar for presentation Details were sought but no one was able to explain the accounting method

In order to compare the situation in Kazakhstan with other producers, data was collected on US mining/smelting industries[5] The US data concentrates on the value of production in an industry and energy consumption can be most easily presented as a percentage of product value as shown in Exhibit 10 4 The US data was spot checked against other world locations and found to be comparable Data from Poland indicated a situation about midway between Kazakhstan and the US

Exhibit 10.4
US ENERGY CONSUMPTION: MINERAL INDUSTRIES

	Fuel Energy as a % of Product Value	Electric Energy as a % of Product Value	Energy as a % of Product Value
1987			
Copper Ores	3 3%	9 9%	13 2%
Lead and Zinc Ores	1 1%	7 9%	8 9%
Gold and Silver Ores	1 9%	2 9%	4 8%
Misc Metal Ores	3 8%	5 8%	9 6%
Coal - Surface Mined	2 6%	1 7%	4 3%
Coal - Underground	0 4%	2 9%	3 3%
Copper Smelting	1 9%	1 3%	3 1%
Nonferrous Smelting	1 9%	3 7%	5 7%
1982			
Copper Ores	6 2%	13 5%	19 6%
Lead and Zinc Ores	1 7%	9 0%	10 7%
Gold and Silver Ores	2 8%	3 4%	6 2%
Misc Metal Ores	4 2%	5 6%	9 9%
Coal - total	2 2%	2 1%	4 3%
Copper Smelting	4 2%	1 4%	5 6%
Nonferrous Smelting	3 9%	4 0%	7 9%

Two methods have been developed to compare the US data with the data from Kazakhstan In the first the Kazakhstani and US data on energy costs are compared and in the second actual physical energy units are compared Neither method is totally satisfactory because the Kazakhstani production data has not been disclosed so the cost analysis requires many assumptions and the physical units approach has limited data available for comparisons In addition much of the data are recent and reflects the problems associated with the break up of the Soviet Union In spite of these problems both analytical methods give approximately the same result, showing the Kazakhstani energy consumption to be about twice as high as the US 'standard'

5 This data is obtained from Department of Commerce publications done by the Census Bureau for Manufacturing and the Mineral Industries and from the Department of Energy

10.3.1 Cost Method of Determining Energy Consumption

Since the Kazakhstan data are presented on a cost basis and the US data are presented on a sales price basis, direct comparisons of the data were not possible In addition the Kazakhstan mineral production data is considered a national security matter To make some sort of a comparison, the Kazakhstan production data has been roughly estimated and a gross production value has been computed based on appropriate metals prices (LME and other markets) for 1993 and 1994 This enables the Kazakhstan energy data to be calculated on a sales price basis, as the US data It should be clearly understood that the production value arrived at is comparable with US data but is not a true value of Kazakhstan's non ferrous mineral income which has substantial freight deductions The comparisons are shown in Exhibit 10 5

Exhibit 10.5
ENERGY CONSUMPTION COMPARISON
USA WORLD VS KAZAKHSTAN

	Fuel Energy as a % of Product Value			Electric Energy as a % of Product Value			All Energy as a % of Product Value		
	1988 USA	1993/1994 Kazakh	Ratio: Kaz/USA	1988 USA	1993/1994 Kazakh	Ratio: Kaz/USA	1988 USA	1993/1994 Kazakh	Ratio. Kaz/USA
Copper Ores	3 3			9 9			13 2		
Lead and Zinc Ores	1 1			7 9			8 9		
Gold and Silver Ores	1 9			2 9			4 8		
Misc Metal Ores	3 8			5 8			9 6		
Copper Smelting	1 9			1 3			3 1		
Nonferrous Smelting	1 9			3 7			5 7		
Combined Copper Industry	2 5	1 74/1 61	0 7	5 2	9 44/11 35	2 0	7 7	11 18/12 9	1 6
Combines Pb, Zn, Ag, Au	2 0	2 10/1 65	0 9	3 8	10 46/9 14	2 6	5 8	12 56/10 7	2 0

Exhibit 10 6 graphs the increase in energy costs at Dzhezkazgan over the first 10 month of 1994

Exhibit 10.6
FUEL PRICE INFLATION DZ 1994

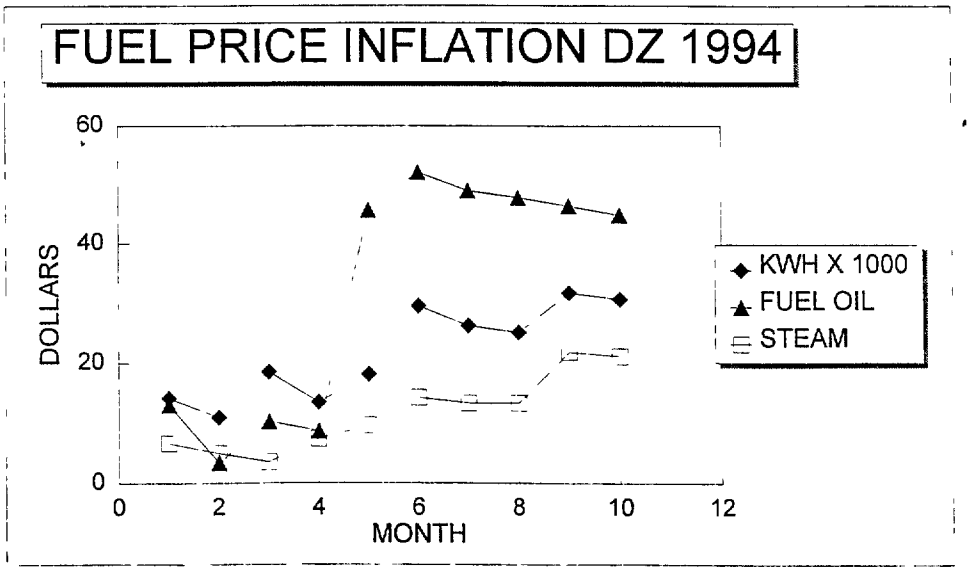

Exhibit 10 7 indicates that electric power and fuel oil costs at Dzhezkazgan are about 45% of the 1991 power and fuel oil costs in the US manufacturing sector

Exhibit 10.7
DZHEZKAZGAN UNIT ENERGY COST HISTORY - 1994

Month	Electric Power (Dollar per kWh)	Fuel Oil (Dollar per ton)
January	0 014	13 049
February	0 011	3 424
March	0 019	10 250
April	0 013	8 642
May	0 018	45 669
June	0 030	52 118
July	0 026	49 004
August	0 025	47 806
September	0 032	46 428
October	0 031	44 905
10 Month Average:	0 022	32 129

1991 US Energy Costs (US$) Average Over All Manufacturing (1991 data)		
Electricity	kWh	0 046
Residual Fuel Oil	Ton	70 587

10.3.2 Physical Energy Units Method of Determining Energy Consumption

In an alternate approach some energy consumption data could be obtained for a few representative mines and smelters This data is presented in Exhibit 10 7 Similar US data are also presented The comparisons in Exhibit 10 8 are most accurate when comparing the two copper industries because similar byproducts are produced and both countries have similar ore grades The analysis of lead and zinc ores (mining and concentrating) should provide a reasonable comparison, although these ores do contain precious metals With the exception of fuel density for copper ores, the energy consumed per metal ton in the Kazakhstan industries are 1 4 to 3 5 times the US estimates

10.3.3 Corrections Necessary to Fully Compare the US and Kazakhstani Data

As already noted both of these analytical methods show that the Kazakhstan industries are using approximately twice the energy that similar operations use in the US The reasons for this are complex but the following points are clear

- The Kazakhstan data often includes the electrical consumption in the workers homes, associated food production facilities, etc
- The present economic disruptions that are effecting the flow of needed supplies, electricity, etc
- The state of Kazakhstan technology
- The low grade of the ores being mined and concentrated

From our work at Dzhezkazgan it appears that roughly 10% of the energy consumed may be assigned to consumption in the homes of the workers and associated facilities Our data is not sufficient to say if this is representative of all of the other operations but it should be a reasonable approximation

The economic disruptions and the state of Kazakhstan's technology and equipment maintenance are somewhat easier to quantify There are energy consumption goals for many activities These goals were set by the Kazakhstani themselves and are based on theoretical energy consumption and operating history (pre 1990) before the present problems started This data are shown in Exhibit 10 9 The data are only detailed for electrical energy but it appears that the present conditions are responsible for at least 10% of the excess energy consumption (mining 7-14% and copper smelting 19%)

Exhibit 10.8
ENERGY CONSUMPTION COMPARISONS
USA/WORLD VS. KAZAKHSTAN

	1988 USA	Electrical Density (kWh per metal ton) 1993/94 Kazakh	Ratio. Kaz/USA	1988 USA	Electrical Density (Gcal per metal ton) 1993/94 Kazakh	Ratio: Kaz/USA	1988 USA	Fuel Density (Gcal per metal ton) 1993/94 Kazakh	Ratio: Kaz/USA	1988 USA	Total Energy Density (Gcal per metal ton) 1993/94 Kazakh	Ratio: Kaz/USA
Copper Ores	3,883 8	8,447 7	2 2	3 34	7 27	2 2	2 86	1 32	0 5	6 20	8 59	1 4
Lead and Zinc Ores	754 4	3,154 3	4 2	0 65	2 71	4 2	0 27	0 50	1 9	0 91	3 21	3 5
Copper Smelting	491 7	2,754 0	5 6	0 042	2 37	5 6	3 11	4 70	1 5	3 53	7 07	2 0
Copper Electrolysis	300 0	600 0	2 0	0 026	0 52	2 0	n/a	n/a	n/a	0 26	0 52	2 0
Zinc Electrolysis	3,050 0	3,115 0	1 0	2 62	2 68	1 0	n/a	0 65	n/a	n/a	3 33	n/a

Exhibit 10.9
ENERGY CONSUMPTION COMPARISONS-KAZAKH GOALS VS. ACTUALS
(Goals are Theoretical or Pre-1990 Practice)

	Electrical Density (kWh per metal ton)			Electrical Density (Gcal per metal ton)		Fuel Density (Gcal per metal ton)		Total Energy Density (Gcal per metal ton)	
	Kazakh Goal	1993/1994 Actual	Ratio. Actual/Goal	Kazakh Goal	1993/1994 Actual	Kazakh Goal	1993/1994 Actual	Kazakh Goal	1993/94 Actual
Copper Ores	7,433 0	8,477 7	1 14	6 4	7 3	n/a	1 32	n/a	8 59
Lead and Zinc Ores	2,938 8	3,154 3	1 07	2 5	2 7	n/a	0 50	n/a	3 21
Copper Smelting	2,323 5	2,754 0	1 19	2 00	2 37	n/a	4 70	n/a	7 07
Copper Electrolysis	300 0	600 0	2 00	0 26	0 52	0 00	0 00	0 26	0 52
Zinc Electrolysis	3,050 0	3 115 0	1 02	2 62	2 68	n/a	0 85	n/a	3 33

Note 1 The "n/a" for fuel consumption indicates that goal data were not available for this study

Note 2 The electrolysis of copper is especially temperature sensitive Dzhezkazgan has an energy consumption of 650 kWh per ton, which is largely temperature related Balkhash is also high at 525 kWh per ton and we believe this is also temperature control related, as an old text lists Balkhash as needing only 300 kWh when the plant was new

This leaves the rest of the excess energy consumption assigned to the ores being mined, the basic condition of facilities, and the technology level of this industry It appears then that deducting the power consumption for the workers homes and the problems caused by the break up of the Soviet Union leaves an energy consumption level of about 1 6 times that encountered in a US or other 'world' operations From the limited data available this makes the situation in Poland and Kazakhstan appear similar for copper

Special note should be made of the effect of ore grade as this appears to be one of the major problems The ore grades being mined, especially for lead and zinc, are generally lower in metal content than those being mined in the US and other countries The Kazakhstan team indicates there are better reserves available but new mines have not been developed on these reserves The solution to this problem is to open new higher grade mines This is an over simplification but it should be understood that when low grade ores are mined the tons of metal produced will have a higher intrinsic energy consumption For many of the metals studied this is a major factor in the high energy consumption with 50-75% of the energy consumed being taken up by mining and concentrating

10.4 RECOMMENDED ENERGY SAVING MEASURES[6]

In all of our questions and observations we noted a general lack of activity on small 'in house' energy reduction or process improvement projects When we questioned our Kazakhstani counterparts it seemed there was almost a cultural imperative to go for the big improvements and not to spend much time on smaller issues

It is certainly understandable that an operation that does not even have enough energy available to keep the homes of its people warm in the winter would concentrate on big issues but we feel there is a tremendous potential being missed by not instituting an overall energy saving/process improving program at the combinat From our past experience with such projects it should be possible to reduce energy consumption by from 5 to 15% This does not compare with the 20-30% savings that might result from the big projects but the small projects can be started right now, they will pay out in six months to three years, and they do not require foreign assistance The kind of projects we are referring to are generally simple, common sense ones, and Kazakhstani specialists ought to be able to add dozens more to our initial list of suggestions

The projects being suggested are divided into three types In the first are short-term measures that will take from 0 to 2 5 years of preparation and will payout in 0 5 years for a total project time of 0 5 to 3 years The second covers medium-term measures that will take up to 5 0 years of design/procurement/preparation time but which will pay out in 3 0 years or less for a project time of 3 to 8 years In the final category are long-term measures with up to 9 years of design/procurement/preparation time and a payout of 6 0 years for a total project life of 8 to 15 years

10.4.1 Short-term Measures

The short-term measures identified are listed below The costs and benefits of these short-term measures are presented in Exhibit 10 10

6 Comments specifically directed at Dzhezkazgan but generally applicable to copper production and other components of the nonferrous industry

Exhibit 10.10: Short Term Measures

Description	Cost	Benefit
1 Stop steam leaks Especially critical in the TES where some are clearly high pressure leaks	Generally low cost, less that $1,000 per leak	Immediate fuel energy savings
2 Install or repair steam traps as needed Many lines appeared to go long distances without traps Training in steam trap maintenance may be needed, with on site class	General $100 to $3,000 for each trap One trainer for one week $10,000	Immediate fuel savings and increase in process steam temperatures
3 Insulate or repair the insulation on pipelines, boilers, steam lines, etc	Amount not quantified But because of present condition initial expenditures may be around $100,000	Immediate fuel savings and increase in process steam and hot water temperatures, also boiler efficiencies
4 Control leaks and spills of solutions in the electrolysis tank house and other process areas Many spills were seen that contain substantial amounts of copper and perhaps silver	Amount not quantified but repairs and improvements are probably possible for around $50,000	Immediate increase in copper production Similar immediate reduction in ores that must be mined and concentrated Will also improve safety/ health conditions for workers
5 Manage the use of vehicles better so that large load carrying vehicles are not used for passenger transport	No cost, just manage the use of vehicles for carrying loads	Immediate reduction in gasoline and diesel fuel consumption
6 Meet the goals for the concentrate grade	No cost, activity already in budget	Immediate reduction in concentrator and smelter waste handling and energy used to melt inert smelter feed
7 Meet the goals for ore grade	No cost, activity already in budget	Immediate reduction in ore mining and concentrating operations energy consumption
8 Clean up the smelter furnace area which is quite dirty The dust appears to contain a high percentage of metals	Area clean up is low cost, perhaps $10,000 Devices to reduce dust emissions need to be repaired or installed, perhaps $50,000	Immediate reduction in ore mining and concentrating requirements Reduction in nonproductive metal smelting Substantial improvement in worker health

Many of the above suggestions can be considered trivial but they can be done without large amounts of capital and there did not seem to be a great deal of effort being expended to fix the problems

- Stopping steam leaks This is especially critical in the TES where some were seen that were clearly high pressure leaks but anywhere leaks occur in the system they need to be repaired There was little mention by the Kazakhstani of steam leaks within the boilers but because the coal is high ash we would expect erosion of the tubes to be a problem, again these cause high energy losses

- Install or repair steam traps as needed Many lines appeared to go long distances without traps and during our visit, though we made a point in looking, we never saw a single trap or saw one function This makes us think very few are in use and the ones in place are not working properly Work on other projects has indicated that the quality of the 'Russian' steam traps is generally poor and intensive maintenance is required to keep them functioning

- Insulate or repair the insulation on pipelines, boilers, steam lines, etc Many lines had uninsulated sections and almost all showed damage to the insulation (10-20% of insulation on the water and steam lines seen appeared missing or damaged) Recent line repairs did not always seem to have the insulation replaced

- Control leaks and spills of solution in the electrolysis tank house and other process areas Many spills were seen in the electrolysis area that contained substantial amounts of copper in solution and perhaps silver slimes, these are also safety hazards to the men who work in the area In other areas of the plant waste spills and streams were noted that seemed to contain ore fines

- Manage the use of vehicles better We observed 138 large trucks and tractor wagons being driven while in Dzhezkazgan Of these only 18 were hauling cargo If the vehicles were being better utilized the number of vehicles with cargo would have been closer to 50%

- Goals have been set for concentrate grade that are not always being met These goals should be met or exceed Low grade concentrate increases energy consumption when barren material is pumped to the smelter, when excess concentrate is pelletized and dried, when excess silica has to be melted in the furnace, and when excess slag must be handled

- Goals for ore grade delivered to the concentrators are not always being met The ore bodies that are available should be better managed to meet the grade goals Producing higher grade ores reduces the mining, transporting, and concentrating energy requirements Until a new, energy efficient smelter is completed or modifications are made on the existing smelter, serious consideration should be given to shipping the concentrators higher grade ores There might also be value in selecting areas where the ore will produce higher grade concentrates if the furnace chemistry can utilize such concentrates

- The smelter furnace area is quite dirty and the dust appears to contain a high percentage of metals Clean up, reprocessing, and control of this dust would improve metal recovery and improve the health conditions for the workers There appears to be a high lead content in the dust Loss of one ton of copper in the last stages of concentrating wastes the mining and concentrating efforts spent on 100 or more tons of ore

10.4.2 Medium-term Measures

The medium-term measures identified are listed below The costs and benefits of these measures are presented in Exhibit 10 11

Exhibit 10.11: Medium Term Measures

	Description	Cost	Benefit
1	Installation of furnace oxygen analyzers	For simple fuel furnaces the cost is $3-5,000 each For more complex smelting furnaces the cost should run about $25,000 each	Immediate reduction in furnace fuel requirements because optimum fuel, air (or oxygen), and perhaps ore ratios are being optimized
2	Investigate better flotation reagent techniques to raise concentrate to optimum levels and minimize waste	$25-50,000 research project with ongoing reagent costs Reagent suppliers often do this work at no cost	Immediate reduction in quantities of ore mined
3	Consider high density polyethylene piping for concentrate and tailings handling	Costs for polyethylene pipe are similar to or below comparable steel piping No cost if replacement takes place when steel lines are worn out	30% of the concentrators energy consumption is related to pumping concentrate and tailings Immediate reduction in pipe friction factor and therefore energy demand
4	Build a network of reliable power stations to supply metallurgical plants to prevent unscheduled shut downs	We believe such a network is in place A better dispatching system at a cost of about $100,000 might improve situation in plants *	It appears that as much as 5% of the power consumed at present may be to restart cooled furnaces after a shut down Such a system will prevent these losses
5	Develop the needed infrastructure to obtain needed repair parts and materials rapidly Consider new warehouses, dedicated rail cars, dedicated air freight, and agencies specializing in timely material procurement	New warehouses $250,000, dedicated rail cars $50,000, and dedicated air freight $1,000,000 (for surplus military aircraft)	Another 5% of the energy wasted seems to be related to shutdowns and inefficient stopgap measures instituted to keep the plant running in spite of these problems This could greatly reduce these energy losses

* This may be an oversimplification of the problem Many of the system power generation facilities are old and in poor repair It may be that even the best dispatching systems cannot correct this basic problem but it is possible that effort in this area may result in improvements in the situation until the needed stations can be repaired or replaced

- Installation of furnace oxygen analyzers Allows optimum fuel utilization in furnaces Smelting furnaces may benefit from a completely different control logic, one not based on oxygen analyses, but the main principle of providing a system to measure fuel and energy input to minimize waste is still the same

- Investigate better flotation reagent techniques to raise concentrate grade and minimize losses to the tailings Waste pumping is 15% of the concentrator's energy consumption so any project that reduces this waste is desirable In addition reduction in copper wasted to the tailings substantially reduces mining requirements Some members of management seemed to strongly agree with this suggestion and we suspect that tailings losses are higher than desirable Many suppliers of chemical reagents will run test at low or no cost to find the optimum reagent mix for a given ore Making use of the suppliers may make this project possible at very low cost

- Consider high density polyethylene piping for concentrate and tailings to reduce pipe friction and pumping energy required From the data gathered it appears that 30% of the concentrator energy consumption is related to tailings and concentrate pumping This plastic pipe is quite smooth, for reduced friction, and it is much easier to install than steel pipe Early plastics could not stand harsh winter conditions but the pipes being suggested here have a wide temperature range in which they are useful and should be usable in the temperature extremes found in Kazakhstan

- Build a network of reliable power stations to supply the metallurgical plant, to prevent unscheduled shut downs This addresses the problems caused by power shutdowns interrupting smelting operations that are designed to be continuous Reheating a cool furnace takes a substantial amount of energy and we estimate almost 5% of the total energy consumption at Dzhezkazgan may be the result of recovering and reheating furnaces after unplanned shutdowns This distribution system is, in our understanding, already in place but many of the stations are old and no more dependable than the TES in Dzhezkazgan It also appears that some power is being preferentially sold into export markets rather than being supplied to the smelter, this situation needs to be resolved so the smelter can be kept operational This suggestion envisions a new switching and control system to maintain electrical energy supply to the smelter The other side of this suggestion is that some present users will be cut off This situation appears as much political as economic

- Develop the needed infrastructure to get needed repair parts and materials rapidly Build warehouses to keep a working supply of needed parts and materials on hand Consider dedicated air freight, dedicated rail cars, and agencies specializing in timely material procurement to deliver the needed materials This seems to be a problem everywhere in Kazakhstan but for the metals industry it causes the same problems that unreliable power does with the processes that are intended to operate continuously and it is also forcing all sorts of inefficient stop gap measures to be taken Some of these problems may be causing accidents and environmental problems due to spills and leaks

10.4.3 Long-term Measures

The long-term measures identified are listed below The costs and benefits of these measures are presented in Exhibit 10 12

Exhibit 10.12: Long Term Measures*

Description	Cost	Benefit
1 Install larger, more energy efficient trucks and loading shovels in the open pit mine	Approximately $10,000,000 for one large shovel and 3 large trucks	Immediate reduction in diesel fuel and electrical energy consumed Newer shovels generate power back into the power grid during part of their operating cycle
2 Install larger, more energy efficient equipment in the underground mines	Each set of trucks and their associated drills and loaders will cost between $3-8,000,000	Immediate reduction in fuel consumed and operating manpower required
3 Replace the old electric furnaces with the latest technology, low energy consumption furnaces	This project is still in the design stages but costs could range from $250,000,000 to $1,000,000,000**	Almost total elimination of electrical consumption by the smelting furnaces (35% reduction in smelting energy)
4 Replace the old TES	Proposals have been solicited on this project but we have no details available costs could range from $250,000,000 to $1,000,000,000	Elimination of most problems related to unreliable energy supply (approx 5% of energy consumed) Make additional export power available
5 Rework the acid production facility and add the capability to produce commercially viable byproduct production	Project being considered, we do not believe a scope has been determined but order of magnitude is probably $50-100,000,000	Project would include heat recovery technology and perhaps power generation Besides utilizing energy now wasted would produce high value products for export
6 Install larger more efficient flotation cells Project would be coupled with reworking the plumbing and piping of facility	Project being considered and no cost estimates are yet available Order of magnitude is probably about $25,000,000 for the three concentrators	Correcting leaks in the system and improving separating efficiencies would cause an immediate reduction in ore mining and transportation energy requirements

* Many of the projects in this table carry such high capital costs that it may not be possible to obtain financing The global copper market, the remaining economic reserves available at Dzhezkazgan, and the stability of Kazakhstan will all play a part in these decisions It would be prudent to begin contingency planning now for alternate plans if the above cannot be financed

** We consider this project to have a low likelihood of being financed There are alternate studies, that have been done by the Kazakhstani for utilizing the existing smelting furnaces but installing heat recovery and cogeneration equipment We believe this option is less expensive and may be more likely to be financed

- Install larger, more energy efficient trucks and loading shovels in the open pit mine Large improvements have been made in diesel engine fuel efficiencies within the last few years Modern loading shovels utilize motor generator systems that generate power from certain parts of the operating cycle These improvements reduce power consumption and improve maintenance life on some components

- In a similar way consider larger scale and newer more energy efficient underground equipment It appeared that a substantial amount of the underground equipment is nearing its economic life and that spare parts supply is also becoming a problem

- New smelter furnace area The Dzhezkazgan smelting furnaces are electric (those at Balkhash use coal) This electric furnace technology is out of date and a new furnace area would greatly reduce energy consumption New equipment could also include waste heat recovery and perhaps cogeneration technology The problem with this solution is that it is costly and Kazakhstan may not be able to fund a project of this size at this time As an alternate a number of smaller energy recovery projects may be able solve many problems such as the generation of reliable heat for the electrolysis operation and power generation Substantial work in the form of energy balance studies has already been done toward measures that would improve the existing furnaces

- Build a new TES at Dzhezkazgan This solution provides improved power reliability and solves steam/ hot water shortages The power reliability problem has already been discussed but the shortages of steam and hot water cause problems in the electrolytic refining of the copper Electrolysis needs to operate with hot solutions or the electrical current consumption goes up dramatically It appears that consumption in Dzhezkazgan is more than twice what it theoretically should be because of cold solutions Cold solutions can also reduce the purity of the refined copper so that it is not marketable Constructing a new TES is another expensive solution that may be difficult to fund Alternatives should be considered although because the TES is an important source of heat for the workers homes One question that does need to be answered before design of the TES is finalized is what power output is needed If energy saving measures are instituted the present design, which was sent out in the request for proposal package is very likely too large

- Rework acid production area to include waste heat recovery and facilities for the manufacture of byproducts that have a higher value and are easier to ship than sulfuric acid The present system appears to be in poor condition and may result in the release of acid gases to the atmosphere The area also appears to need redesign to improve the working conditions for the men with regard to heavy metal dusts and acid fumes It appears that improvements could be made in this area at costs which Kazakhstan will be able to afford

- New flotation cells, especially if coupled with a reworking of the plumbing, piping, and conveying systems to prevent leaks and spills seems to be a reasonable large scale project that is being considered These cells should be coupled with reagents capable of making improved separations Again the concentrator facilities are large and many improvements are desirable but we suggest holding the budget for this work down under $25,000,000 Since shipping ores 10 to 20 kilometers from the mines to concentrators involves a large shipping expense for barren rock These improvements might be coupled with new, small crushers and concentrators located at each mine This would eliminate 70-80% of the rail transportation energy consumption costs With ore grade sometimes a problem there are also very large volume flotation cells (100 cubic meter) that can be used to treat large volumes of low grade

ore Using such machines as roughers at the mines and then sending partially concentrated ores to the main concentrators may have some potential Such machines would allow waste rock dumps at the mines to be reprocessed along with new low grade ores

10.5 ESTIMATED ENERGY SAVINGS MEASURES

As noted all of the suggestions above are specifically related to the problems noted at Dzhezkazgan Reviewing the situation with the team's Kazakhstani specialists revealed that the situations are similar in many of the other mining/smelting sites in Kazakhstan We feel that it is reasonable to expect 5% energy savings from the short-term measures and up to 10% from the medium-term suggestions at Dzhezkazgan Similar suggestions appear to be reasonable for at any operation in the nonferrous industry

While 15% may be an excellent goal, it is more reasonable to expect a 7 5% energy reduction from the short and medium-term measures as the measures for reliable power and higher ore grades may be difficult to accomplish This would indicate that the nonferrous industry can save about $10,000,000 per year in energy consumption The cash flow from this can be used to fund further improvements within the industry

With the long-term measures it appears that Dzhezkazgan expects to decrease its energy consumption by an additional 10 to 30% We would estimate that similar projects at other operations could achieve similar results However, the overall effect may be somewhat less than what is expected at Dzhezkazgan because some units already have operative heat recovery systems in place and power is somewhat more reliable Projects with budgets as large as those found under the long-term suggestions may not be appropriate for the lead and zinc operations until the market conditions for those metals improve

In discussing some of the large projects contemplated for Dzhezkazgan questions were raised on financing This study suggests a rapid payout (6 years) for such projects, partly because such a rate would be attractive to a foreign investor The financial analysis of such projects is complex but a project that saved 10% of Dzhezkazgan's annual energy bill could only fund a $25-$30,000,000 project Clearly a project that enables Dzhezkazgan to raise its production levels back up to 200,000 plus tons of black copper has more economic incentive (perhaps funding another $150-$250,000,000) but some of the projects being considered may have to be tied into production increases well over 200,000 tons per year, scaled back, or dropped altogether

In addressing the financing associated with the long-term measures, the stability of Kazakhstan must also be considered This study identifies the copper industry as a major source for income to the country yet the operations are not being funded adequately Potential investors will have to have assurances that they are investing in a viable industry, not one barely able to function because of financial maneuvering If Kazakhstan will not invest in this industry, foreign firms will not be interested in investing either

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Annex A
Exhibit A-1: KAZAKHSTAN'S ENERGY PRICES

	January 1992 Roubles	November 1993 Tenge	November 1994[1] Tenge
Crude Oil			
Wellhead, per Ton	350	100	1600
Refined Products			
Gasoline, per Ton	1057	1212	3612
Diesel fuel, per Ton	932	745	3873
Fuel Oil, per Ton	2880	332	1372
Natural Gas			
Wellhead, per Thous CM[2]	75	230	4016
Industrial, per Thous CM	870	--	7230
Residential, per Thous CM	74	280	760
Ekibastus Steam Coal			
Minemouth, per Ton	31 5	11	78
Power plant, per Ton	31 5	--	173
Electricity			
Industrial, per kWh	0 27	0 11	1 78
Residential, per kWh	0 12	0 04	1 50
Heat[3]			
Industrial, per Gcal	146	54 5	1435
Residential, per Gcal	90	25 3	798

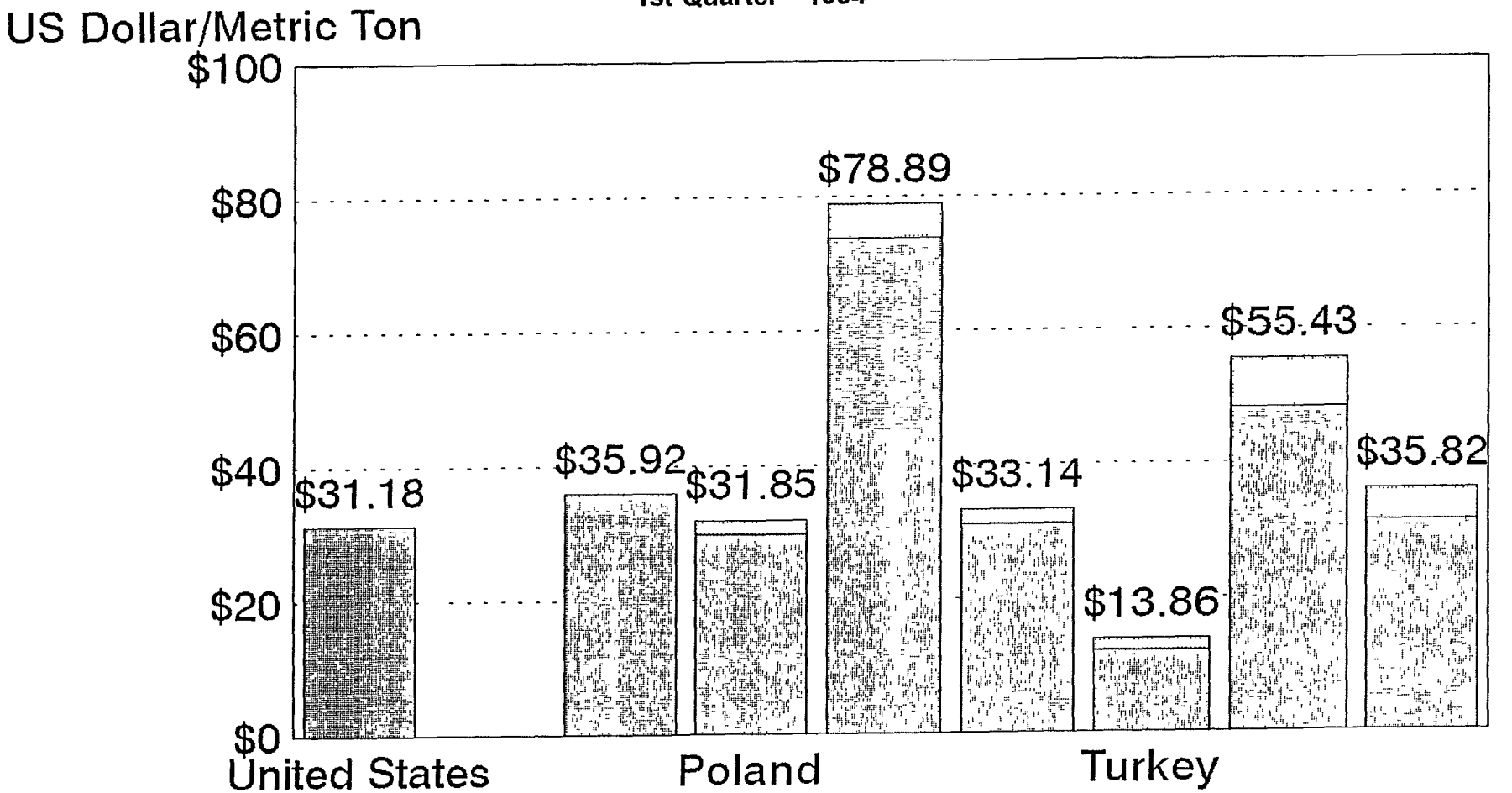
Source World Bank's 1993 Kazakhstan study, Ministry of Economy

1 Petroleum products are for May 1994, steam coal for June 1994 and heat tariffs for September 1994

2 CM is Cubic Meters

3 Heat tariffs for Almaty

Exhibit A-2
COMPARATIVE STEAM COAL PRICES AND TAXES
1st Quarter - 1994



Tax Component % =	n/a	n/a	6.5	6.5	6 5	13	13	13

1st Bar = Electricity Generation Steam Coal Consumption
2nd Bar = Household Steam Coal Consumption (US Data n/a)
3rd Bar = Industrial Steam Coal Consumption

Source IEA

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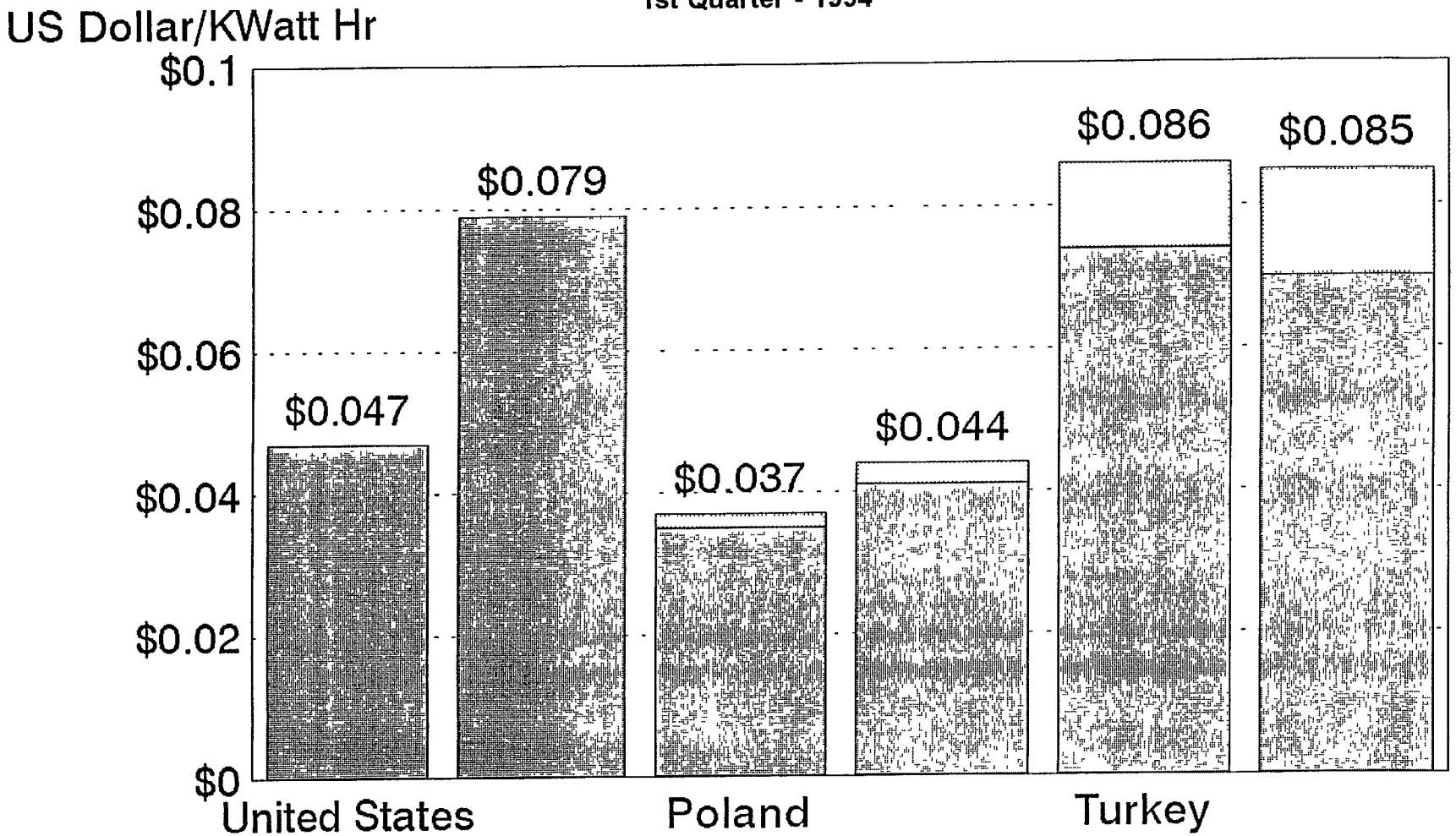
Exhibit A-3
COMPARATIVE ELECTRICITY PRICES AND TAXES
1st Quarter - 1994



	United States		Poland		Turkey	
Tax Component % =	n/a	n/a	5.4	6.5	14	17

1st Bar = Industrial Electricity Consumption
2nd Bar = Household Electricity Consumption

Source IEA

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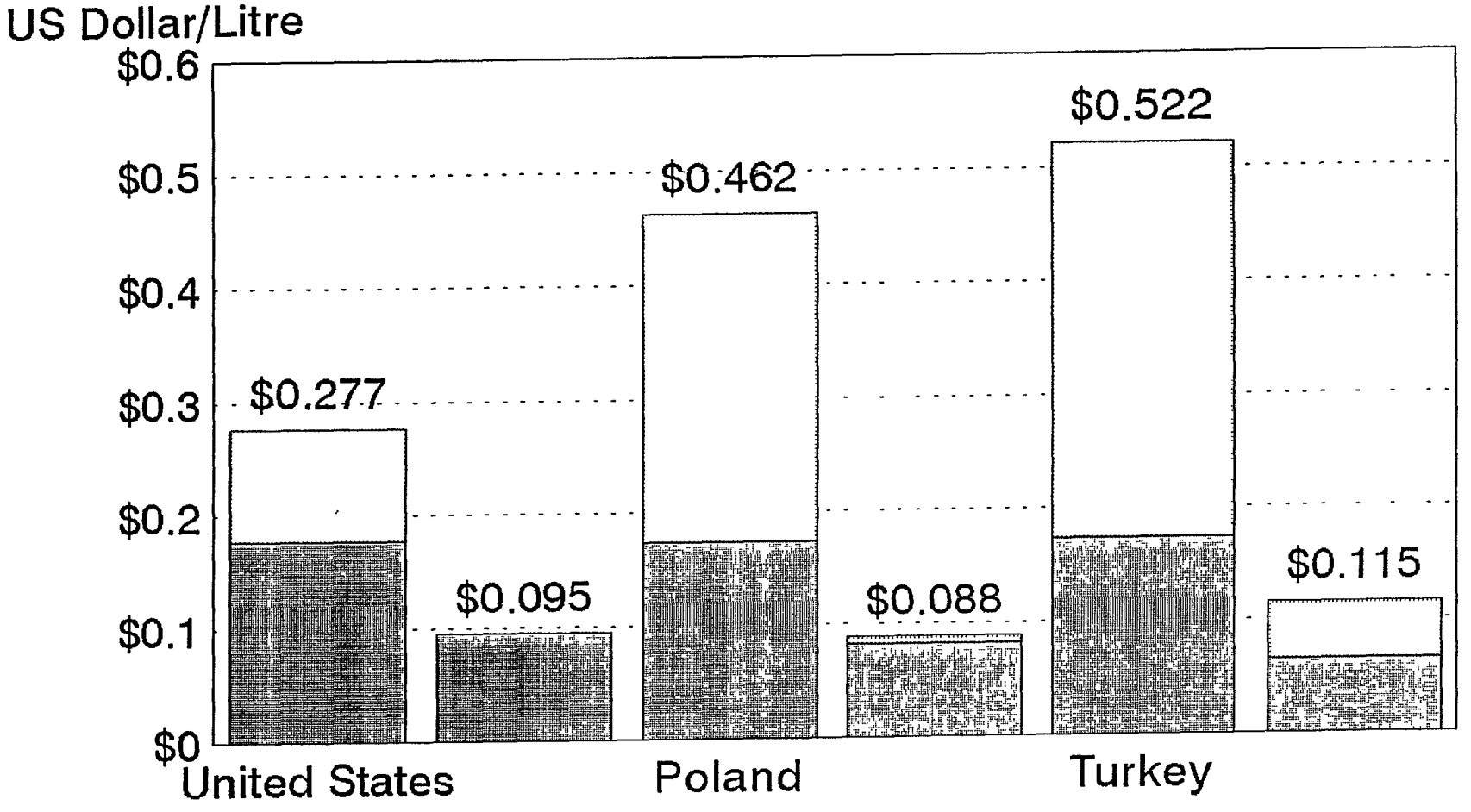
Exhibit A-4
COMPARATIVE PETROLEUM PRICES AND TAXES
1st Quarter - 1994

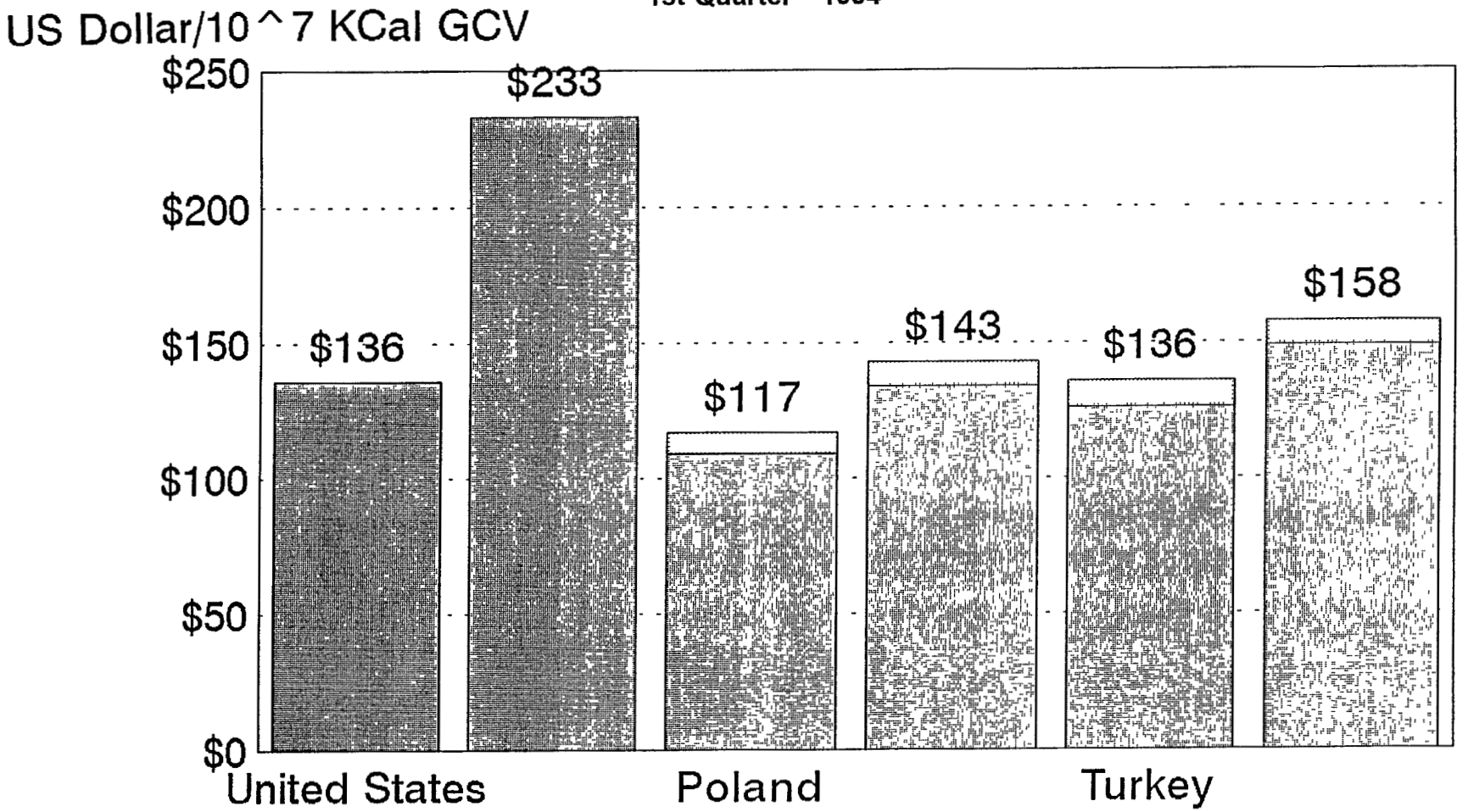


	United States		Poland		Turkey	
Tax Component % =	36	n/a	62	6.5	66	43

1st Bar = Automotive Fuels
(US Regular Unleaded, Poland Regular Leaded, Turkey Premium Leaded)
2nd Bar = Heavy Fuels

Source IEA

Exhibit A-5
COMPARATIVE NATURAL GAS PRICES AND TAXES
1st Quarter - 1994



	United States		Poland		Turkey	
Tax Component % =	n/a	n/a	7	6.5	7	5.7

1st Bar = Industrial Natural Gas Consumption
2nd Bar = Household Natural Gas Consumption
GCV = Gross Calorific Value

Source IEA

Exhibit A-6
KAZAKHSTAN SHARES OF END-USE ENERGY CONSUMPTION
(%)

	1990	1993	1994	1995	2000
Industrial	45	41	38	38	43
Agricultural	21	21	22	21	20
Transportation	10	12	13	13	13
Construction	2	1	1	1	0
Residential	14	16	18	18	15
Public/Other	8	8	8	9	9
Total	100	100	100	100	100

Exhibit A-7
KAZAKHSTAN - ENERGY CONSUMED
(Million Tons of Fuel Equivalent)

	1990	1993	1994	1995	2000
Industrial	44 9	39 2	33 9	33 8	42 5
Agricultural	21 3	20 4	19 6	19 3	19 2
Transportation	10 4	11 9	11 5	12 0	12 8
Construction	1 7	1 4	0 7	0 5	0 4
Residential	14 3	15 3	16 0	16 6	14 6
Public/Other	7 9	7 4	7 3	7 8	8 5
Total	100 5	95 6	89 0	90 0	98 0

Exhibit A-8
ENERGY INTENSITIES OF FREIGHT MODES, 1970-91

	Trucks			Class 1 freight railroad		Domestic waterborne
Year	Light truck[4] (Btu per vehicle-mile)	Other trucks (Btu per vehicle-mile)	Total trucks (Btu per vehicle-mile)	(Btu per freight car-mile)	(Btu per ton-mile)	
1970	12,491	24,142	16,399	16,748	655	545
1971	12,229	23,685	15,945	17,655	696	506
1972	12,099	23,350	15,646	18,087	706	522
1973	11,909	23,251	15,417	18,046	662	576
1974	11,398	22,555	14,669	18,422	665	483
1975	11,161	21,997	14,286	18,604	682	549
1976	11,167	22,644	14,335	18,843	677	468
1977	10,926	22,679	14,157	19,180	667	458
1978	10,765	22,887	14,093	18,802	637	383
1979	10,599	23,027	13,978	19,113	616	457
1980	10,143	22,352	13,489	18,585	592	358
1981	10,002	22,640	13,394	18,582	571	360
1982	9,741	22,736	13,103	18,224	547	310
1983	9,755	22,967	13,146	17,719	521	319
1984	9,777	22,884	13,147	17,740	508	346
1985	9,730	23,100	12,851	17,131	487	446
1986	9,729	23,106	13,082	16,855	474	463
1987	9,705	23,136	13,010	16,307	443	402
1988	9,350	23,387	12,767	16,436	434	361
1989	9,081	23,128	12,532	16,525	427	403
1990	8,904	22,581	12,230	16,254	411	388
1991	8,632	21,917	11,843	15 577	384	393[5]
Average annual percentage change						
1970-91	-1 7%	-0 5%	-1 5%	-0 3%	-2 5%	-1 4%
1982-91	-1 3%	-0 4%	-1 0%	-1 7%	-3 9%	2 9%

Source Transportation Energy Data Book, Edition 14, Center for Transportation Analysis, Oak Ridge, National Laboratory

a Two-axle, four-tire trucks

b Assuming ton-miles remain constant from 1990 1991 data are not yet available

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Annex B
ELECTRICITY POWER TARIFFS

PRINCIPLES

This annex focuses on the importance of the Republic of Kazakhstan adopting power pricing policies to maximize the net economic benefits of electricity consumption and discusses some preliminary observations regarding regional differences in power tariffs The proposed approach to electricity pricing recognizes the following objectives of electric power tariffs (a) national economic resources must be allocated efficiently, (b) certain principles relating to fairness and equity must be satisfied, (c) power prices should raise sufficient revenues to meet financial requirements, (d) the structure must facilitate the metering and billing of customers, and (e) other economic and political requirements, including subsidized rates to certain sectors to enhance economic growth First, the long-run marginal costs (LRMC) of electricity supply must be calculated to satisfy the criterion of economic efficiency. Then the calculated LRMC is adjusted to arrive at an acceptable tariff structure that meets the other criteria and constraints Any tariff based on this two step approach is a compromise between several objectives By using this approach, it is possible to revise and improve the tariff overtime. Thus, the optimal tariff structure can be reached over several years without subjecting consumers to shocks

A tariff based on LRMC is consistent with allocating resources efficiently. In estimating the LRMC, a key consideration is the amount of future resources used or saved by consumer decisions. So LRMC based prices should signal to consumers the economic value of future resources required to meet changes in consumption, or prices should reflect marginal costs incurred to meet new demand In general, the following three broad categories of marginal costs need to be identified in order to calculate LRMC· capacity costs, energy costs, and consumer costs.

Marginal capacity costs are investment costs in generation, transmission and distribution facilities to supply additional power Marginal energy costs are the fuel and operating costs associated with supplying additional kilowatts from a thermal plant [1] Marginal consumer costs are the incremental costs attributable to consumers, including hook-up, metering and billing costs When possible and appropriate, these components of LRMC must be broken down by time of day, voltage level, consumer categories, and seasons Particularly important is defining peak period and off-peak period during the time of day. Structuring tariffs based on LRMC leads to the conclusion that peak consumers should pay for marginal capacity, energy and consumer costs while off-peak customers should pay only the marginal energy and consumer costs. Also, LRMC pricing usually indicates that the lower the service voltage the greater the cost that the consumer imposes on the system.

In the second step, adjustments are made to LRMC calculated tariffs in order to meet other objectives. When the unit costs of supply are increasing[2], then by setting power prices equal to the calculated LRMC a financial surplus is likely Such surplus revenues can be used to achieve other objectives. For example, sociopolitical and equity objectives can be achieved by incorporating "lifeline" tariffs to supply basic electricity needs of low-income consumers In theory,lump sum cash transfers to low-income households would be preferable to subsidized tariffs However, the ineffectiveness of administration and policy tools for directly redistributing income and the persistence of large disparities of income often lead authorities

1 In a hydroelectric plant, a part of the investment costs associated with storage may be included in marginal energy costs

2 This is because marginal costs exceed average costs when unit costs of supply are increasing This is likely to be the case in Kazakhstan over the next several years

to use subsidized tariffs The appropriate lifeline rate and the associated size of the tariff block requires careful consideration The size of the block should be based on criteria for identifying low-income consumers and estimates of minimum levels of their electricity consumption These would likely be the amount required to supply requirements for lighting and minor appliances. In most developing countries, this amount would be less than 100 kilowatt hours per month The level of the lifeline rate could be determined such that the rate times the block size does not exceed a certain percentage of the consumer's income. Along with the lifeline tariff policy, an appropriate subsidized house connections policy needs to be established

PROPOSED REGULATORY REFORM IN KAZAKHSTAN

As reported in Power International's Draft Privatization Plan for Kazakhstan's Electric Sector, the Electric Energy Law that is being drafted is likely to recommend the establishment of the Republic Energy Regulatory Commission (RERC) and Oblast Energy Commissions (OECs) as the principal bodies to regulate Kazakhstan's electric power sector The fundamental task of the RERC will be to regulate wholesale power transactions while the OECs will be responsible for regulating transactions associated with distribution The OECs are likely to be formed by oblast or distribution region The proposed RERC and OEC tariff regulatory functions are listed below

- The RERC will perform rate-making for the following transactions: wholesale power purchases from generating companies, wholesale power sales to distribution companies, transmission and dispatch services, across border sales, direct power sales from the system to final consumers (when this becomes an option)

- The OECs will perform rate-making for the following transactions: power sales by distribution companies to captive retail customers, low voltage transmission services provided at the regional level, and local power procurement agreements with suppliers outside the national electric power system.

It is recommended that the RERC and OECs use LRMC pricing as the basis for rate-making.[3] Assuming that generation, transmission and distribution marginal costs of capacity, energy and consumer[4] have been separately calculated, it will then be necessary to allocate these costs to each major category of end-consumer Initially, the major end-consumer categories are likely to include industrial, commercial, agricultural, state consumers, and residential.[5] The determination of total cost allocation for capacity and energy costs to an end-consumer category is made by undertaking extensive load flow analysis and allocating costs based on customer load requirements imposed on the system The consumer costs should be compiled and summed and allocated to end users as well.

Over the longer term, it is recommended that time of day tariffs be introduced once the necessary metering is installed. In a recent Asian Development Bank tariff study on Pakistan, rough calculations suggest that load management resulting from the introduction of time-of-day tariffs could produce a 10% reduction in

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3 The LRMC methodology is consistent with the cost of service approach proposed by Power International in the Draft Privatization Plan

4 In addition, in capacity-constrained power markets, there is an additional cost component of LRMC which is referred to as opportunity costs of unmet demand It can be measured as the difference between costs of alternative fuels and the displaced electricity resulting from load shedding

5 Currently broad tariff categories in Kazakhstan include two categories of industrial, rail transport, town transport, non-industrial, budget organizations, agriculture, urban population, rural population and electricity for heat needs

peak demand, equivalent to a saving in generation capacity investment of $450 million [6] The total costs of installing required metering would be around $125 million spread over five years.

REGIONAL TARIFFS

As of November 1994, there were substantial differences in electricity tariffs among the regions of Kazakhstan. For example, electricity tariffs averaged about $ 01 USD/kwh in the Northeast compared to $ 05 in the Southeast The staff of several ministries indicated concern that regions with substantially higher tariffs would contribute to enterprises in these regions going out of business or relocating, resulting in significant unemployment in these regions.

For comparative purposes, Table B-1 presents 1991 average electricity prices for the manufacturing sector in the USA. As shown in B-1, the average price in the South was $ 041 USD/kwh or $ 023 lower than prices in the Northeast In general, regional electricity prices within a particular industry vary by about $ 01 to $ 02, with the exception of the plastic materials and resins industry, which averages $ 036 USD/kwh in the South compared to $ 076 in the West

Table B-1
1991 AVERAGE PURCHASE PRICE OF ELECTRICITY
IN THE US MANUFACTURING SECTOR
(US cents per kWh)

	Total US	Northeast	Midwest	South	West
Food	5 4	7 2	4 7	5 2	6 0
Rubber & Misc. Plastic Products	5 8	7 5	5 6	4 9	7 3
Plastic Materials & Resins	4 0	5 9	4 1	3 6	7 6
Chemicals & Allied Products	3 4	5 2	3 1	3 4	3 1
Phosphatic Fertilizers	4 1	--	--	--	--
Petroleum Refining	4 1	4 9	3 9	3 7	5 0
Blast Furnaces & Steel Mills	4 1	4 5	4 3	3 7	3 5
Primary Copper	4 8	--	--	4 4	4 8
Total Manufacturing	4 6	6 4	4 6	4 1	4 5

In the USA, historically utilities have been granted monopoly franchises over consumers in specified regions of a state State public utility commissions have set tariffs for these utilities based on costs of service which included generation, transmission and distribution costs of a utility for a specific region Consequently tariffs across the USA have differed substantially on a regional basis, reflecting the differences in plant capital costs, delivered fuel costs, and local operating costs, especially wages and taxes For example, utilities in the Northwest have cheap hydro generation facilities and lower operating costs as contrasted to the Northeast which rely heavily on thermal generation and carry higher operating costs If the RERC chooses to establish a uniform republic tariff based on the total costs of generation and transmission and the OECs set tariffs to end-consumers that include the RERC's tariffs plus distribution costs that are tied to specific regions, then the regional differences in electric prices are likely to be smaller than in the USA

6 See Asian Development Bank Final Report Volume IV, " Integrated Operations and Tariff Study for WAPDA and KESC," April 1991, page 122

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If the Government of Kazakhstan restructures the power sector and institutes the reforms as recommended in the Draft Privatization Plan, then it is recommended that the RERC consider and assess a tariff structure that incorporates the following (a) a uniform republic tariff to reflect the capacity costs of generation and transmission and (b) regional tariffs that reflect the differences in capacity costs of distribution, energy (delivered fuel and operation and maintenance) costs, both at the generation and transmission and local distribution level, and consumer costs Also, the RERC should consider setting special enterprise discounts for economic growth and development objectives These discounts should be eliminated over a specified number of years

Table B-2 presents, simply for informational purposes, how the capital, fuel, operational and maintenance, , and wholesale power cost components of regional electricity prices vary in the USA

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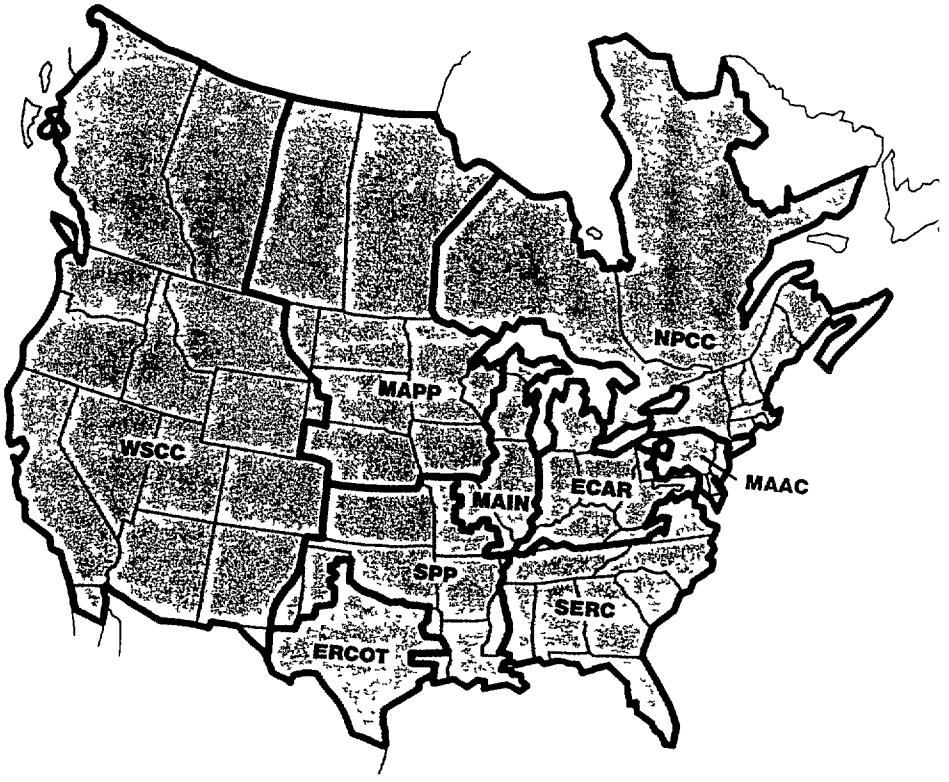
Table B-2
1993 US ELECTRICITY PRICES AND COMPONENTS
(US cents per kWh)

Region	Capital Component	Fuel Component	Operational/ Maintenance Component	Wholesale Power Cost	Total
NPCC/NY	4 1	1 3	4 1	0 4	9 9
MAPP	2 2	0 8	2 5	0 1	5 6
MAIN	3 7	1 2	2 2	-0 1	7 0
SERC	2 2	1 4	3 0	0 6	7 2
ERCOT	2 3	1 6	2 1	0 2	6 2
WSCC/CAL	2 7	0 8	4 3	1 5	9 3
WSCC/NWP	1 6	0 6	1 9	-0 1	4 0
Total US	2 8	1 2	2 7	0 1	6 8



Key:

ERCOT
Electric Reliability Council of Texas
MAIN
Mid-America Interconnected Network
MAPP
Mid-Continent Area Power Pool
NPCC
Northeast Power Coordinating Council
SERC
Southeastern Electric Reliability Council
WSCC
Western Systems Coordinating Council

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Annex C
POLICY MEASURES TO INFLUENCE PASSENGER TRANSPORT SUPPLY AND DEMAND, AND THEIR AREAS OF IMPACT

Area of Impact	Economic Measures	Regulatory Measures	Information
1 **Fleet growth**	▸ Annual fees for "right of access" to a vehicle ▸ Vehicle purchase taxes ▸ Fuel taxes ▸ Annual ownership taxes ▸ Parking fees Road use fees or kilometrage charges	▸ Annual sales quotas ▸ Individual ownership limits (e g total number, no car without a parking space) ▸ Closing some urban districts to cars ▸ Limits on elective or professional travel ▸ Limits on numbers of parking spaces ▸ Increasing congestion by not improving infrastructure ▸ Better infrastructure for bicycles pedestrians ▸ Expanded/improved public transport and lanes restricted to certain users	▸ Public information on mode cost comparison
2 **Fleet mix**	▸ Taxes and rebates on vehicle purchase determined by size, power or fuel consumption ▸ Fuel taxes ▸ Annual registration taxes determined by engine size ▸ Manufacturer fiscal incentives for fuel efficiency, or fees for non-compliance with standards	▸ Minimum fuel efficiency standards (e g CAFE) ▸ Maximum missions standards ▸ Maximum power/weight ratios ▸ Civil penalties for manufacturer non-compliance with standards or requirements ▸ Annual sales quotas (by vehicle size)	▸ Public advertising promoting clean, fuel-efficient small cars
3 **Unit emissions**	▸ Fiscal incentives for successful vehicle inspection, or non-compliance fees ▸ Fiscal incentives to retire old vehicles, or non-compliance fees ▸ Fiscal incentives for vehicle maintenance, or non-compliance fees ▸ Fiscal incentives or non-compliance fees for driver training, especially professional drivers ▸ Subsidies for R&D focused on vehicle performance ▸ Annual registration taxes determined by engine size/fuel efficiency ▸ Manufacturer fiscal incentives for performance standards (e g durability of fuel efficiency), or non-compliance fees	▸ Vehicle performance standards (e g durability of fuel efficiency) ▸ Maximum power/weight ratio ▸ Mandatory driver training, especially for professional drivers ▸ Mandatory retirement of old vehicles ▸ Mandatory vehicle inspection using fuel efficiency criteria ▸ Mandatory regular vehicle maintenance ▸ Penalties for non-compliance with standards or requirements ▸ Speed limits (enforced)	▸ Automotive press coverage of vehicle performance and operating costs ▸ Use of vehicle inspections to inform consumers about driving behaviour and vehicle maintenance ▸ Public campaigns associating efficient driving with safe driving ▸ Public information on efficient driving and vehicle maintenance

Area of Impact	Economic Measures	Regulatory Measures	Information
4. Vehicle use	▸ Fuel taxes ▸ Insurance rates by annual kilometrage ▸ Parking fees ▸ Road use fees or kilometrage charges	▸ Car use restrictions (e g odd/even plate numbers) ▸ Closing some urban districts to cars ▸ Limits on elective or professional travel ▸ Limits on numbers of parking spaces ▸ Premium parking for high occupancy ▸ Increasing congestion by not improving infrastructure ▸ Speed limits (enforced) ▸ Expanded/improved public transport and lanes restricted to certain users ▸ Better infrastructure for bicycles, pedestrians	▸ Public information on efficient driving and route planning ▸ Public information on alternatives to mobility (e g telecommunications)
5 Fuel mix	▸ Fuel taxes differentiated by fuel ▸ Taxes for high emitters/rebates for low emitters at purchase or in annual car registration fees ▸ Fiscal incentives for development of alternative fuel distribution networks ▸ Subsidies for R&D on alternative fuels ▸ Rebates for conversion to dual-fuel vehicles ▸ Low rental rates for alternative fuel equipment ▸ Manufacturer fiscal incentives for fuel quality standards, emission standards, performance standards, or non-compliance fees	▸ Fuel quality standards ▸ Emission standards ▸ Performance standards ▸ Penalties for non-compliance with standards or requirements	▸ Automotive press coverage of vehicle performance and operating costs ▸ Use of vehicle inspections to inform drivers about alternative fuels ▸ Education and information programmes
6 Modal split	▸ Vehicle purchase taxes ▸ Fuel taxes ▸ Annual licensing taxes ▸ Annual ownership taxes ▸ Parking fees ▸ Road use fees of kilometrage charges ▸ Subsidies for public transit, trains	▸ Car use restrictions (e g odd/even plates) ▸ Ownership limits ▸ Closing some urban districts to cars ▸ Limits on elective/professional travel ▸ Limits on numbers of parking spaces ▸ Expanded/improved public transport and lanes restricted to certain users ▸ Park-and-ride facilities ▸ Better infrastructure for bicycles, pedestrians ▸ Subsidies for taking alternative transport to work	▸ Public campaign promoting alternative transport modes ▸ Public campaign promoting alternatives to mobility (e g telecommunciations) ▸ Cost comparisons for cars and public transport

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Area of Impact	Economic Measures	Regulatory Measures	Information
7 **Fuel efficiency technology**	▸ Fuel taxes ▸ Taxes for high emitters/rebates for low emitters at purchase or in annual car registration fees ▸ Grants, loans, subsidies for fuel-efficient vehicles ▸ Subsidies for R&D on fuel efficiency ▸ Manufacturer fiscal incentives for fuel efficiency standards, emissions standards, power/weight ratio limits, or non-compliance fees ▸ Tradable fuel economy credits	▸ Minimum fuel efficiency standards (CAFE or some other concept) ▸ Maximum emissions standards ▸ Maximum power to weight ratios ▸ Penalties for non-compliance with standards or requirements	▸ Annual publication promoting new car fuel efficiency technology
8 **Fleet emissions abatement**	▸ Tax differentials favouring abatement technology on new cars ▸ Taxes for high emitters/rebates for low emitters at purchase or in annual car registration fees ▸ Fiscal incentives for retiring old cars ▸ Rebates for conversion to dual-fuel vehicles ▸ Manufacturer fiscal incentives for fuel efficiency standards, emissions standards power/weight ratio limits, technology prescriptions, or non-compliance fees ▸ Fiscal incentives or non-compliance fees for vehicle inspection	▸ Maximum emissions standards ▸ Fuel quality standards ▸ Maximum power to weight ratios ▸ Technology prescriptions (e g catalytic converter) ▸ Mandatory retirement of old vehicles ▸ Mandatory vehicle inspection using emission technology and/or performance criteria ▸ Civil penalties for non-compliance with standards or mandatory requirements	▸ Annual publication of new car emissions levels by fuel and vehicle type ▸

Annex D
POWER SECTOR RESTRUCTURING

Most electricity sectors worldwide traditionally have been organized as vertically integrated monopolies either owned or heavily regulated by the government This organizational structure is based on the assumption that electric utilities are natural monopolies, i e electricity should be provided by one supplier in order to take advantage of economies of scale in the production and delivery of services

Recently, this assumption is being challenged In particular, generation is not necessarily universally considered a natural monopoly it has been demonstrated that the relatively few economies of scale associated with power plants can be achieved without concentrating ownership and control of generation within one company For example, the introduction of highly efficient gas turbine technology and the growing utilization of natural gas have resulted in generating units for which the costs of kilowatts of capacity exhibit little difference between large and small stations Combined with new developments in communication and control technologies, it is now possible to achieve the economies of an integrated system without necessarily having integrated ownership Despite these changes in generation, high voltage transmission is still viewed as a natural monopoly Distribution is also viewed as a natural monopoly, but one in which economies can be achieved without regard to the size of the geographic territory served This suggests that economies of scale in distribution can be achieved despite having more than one distribution company connected to the high voltage network of a single transmission company

As a result, many governments have reorganized their vertically integrated utilities into multiple companies which separately supply generation, transmission and distribution services Competition has been introduced into power sectors by permitting multiple owners and operators of generation Such reforms have taken a variety of forms distinguished generally by the degree of choice and competition among generation suppliers and their access to customers

However, the characteristics of electricity limit the structures and institutional arrangements that can work successfully Unlike other commodities, the production and consumption of electricity must be coordinated across an integrated transmission grid on a virtually instantaneous basis This coordination is vital to maintain system reliability, safety and economic efficiency There are four basic structural models available for achieving this coordination efficiently

Model 1: Vertical Integration

This model gives a single enterprise the exclusive right to engage in the generation, transmission and distribution of electricity Figure D-1 depicts this industry structure The state-owned monopolies in Pakistan, Thailand, Malaysia, India, France, and the privately-owned regional monopolies in the US and Germany are versions of this model The utility is responsible for operational dispatch in the short-run and for assuring the adequacy of power supply in the long-run

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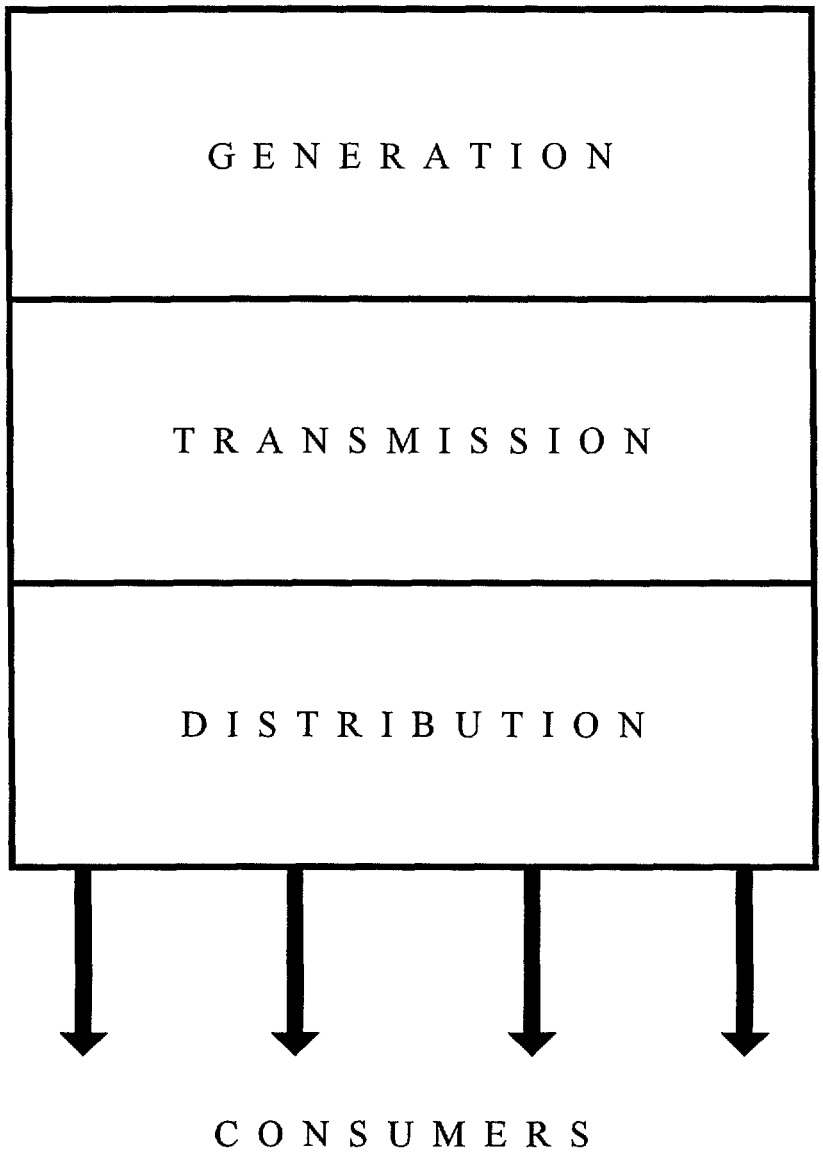
Figure D-1: Model 1 - Vertical Integration



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The defining characteristic of this model is that the utility is the sole source of power and the sole seller of electricity to consumers There is no need for market mechanisms and transactions among elements within the power system because the monopoly utility uses direct command and control to operate the entire electric system, pools all costs and revenues into unified accounts, and relies on captive customers to assure that its costs and investments are covered

There are generally several advantages associated with a vertically integrated structure First, vertical integration enhances control, coordination, and operational efficiency of the power sector All operational activities and sectoral decisions are under the control of one management structure Efficient dispatch of generation and coordinated maintenance of all facilities is promoted Decisions are efficiently made, delivered and executed The sectoral impact of any investment or operational decision is internalized within one company and therefore is more easily identified and evaluated Concentrating management also economizes on management resources

Second, the vertically integrated structure can facilitate the power sector's access to capital markets The vertically integrated utility has a secure monopoly over its customers which provides a better guarantee of cost recovery, and therefore is financially better able to tolerate inefficiencies and poor investment decisions This secure market therefore enhances the credit-worthiness of the utility Furthermore, the financially weak portions of the power sector, such as distribution service to predominately rural territories, are supported by the rest of the system Investments for the subsidized areas of the system can be financed on the strength of the utility's complete balance sheet, and not the financial viability of particular utility activities As a result, a vertically integrated utility can serve as a vehicle for introducing private investment into the power sector, since the guaranteed market could increase the attractiveness of any public tendering of stock

However, the vertically integrated structure does not guarantee investor interest Fundamentally, the investor is concerned with the rate of return on his investment This depends on many factors in addition to the security of the utility's revenue stream the viability of the tariffs, the transparency of the regulatory regime, the quality of management, and the efficiency of operations The success of attracting private equity may also depend on whether the government intends to retain a majority interest in the venture Private investors will be reluctant to take a minority interest if they are convinced that the government will use its majority position to ensure that the utility pursues social and governmental policies, rather than commercial objectives

There are also serious disadvantages to a vertically integrated framework First, a vertically integrated utility will preclude the introduction of competition into the power sector There is no room for alternative sources of power purchase and supply Second, as a result of the absence of competition, the vertically integrated utility has little incentive to maintain or increase operational efficiency The secure market creates greater tolerance for poor planning, poor investment decisions and poor management

Third, ***the only protection against poor management becomes regulation -- and the difficulties of regulation are maximized with a vertically integrated utility*** With vertical integration, the utility possesses all information about the power sector, making it difficult for the regulator to obtain information about the utility's operations and to monitor costs Vertical integration also eliminates the ability of the regulator to compare performance among different power sector entities Thus, it becomes easier for monopolistic activities to evade effective regulation

Fourth, although economic regulation may be less effective, the fact that the power sector is managed by one company makes it easier for the government to pursue non-commercial, social objectives For example, the monopoly over customers permits electricity prices to be set at non-economic levels, cross-subsidies to be maintained, and non-economic projects pursued A commitment to the maintenance of the vertically integrated structure also precludes the use of commonly used mechanisms for introducing private

investment into power sectors, such as non-recourse, privately-financed generation projects

Model 2: Separate Distribution Companies

This model separates distribution from the generation and transmission functions Generation and transmission remain the responsibility of a single, national vertically integrated company (G&T Company) The service territory of the distribution company can coincide with that of the G&T Company, or the G&T can serve multiple distribution companies Figure D-2 depicts this industry structure The power sectors in the Philippines and Jordan are examples of this model

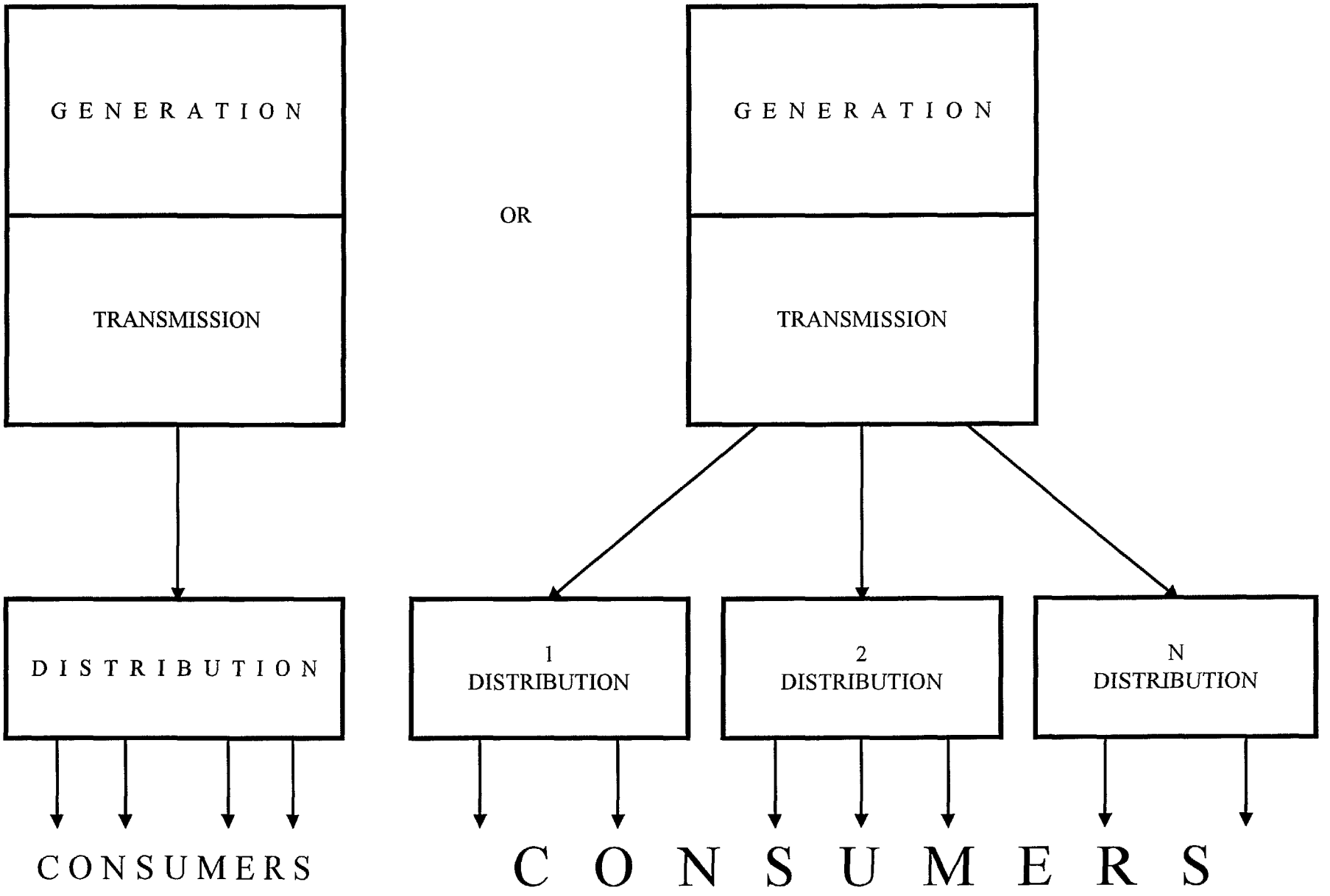
As is the case with Model 1, the defining characteristic of this model remains that of monopoly The G&T company remains the sole supplier of power and is responsible for operational dispatch as well as planning for and assuring the adequacy of power supply Similarly, the distribution companies have a complete monopoly over retail sales to customers located within their respective geographic franchise The only difference from Model 1 is that there is one or more distribution companies, ***with separate ownership***, purchasing power from the G&T Company

All operations of the power sector are coordinated through command and control mechanisms exercised by the monopolistic G&T and distribution companies rather than market mechanisms The only transaction introduced by this model is the G&T Company's wholesale sales of power to the distribution company under a regulated Bulk Power Tariff that will reimburse the G&T Company for the costs of its integrated operations

There are many advantages to this reform option First, the continued consolidation of existing generation and transmission responsibilities within one organization yields many of the benefits associated with complete vertical integration, including sector coordination and operating efficiency This is owing to the fact that generation and transmission are still managed under the direct command and control of one management The assessment of the sectoral implications of major investment decisions will remain the responsibility of one management

Second, this reform option also provides a viable vehicle for attracting private capital and introducing private ownership into the power sector As in the case of the vertically integrated utility, the G&T Company has a guaranteed market for its power sales This guaranteed market reduces the risks associated with investments in power projects, whether owned by the G&T Company or by private investors Investors in power projects will be sheltered from the market and, to varying degrees, political risks

Figure D-2: Model 2 - Separate Distribution Companies



In addition, unlike the vertically integrated option, individual distribution companies with their small capital needs will make an attractive investment opportunity for domestic capital markets ***This statement assumes, however, that there are cost-reflective tariffs and a stable independent regulatory regime***

Third, the monopolistic position of the G&T Company is weaker than that of the vertically integrated utility The distribution companies will provide a counterweight to the G&T Company The G&T Company will not be the only source of information about the power sector Also, the distribution companies will closely follow the G&T Company's power procurement and resource acquisition programs and develop their own load forecasts and projections for resource needs At a minimum, the distribution companies will make their views known to the regulatory authority The distribution companies' views on developments within the power sector, their provision of an alternative source of information, and their participation in the development of tariffs and in regulatory proceedings will make regulation of the G&T Company easier and more effective

Fourth, the separation of distribution from generation and transmission should encourage better service Creation of separate distribution companies prevents distribution from being relegated to a lower priority than other activities Also, separate distribution companies will foster greater responsiveness to local conditions and concerns

Fifth, separating distribution from generation and transmission will help to segregate the costs of distribution clearly from the costs of transmission and generation, resulting in cost transparency and operational accountability Greater cost transparency, in turn, requires Governments to consider the financial costs of its subsidy decisions explicitly

Finally, ***a critically important advantage of partial disaggregation is that it is not static and can be readily adapted to introduce elements of competition and to set the stage for further evolution of the power sector.*** First, competition for new generation capacity can be easily introduced within the context of a national G&T Company All existing generation will be controlled by the G&T Company The G&T Company will have to compete with other sources, however, before being permitted to build new generation This limited introduction of competition will discipline the G&T Company in its construction of power plants without a radical change in the structure of the power sector Also, the presence of independent power plants will provide benchmarks for evaluating the operating efficiencies of the G&T Company's power plants

As with the vertically integrated model, partial disaggregation has disadvantages Maintaining a G&T Company essentially shelters the generation and transmission business from competitive pressures, and therefore will not maximize operating efficiencies With a secure power market, the G&T company will not be forced into becoming commercially oriented The G&T company will be able to recover from its captive customers the costs of inefficiencies in operation, poor planning and inappropriate supply acquisition decisions

The only protection against such inefficiencies is regulation -- which, although more likely to be effective owing to the presence of the separate distribution companies, will still be an imperfect substitute for competition. Further, the G&T Company will continue to allow the government to pursue social objectives unrelated to, and perhaps inconsistent with, the cost-effective provision of electric service.

Model 3: Multiple Sources of Generation

Under Model 3, multiple sources of generation are permitted These generation companies sell all of their power to the company which controls the transmission network, that is, either the vertically-integrated utility under Model 1 or the G&T Company under Model 2 Figure D-3 depicts how the addition of

multiple generation sources changes the industry structure associated with Model 2

Negotiated power purchase agreements specifying the terms and conditions of the generation companies' supply responsibilities replace the monopolist utility's direct command and control of power plants present in Models 1 and 2

The company controlling the transmission network remains a monopsony because it is the only entity allowed to buy power from the generation companies Further, the company controlling the transmission network retains a monopoly over wholesale sales to the distribution companies (as well as any direct sales to large consumers directly connected to the transmission network) Hence, all electricity is generated by, sold to, and purchased from the company controlling the transmission network, which is sometimes referred to as a "central purchasing agency "

The company controlling the transmission grid remains responsible for operational dispatch and for planning and acquiring adequate power supply resources In some versions of this model, it may also remain responsible for building and operating generation The introduction of multiple sources of generation will impose competitive discipline on the generation market However, the monopolist's control over all power sales to the distribution companies protects the capacity planning and acquisition process from competitive pressures

The advantages of soliciting independent power proposals has been demonstrated around the world Independent power plants have increased utilities' access to capital markets and have been successfully used to encourage private ownership of power sector assets Solicitations for independent power have routinely resulted in the construction and operation of power plants at costs well below that initially projected by the purchasing utility Competitive procurement of new generation can lower the cost of generation by attracting diverse entrepreneurs who may be better than the purchasing (state-owned) utility at finding sites, fuel sources, technologies, and managing construction, plant operations and staff

Procuring new generation capacity competitively enables the G&T Company to shift some of the risks associated with new power plants to private investors, such as the risks of construction delays, cost overruns, inflation, currency volatility, and poor fuel procurement decisions Even though the risk premium for shifting the risks to private investors may make the cost of power procured from independent developers appear unreasonably high, the net effect may be lower costs since the G&T Company, as a regulated monopoly, has incentives to underestimate costs at the time it proposes to build a power project, has limited incentives to control costs during the plant's construction, and can make unrealistic assumptions about the plants fuel costs and other operating costs over its operating life Indeed, the regulated utility's cost estimates may not even include a risk premium as it assumes that it can pass these risks on to its captive customers

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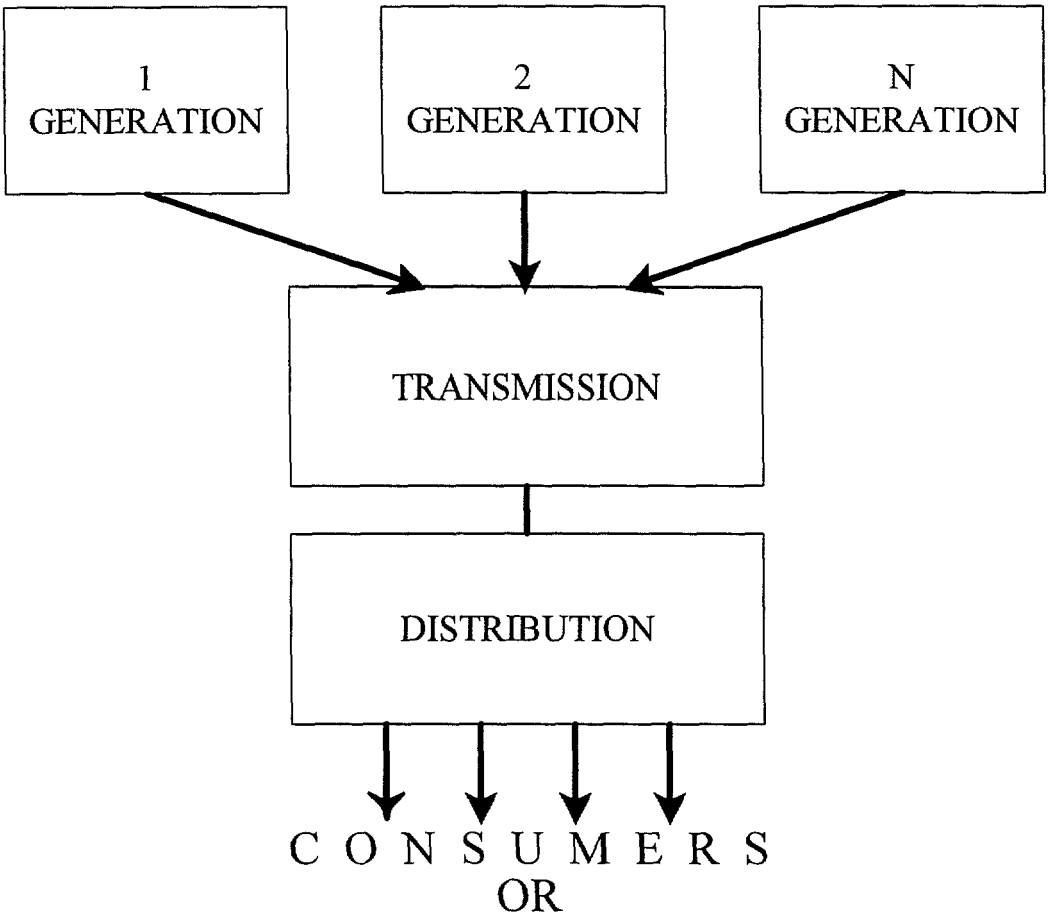
Figure D-3: Model 3 - Multiple Sources of Generation



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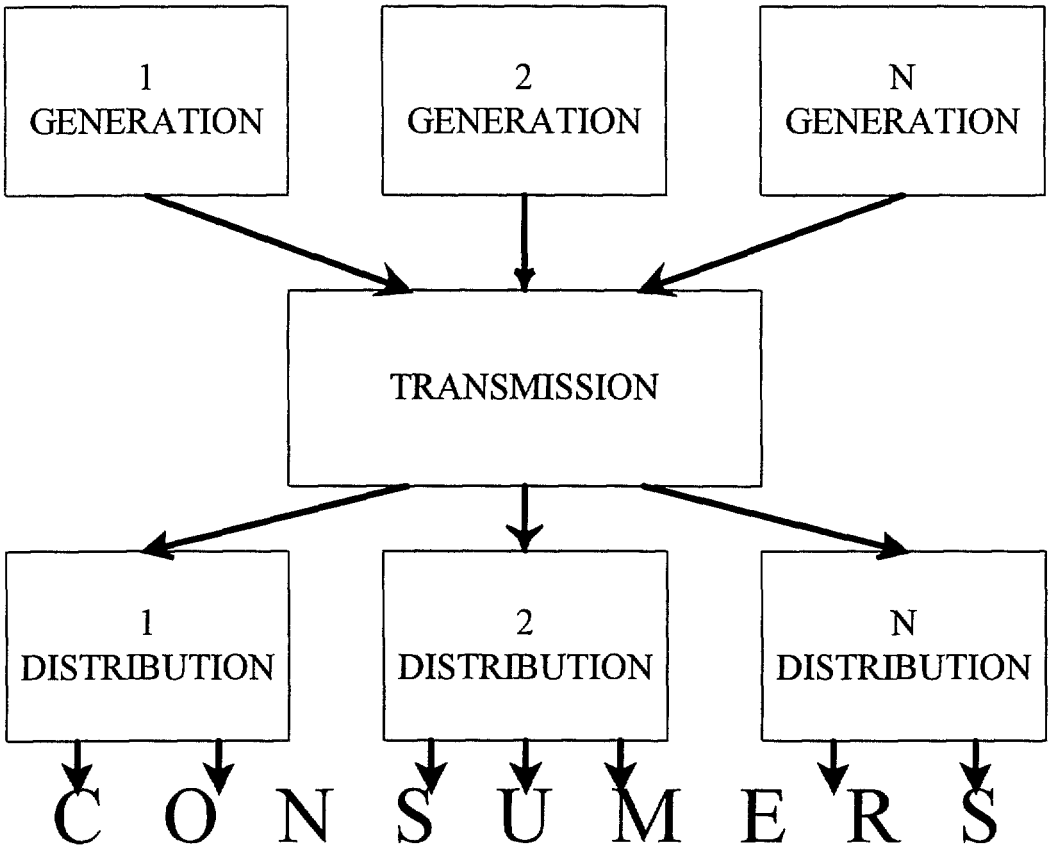

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Finally, the potential entry of new suppliers introduces competitive discipline on the investment decisions and operations of the G&T Company The G&T Company should remain free to proceed with its own projects if it is not satisfied with the project proposals it receives ***However, the G&T Company must be prepared to defend its decision before the regulatory authority under the scrutiny of the distribution companies. Further, the G&T Company also runs the risk that it may not recover the full costs of its own project if its costs of construction or operation greatly exceed the cost estimates that the G&T Company used to reject developers' competing proposals.***

Permitting independent power projects has few disadvantages There is no question that the global market for new generation projects is highly competitive Independent power projects using traditional technology have been competitively procured and successfully developed in power markets of all sizes Less traditional technologies, such as cogeneration and various renewable resources (e g solar), are generally installed at a size that can support multiple projects notwithstanding the small size of a power sector

As is the case with full competition, independent power projects will not ensure the financial viability of the power sector or guarantee that all power projects obtain access to capital The fact that the independent project developers will sign long-term contracts with the G&T Company, which has a secure market, will help to finance projects by insulating the developers from political and market (load growth) risks The independent power projects do not themselves have a guaranteed market Poorly designed projects will have to stand on their own economic merits and may not be able to be financed Poorly-managed projects can go bankrupt It is precisely this financial and competitive discipline, however, that encourages efficiency and the commercial orientation desired for the power sector

The fact that individual projects may go bankrupt does not pose a risk to the power sector The purchasing utility is able to protect itself contractually regarding the risk of bankruptcy, as well as performance and the other risks generally associated with a poorly run power project

The reliance on contracts and market mechanisms is the biggest drawback of permitting multiple generation companies Coordination of the power sector becomes more difficult with multiple generation companies Contracts have to replace consolidated direct management and control This can require complicated agreements and time-consuming negotiations between the various power sector entities This task is not insurmountable, and is greatly simplified by retaining the G&T Company and limiting the introduction of multiple generation companies to *new* generation projects There is significant international experience regarding the long-term power purchase agreements necessary to support the development of independent power projects

The G&T Company's need for flexibility in purchasing from independent project developers, while at the same time being a competitor of such developers, raises the difficult issue of ensuring that the G&T Company objectively evaluates developers' proposals Ensuring such objectivity is the difficult task of the regulatory authority This task can be simplified, however, through different structural options for the power sector

The establishment of separate operating subsidiaries for generation and transmission will provide several important advantages First, separating generation from transmission will make it easier for the regulatory authority to trace the generation costs and will make comparisons between the G&T Company's and developers' project proposals easier The separation will also remove the management responsible for developing project proposals from the management responsible for project evaluation, helping to reduce bias and reinforcing the commercial orientation of managers responsible for arranging resources to satisfy the sector's power needs

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Model 4: Wholesale and Retail Competition

Under Model 4 the transmission company's monopoly over power sales is eliminated The monopoly over power sales can be eliminated at either the wholesale or retail levels Figure D-4 illustrates the competitive industry structure

With wholesale competition, the distribution companies are permitted to buy power from any generation source The transmission company, to the extent it retains ownership of generation, must compete with other sources of generation to make sales to the distribution companies Under this approach, responsibility for planning and acquiring power supplies has shifted from the transmission entity to the distribution companies, which continue to have a monopoly over sales to final customers

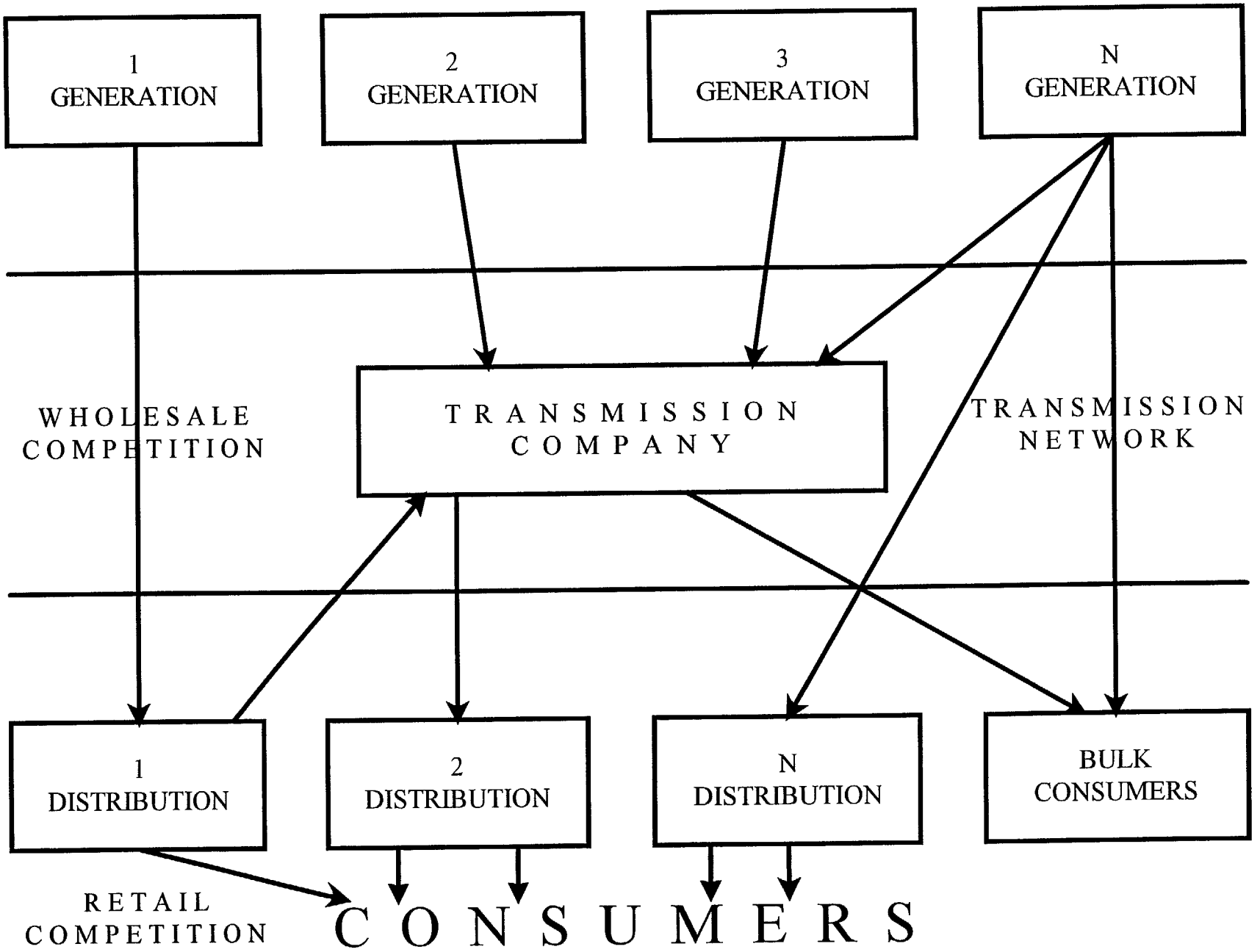
With retail competition, power suppliers can sell directly to final consumers The distribution companies deliver power sold by generators directly to the retail customer The distribution companies, to the extent that they want to sell power (that they have either purchased or produced themselves), must compete with all other power suppliers Under this approach, competitive discipline is introduced into the capacity planning and acquisition process Cost increases owing to miscalculations or unexpected events will not be automatically recovered from consumers

Full competition offers several advantages The power sector will become commercially oriented by the fact that consumers have supply choices Competitive discipline will be fully imposed on the generation sector, encouraging efficient operation of existing power plants and the addition of new generation at minimum cost To the extent some degree of retail competition is permitted (even if it is just the installation of generation by large industrial customers), competitive discipline will also be imposed on the distribution companies' generation capacity planning and acquisition decisions

By having prices of power set competitively, prices will reflect costs, which will result in power suppliers and consumers making efficient decisions about energy production and use Significant competition at the retail level will make it difficult to cross-subsidize — although the transmission network, as a monopoly service, could be used to tax the power sector

The disaggregated structure of the industry facilitates the introduction of private capital There will be several companies available for private ownership Once tariffs are competitively established, there should be no difficulty attracting both domestic and international participation in generation companies

Figure D-4: Model 4 - Wholesale and Retail Competition



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Further, regulation becomes much easier with vertical disaggregation Regulation will only have to focus on the activities that remain monopolistic, that is, the provision of transmission and distribution wire services The more limited role of regulation will also limit the scope for government interference with investment decisions and management of generation With full retail competition, the distribution companies' resource planning and acquisition decisions do not need to be regulated

There are drawbacks, however, to this approach First, market mechanisms and contracts will have to replace direct management and control as the means for coordinating operation of the industry [1]

This will require a very complex system and impose significant transaction costs Technical agreements for the dispatch of generation, network agreements for use of the transmission and distribution networks, and "balancing agreements" to address system impacts for shortfalls between power output, contracted output and power consumption will have to be developed In addition, contracts for all power supply transactions will have to be negotiated

These problems are not insurmountable The concepts and methods necessary to operate a competitive wholesale electricity market and associated contracts are becoming well-established and applied around the world

With the introduction of competition, financial viability of and access to capital for all power sector entities cannot be assured Since the power suppliers do not have captive customers, and prices are established and fixed through competitively negotiated contracts, there is no guarantee that all of a supplier's costs will be able to be recovered With fixed contracts, costs exceeding expectations can cause financial hardship and bankruptcy Similarly, with retail competition, the distribution companies will lose their secure market—with the possibility of imbalances between supply and demand resulting in unrecovered costs

This last drawback to full competition may in fact be an advantage That the financial health of a power sector entity is not guaranteed is the mechanism for imposing competitive discipline on the commercial operation of the power sector Poor investment decisions and bad management result in poor financial performance—thus helping to provide protection against such practices Experience worldwide documents that wholesale competition does not pose problems attracting finance from private sources Viable projects are financed Wholesale competition does result, however, in financial institutions closely analyzing the economic viability of projects As such, competition essentially enlists the aid of private sector financial institutions in policing against poor investment decisions and poor management

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The provision of service by the transmission network and bilateral contracts between power suppliers and customers cannot alone result in efficient competition and coordinated operation of the power sector because an action by one entity on an integrated transmission grid can affect other entities on the grid in immediate, uncontrollable and unpredictable ways Thus, no two parties can be allowed to enter into transactions without regard to the impact on third parties Also, all parties to the system need to be able to compare their transactions to other market opportunities for efficiency to prevail Consequently there needs to be a system or "pool" rules that apply to all generators and govern dispatch of generation and pricing of power

Annex E
REGULATION OF THE RUSSIAN EXTRA-BUDGETARY INTERINDUSTRIAL ENERGY SAVING FUND

General Provisions

1 The Russian extra-budgetary interindustrial energy saving fund hereinafter referred to as the Energy saving fund/ is set up in compliance with the Regulation of the Government of the Russian Federation of June 1, 1992 No 371 "On urgent energy saving measures in the field of extraction, production, transportation and utilization of oil, gas and oil products" in view of providing financial support to government energy saving policy

2 The Energy saving fund performs its activities on regional as well as on federal levels as an entity comprised of regional extra-budgetary energy saving funds, set up under paragraph 1, article 20 of the Russian Federation Law of March 5, 1992 "On Soviets of People's Deputies of Krajs and Oblasts and on Administrations of Krajs and Oblasts" as well as of the Federal extra-budgetary fund

3 The Energy saving fund is managed, in conformity with Regulation of the Russian Federation Government of June 1, 1992 No 371, by the Management Board of the Energy saving fund, incorporated within the system of the Ministry of Fuel and Energy of the Russian Federation as an economically independent legal entity The guidelines for utilization of the Energy saving fund's resources are coordinated by the Supervisory Board of the Fund, set up by the Ministry

Coordination of works, connected with the utilization of resources of regional energy saving funds, is carried out by the relevant departments and energy committees of administrations of krajs and oblasts Regional energy saving funds are managed by self-supporting energy saving centers and other similar structures, set up by administrations of krajs and oblasts, on the accounts of which the resources of those funds are accumulated

The Management Board of the Energy saving fund provides methodical guidance and takes part in the activities of energy saving centers of krajs and oblasts in view of promoting the government energy saving policy and providing it with financial and technological support

4 The Management Board of the Energy saving fund as well as the regional energy saving centers are governed in their activities by the Constitution of the Russian Federation, laws and other legal acts, adopted by congresses of people's deputies of the Russian Federation and by the Supreme Soviet of the Russian Federation, decrees and ordinances of the President of the Russian Federation, the Government of the Russian Federation, charters of the Management Board of the Energy saving fund and of regional energy saving centers, as well as by the present Regulation

5 Resources of the Russian extra-budgetary energy saving fund on federal and regional levels are formed out of

- Quarterly remittances by industrial, construction and transport enterprises and organizations of 0 5% of cost of energy resources consumed over the previous quarter, including the above sums into the costs of production (works, services) of the above enterprises

- Payments of statutory penal sanctions for irrational utilization of fuel and energy resources

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- Resources allocated to the Management Board of the Fund and to regional energy saving centers out of federal and local budgets as well as received from other sources for carrying out their investment activities, financing research and development and other energy saving programs, as well as those received in form of dividends, interests on deposits and on loans and other proceeds from their economic and commercial activities

- Donations of legal and physical entities

Administrations of krajs and oblasts are permitted to use part of resources of environmental funds to form their regional energy saving funds

6 Industrial transport and construction enterprises, consuming fuel and energy resources, are to make quarterly remittances, starting with the fourth quarter, 1992, to the accounts of federal and regional funds, to the amount of 0 5% of the cost of energy resources, actually consumed by them in the previous quarter The above sums are included into the cost of production works, services) of the above enterprises and organizations, as provided for by Regulation of the Government of the Russian Federation of August 5, 1992 No 552 "On adoption of the Regulation ~ n expenses on production and sale, included in the costs of production (works, services) and on the methods of accounting financial results for the purposes of taxation "

The above resources are to be remitted by enterprises and organizations to the Energy saving fund ont eh following pro rata basis

- To the Federal energy saving fund - 30%

- To regional energy saving funds at the place of location of enterprises and organizations 70%

Budgetary organizations, providing services to population, public utilities and social sector organizations, farms, collective farms, state farms are exempt for such payments

Payments to energy saving funds are effected for the consumption of the following fuel and energy resources natural gas, engine fuel, coal, electric and thermal energy Administrative bodies of krajs, oblasts, autonomies of the Russian Federation, of Moscow and St Petersburg, as well as the Ministry of Fuel and Energy of the Russian Federation advise the above enterprises and organizations of account numbers of energy savings fund

7 In compliance with Regulation of the Russian Federation Government of June 1, 1992 No 371 the Ministry of Fuel and Energy of the Russian federation and the Ministry of Science, Higher and Technical Education of the Russian Federation starting with 1993 provide joint financing on an annual basis of research and development in the field of energy saving technologies out of relevant extra-budgetary funds

8 Payment of statutory penal sanctions for irrational utilization of fuel and energy resources are earmarked for regional energy saving funds on terms and conditions provided for by law

9 The Ministry of Fuel and Energy of the Russian Federation as well as other ministries and departments of the Russian Federation, which have set up extra-budgetary investment funds, provide financing of energy saving expenditures, proposed by the Management Board of the Energy saving ~ fund, connected with implementation of energy saving programs, to the amount of 1% of the relevant extra-budgetary investment funds

10 Legal and physical entities, as a rule, make their donations to their local energy saving funds

11 Enterprises and organizations, making remittances to the Federal as well as regional energy saving funds, charge the above sums to the debit of production accounts and to the credit of account 67 of chart of accounts, approved by the ministry of Economy and Finance of the Russian Federation on December 19, 1991, No 18-05

Remittances are credited by banks to special accounts of Federal and regional energy saving funds, opened by the Management Board of the Energy saving fund as well as by energy saving centers of krajs and oblasts and by other similar self-supporting organizations, set up by local administrative bodies

Responsibility for timely and accurate remittances of the above resources is borne by enterprises and organizations, effecting such payments, as provided for by law

Guidelines for Utilization of the Energy Saving Fund's Resources

12 Resources of the Federal fund are allocated for large-scale inter-industrial and inter-regional energy saving programs mostly on the basis of equity participation in joint stock companies and other enterprises and organizations, granting soft loans and other forms of activities
Resources of the Federal fund are to be allocated mainly for the following purposes

- Financing of research and development, providing legal consultations and creating legal framework as well as of working out energy consumption standards .

- Supporting energy saving programs, taking into account their environmental aspects, on the basis of equity participation with organizations, commissioning such works, the contribution of which may not be less than 40% of total costs of the above programs

- Financial support of the development of production of sophisticated energy saving equipment, used for interindustrial purposes, of energy utilizing equipment, produced on a large-scale basis, as well as financing of creating the market infrastructure ~ or energy saving equipment

- Financial support of energy saving projects, connected with the complex production of highly efficient materials, constructions, equipment, technical re-tooling of enterprises, which ensures the engagement of energy saving reserves

- Granting soft loans to small and medium-size energy saving projects, which have undergone necessary technical and economic expert examination, directed a support of large-scale energy saving programs, production of consumer goods, foodstuffs, development of farms, construction of energy saving housing

13 Resources of regional funds are allocated for financing of territorial interindustrial energy saving programs, development of local base for the production of energy saving equipment used for interindustrial purposes, financial support of activities as well as providing adequate technical facilities to regional expert councils and extra-ministerial bodies, supervising the efficient utilization of fuel and energy

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14 Administrative bodies of krajs, oblasts, regional energy saving committees and other relevant local organizations utilize resources of regional energy saving funds as provided for by the present Regulation

15 Soft loans are granted by the Management Board of the Energy saving fund as well as by energy saving centers of krajs and oblasts (and other similar structures) after approval of their plans and programs by the Supervisory board or by energy committees of krajs and oblasts respectively Interest payable on the above loans granted out of the Fund's resources is determined by the Management Board of the Energy saving fund, as a rule, for two years to the amount of up to 50% Part of interest payments, not exceeding 20%, is used for financing of Management Board of the Energy saving fund

16 In view of providing additional economic incentives to enterprises, designing and producing energy saving equipment, to ensure higher technical level of the above equipment and increase its production volumes, according to decisions taken by energy committees as well as by the Management Board of the Energy saving fund, resources of Federal and regional energy saving funds may be allocated for grants, given for the following purposes

- Equity participation in the financing of research and development in interindustrial fields up to 50% of its cost

- Development of production of trial lots of energy saving equipment, equipment for utilization of non-traditional energy resources, equipment for utilization of local energy resources, recycled wastes and secondary energy resources - up to 25%

- Construction and refurbishing of buildings, ensuring higher energy efficiency, up to normative levels - 2%

The amount of resources, allocated for grants given out of regional energy saving funds, is not to exceed 20% of their annual proceeds Enterprises and organizations, consuming fuel and energy, which ensure sustainable increase of utilization of secondary energy resources, in view of providing incentives to them, may be refunded for 20% of their expenditures, connected with the carrying out of such works

Resources of the Energy saving fund are being used for setting up an information database of energy efficient technologies, for creating a legal framework for the system of management, which is being established, for insurance of investments into energy saving programs, made by domestic and foreign companies and firms, for training of staff, including training abroad

17 Enterprises and organizations, ensuring the carrying out of expert examination of their energy stocks to find reserves for energy saving with the help of special diagnostic devices, may be refunded for 25% of total costs of such works out of resources of energy saving funds of krajs and oblasts

Resources of the Energy saving fund are allocated primarily for providing incentives for examining energy stock of enterprises and organizations consuming in excess of 30 thousand tones of coal equivalent, heating boilers with the capacity in excess of 10 hectocalories per hour, heating units of magistral heating networks

18 Benefits under pp 15, 16 and 17 of the present Regulation are primarily granted to enterprises and organizations, which ensure the carrying out of expert examinations of their energy stocks

Supervision Over Forming and Utilization of Resources of The Energy Saving fund

19 Enterprises and organizations, relevant government agencies, connected with the ensuring of proper utilization of the Energy saving fund resources on both federal and regional levels, are not permitted to use the above resources for purposes, not provided for by the present Regulation

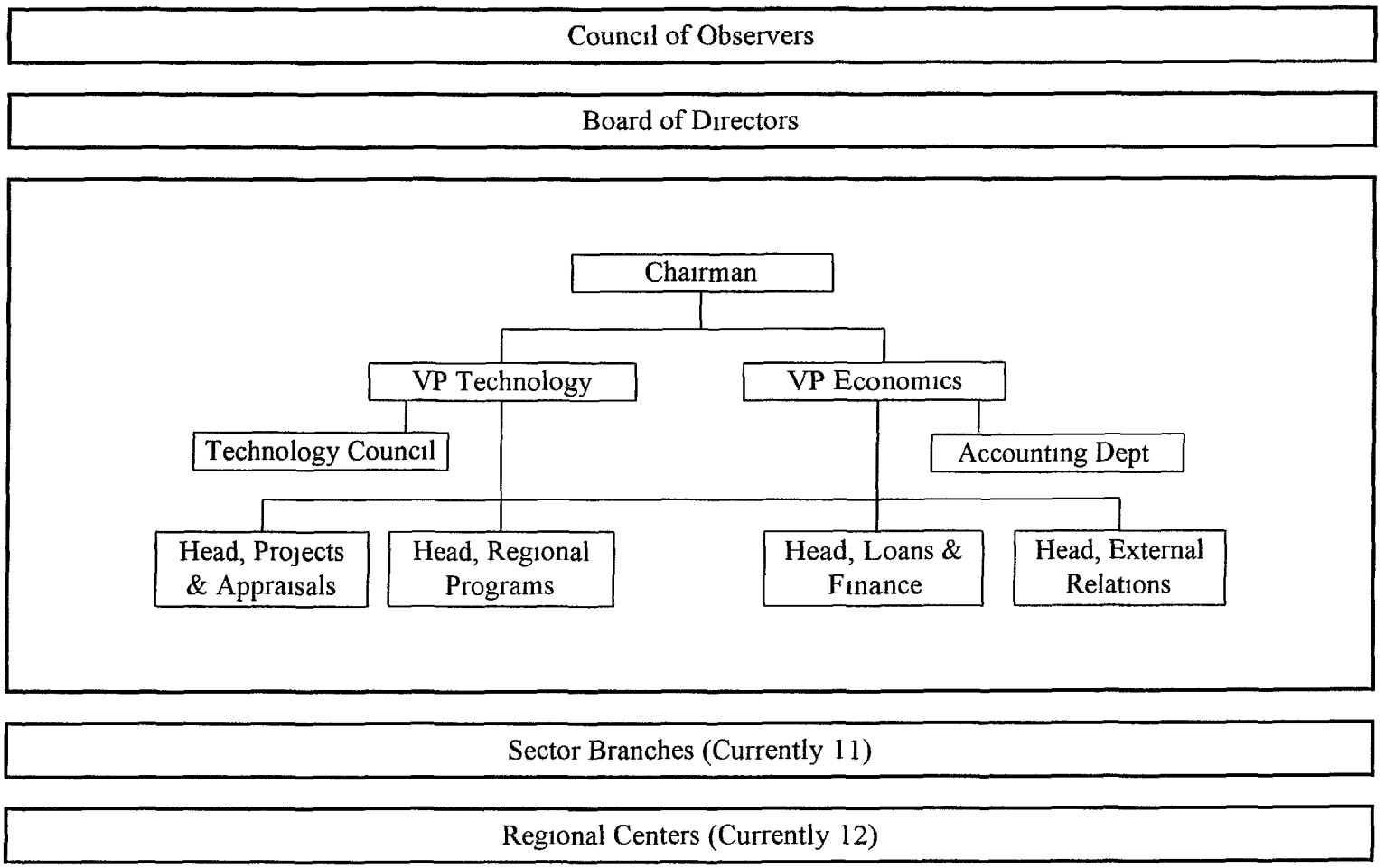
20 Supervision over the accuracy and timeliness of payments to federal and regional energy saving funds is to be carried out by the relevant administrative bodies of krajs and oblasts as well as by the energy saving fund Management Board

21 The Management Board of the Energy saving fund as well as self-supporting energy saving centers set up by administrations of krajs and oblasts and other similar structures bear responsibility for the proper utilization of the Fund's resources

22 Should the competent bodies detect the breach of the order of utilization of the Fund's resources, provided for by the above Regulation, officials, directly responsible for the above wrongdoing/are to be brought to responsibility under the Russian Federation rules of law in force The Management Board of the Russian Federation extra-budgetary inter-industrial energy saving fund as well as regional energy saving centers are to ensure the including of provisions on penal sanctions for breach of order of utilization of the Fund's resources into contracts to be concluded with their employees

- Deputy Minister of Fuel and Energy of Russian Federation
- Deputy Minister of Economy of the Russian Federation
- Deputy Minister of Finance of the Russian Federation

Exhibit E-1
RESF - Organization Chart



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Annex F
EUROPEAN BANK (EBRD) OUTLINE OF PROPOSED CONTRACTUAL RELATIONSHIPS, PERFORMANCE GUARANTEES, LEGAL STRUCTURE AND MONETARY FLOWS FOR FINANCING ENERGY EFFICIENCY DEMONSTRATION ZONES IN THE RUSSIAN FEDERATION

A. Creation of Special Purpose Project Company (SPPC)

- SPPC is the Borrower for the project loan
- Purchases gas from local distribution companies and sells to District Heating company, sells saved gas to Foreign Purchaser (via Gazprom either through direct contracts or TPA structure when finalized in Russia)

B. Contractual Relationship

- Gas Supply Contracts (between Gazprom and SPPC)
- Gas Transportation Contracts for the saved gas (between SPPC and Gazprom)
- Gas Sales Contracts for the saved gas (between Gazprom and Foreign Gas Purchaser)

The three contracts would be linked through common mechanisms determining gas prices, tariffs, volumes, and contracts duration Contracts also include performance incentives and penalties on both parties

C. Performance Guarantees

- Foreign equipment supplier would provide guarantee of performance of energy savings equipment
- Gazprom would provide performance guarantees to IFIs and commercial banks regarding its fulfillment of gas supply and gas transportation obligations to SPPC

D. Legal Structure

- SPPC is Joint Venture, potential owners include
  - Foreign equipment supplier
  - Foreign gas purchaser
  - Gazprom
  - District Heating authority
  - Municipality
  - Gas distribution company
- SPPC is Borrower for loans from EFIs and commercial banks

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- IFIs and commercial banks jointly appoint offshore agent bank which administers offshore escrow account, through which project proceeds pass and from which debt servicing is paid

E. Monetary Flows

- SPPC purchases from Gazprom the same volume of gas as initially

- SPPC sells gas to District Heating company, which provides heat to local industrial, commercial, and residential customers utilizing less gas than before efficiency improvements were made

- SPPC transports saved gas through Gazprom system under gas transportation contract and sells the saved gas to Foreign Gas Purchaser under long-term gas sales contract

- Revenues from this sale (in hard currency) are paid into the offshore escrow

- IFI loan (and commercial bank B-loan) repayments made from escrow account (escrow account maintains 12-month debt service reserve, including interest and capital repayments)

- Balance of funds in escrow account returns to SPPC and is shared between owners

Exhibit F-1
Proposed Contractual Relationship

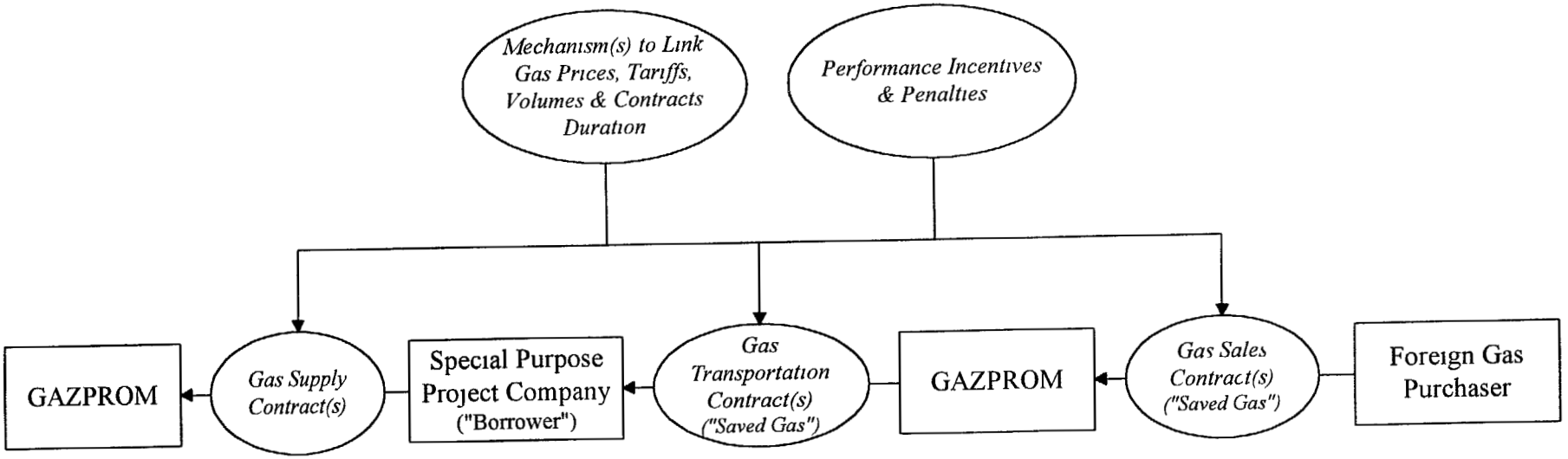

Exhibit F-2
Proposed Finance Garantees

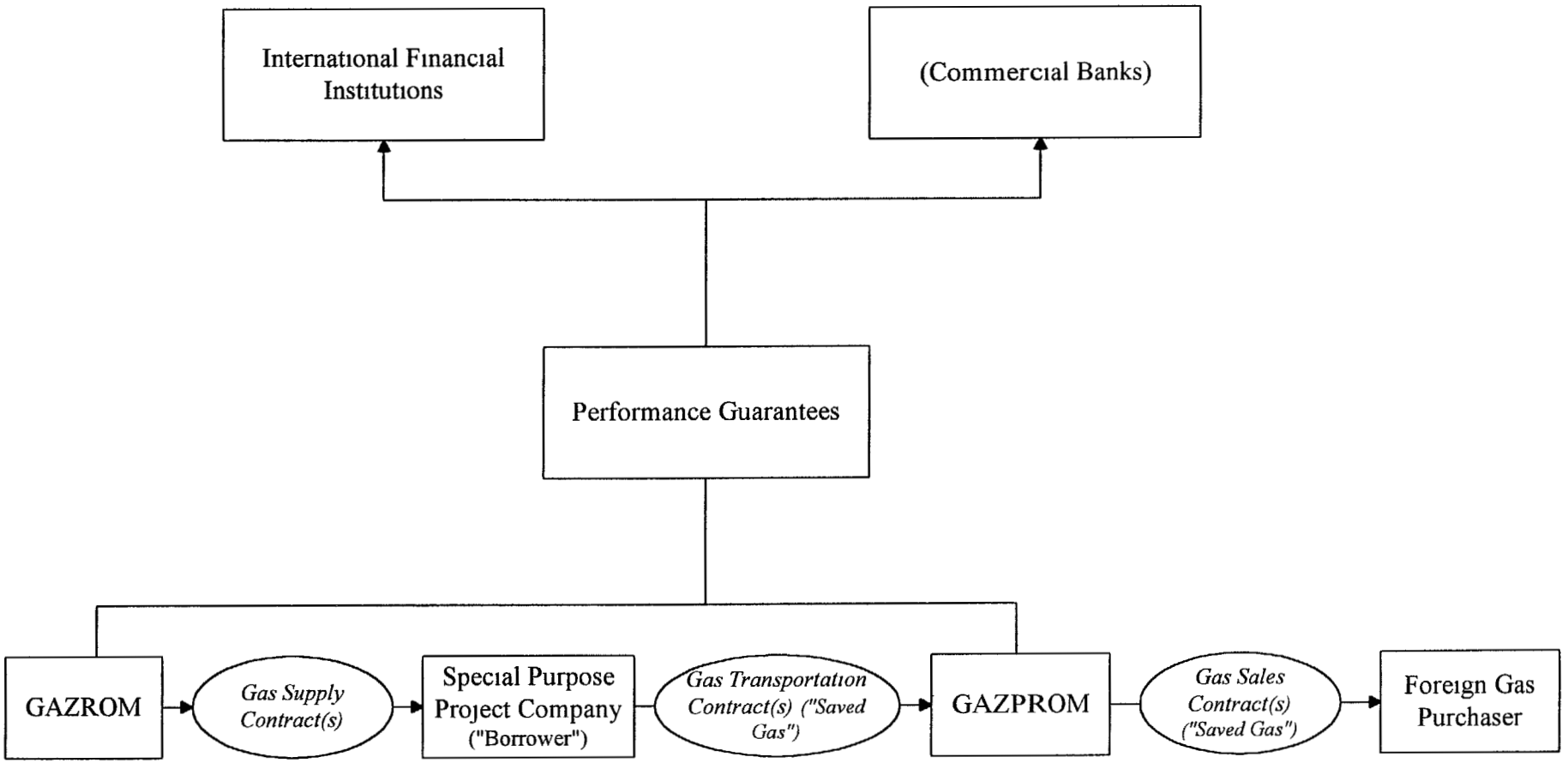

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Exhibit F-3
Proposed Legal Structure

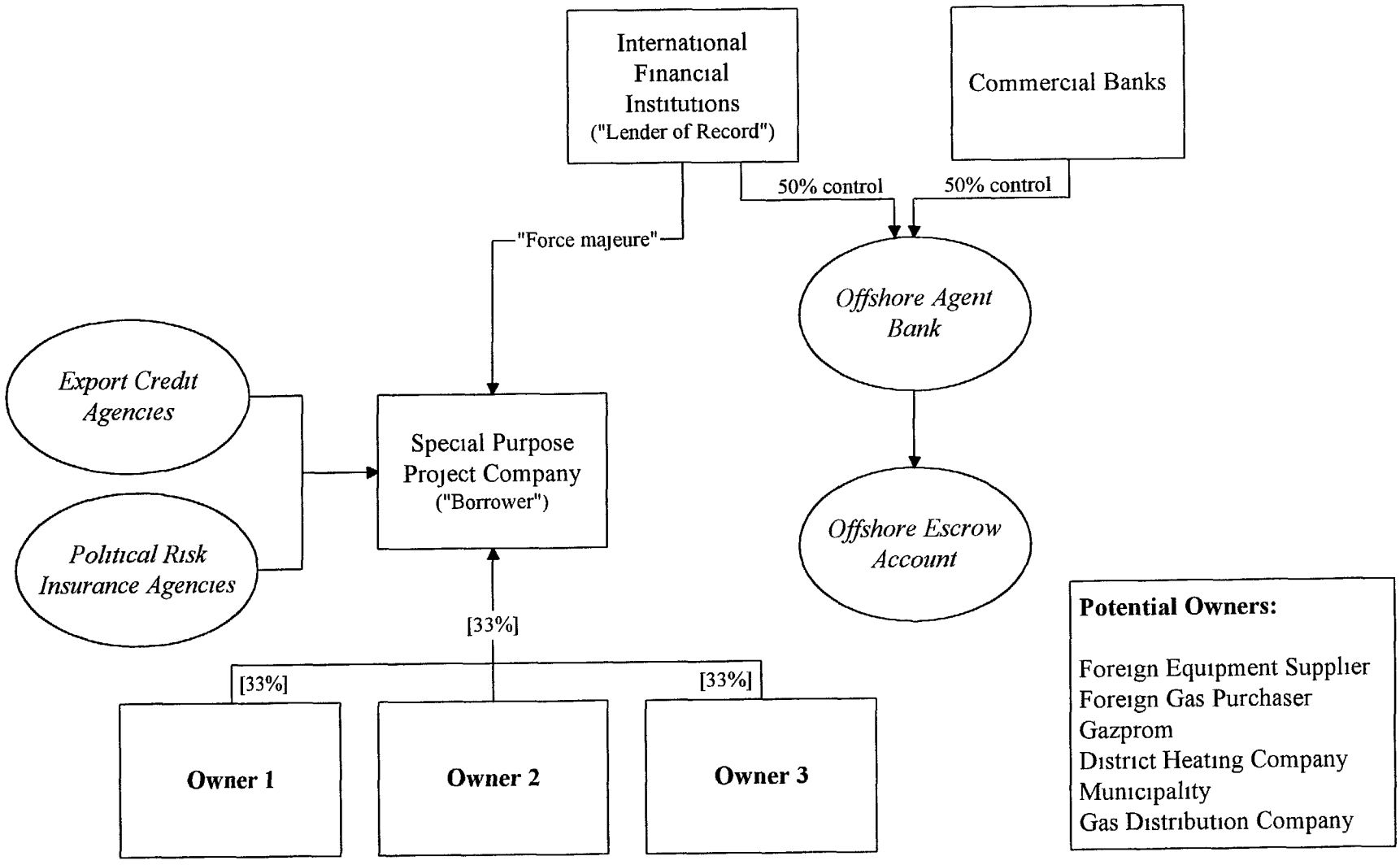

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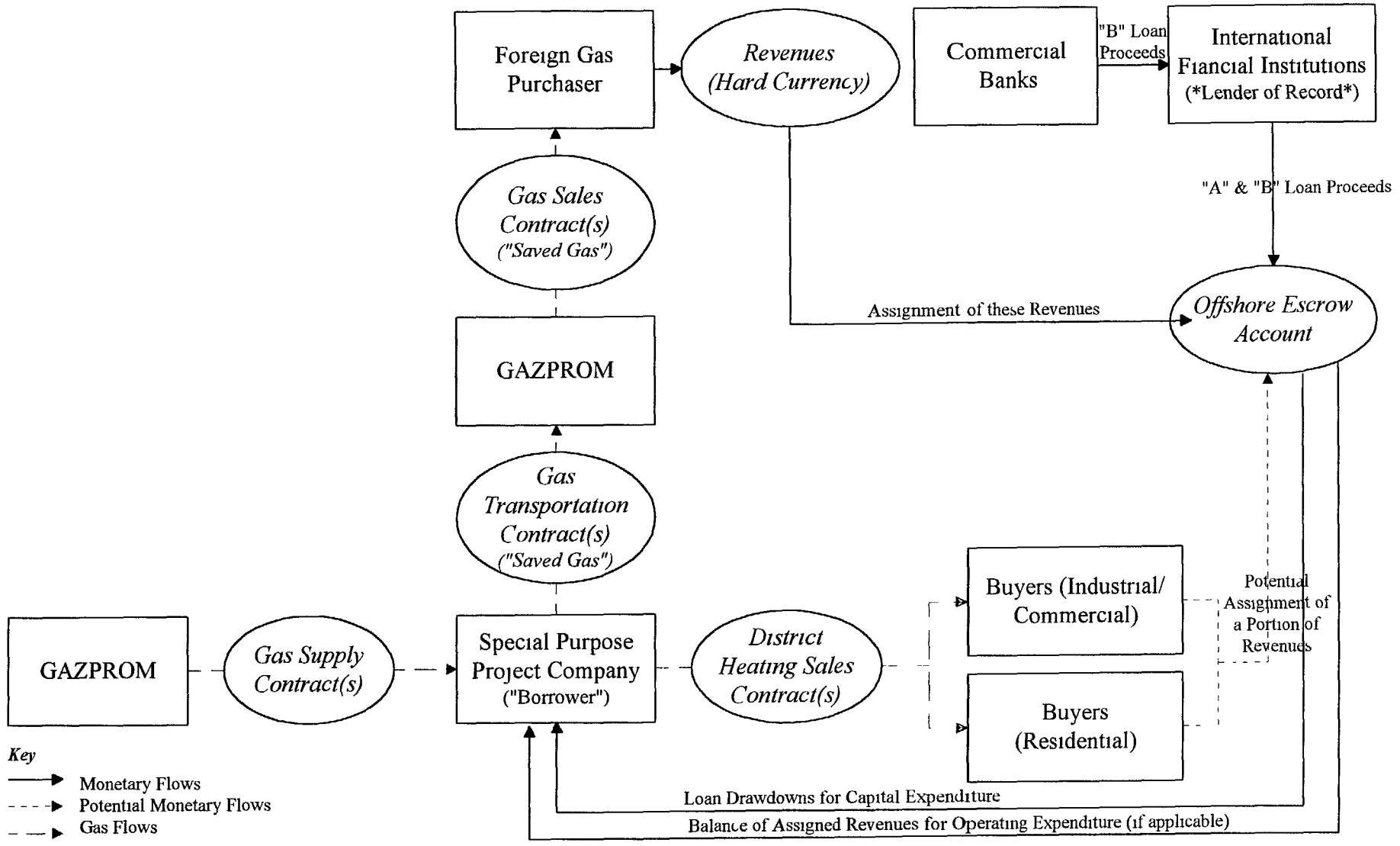
Exhibit F-4
Proposed Monetary Flows



Note (1) It is proposed that ownership of the SPPC's "saved" gas legally remains with the SPPC

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Annex G
ENERGY MANAGER JOB DESCRIPTION

A typical job description for an Energy Manager would be as follows

Job Title	Energy Manager
Reports to	Plant Manager
Supervises	2 Technicians

Energy Data Collection and Analysis

- Maintain records of all energy and water consumption in the plant
- Check the reading of all meters and submeters on a regular basis
- Specify additional meters required to provide additional monitoring capability
- Develop indices for specific energy consumption relative to production and maintain these indices on a monthly basis for all major production areas
- Set performance standards for efficient operation of machinery and facilities

Energy Purchasing Supervision

- Review all monthly utility and fuel bills, ensure billing is proper and that the optimum tariff applied in each case
- Investigate and recommend fuel switching opportunities where a cost advantage to the company is possible
- Develop contingency plans to implement in the event of supply interruptions or shortages
- Work with individual departments to prepare annual energy cost budgets

Energy Conservation Project Evaluation

- Develop energy conservation ideas and projects, working with in-house staff, equipment vendors and outside consultants
- Summarize and evaluate possible energy saving projects according to the company financial planning requirements, perform the necessary economic analyses to permit management evaluation of the projects
- Obtain management commitment of funds to implement conservation projects
- Re-evaluate possible projects as the company operations change or grow, evaluate energy efficiency of new construction, building expansion or new equipment purchases

Energy Project Implementation

- Initiate equipment maintenance programs for energy saving
- Supervise the implementation of conservation projects, including specification of equipment, requests for quotation, evaluation of offers, ordering of materials, construction/installation, operator training, start-up and final acceptance

Communications and Public Relations

- Prepare monthly reports to management, summarizing monthly energy costs and consumption as well as specific energy consumption
- Communicate with all production and support departments, so that all participate in the energy management program
- Develop an awareness program within the company to encourage active participation by all employees in energy saving activities
- Develop training programs to upgrade knowledge and skills of all levels of employees in energy related matters
- Publicize the company commitment to energy conservation where appropriate, providing information for press releases and internal notices, presenting papers in professional conferences, and entering the company in energy award programs

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Annex H
ENERGY CONSERVATION OPPORTUNITIES

Summary Checklist

1 COMBUSTION

- 1 1 Operational equipment efficiency
- 1 2 Equipment maintenance and replacement
- 1 3 Heat recovery
- 1 4 Heat confinement

2 STEAM

- 2 1 Steam system equipment upgrade and repair
- 2 2 Steam system changes

3 OTHER UTILITIES

- 3 1 Electricity
- 3 2 Compressed air
- 3 3 Water

4 SCHEDULING AND SHIPPING

- 4 1 Equipment scheduling
- 4 2 Plant scheduling
- 4 3 Packing, shipping, handling and transportation

5 PROCESS EQUIPMENT AND PROCESS CHANGES

- 5 1 Equipment maintenance and replacement
- 5 2 Operation and process design
- 5 3 Process specific techniques
- 5 4 Process heat recovery
- 5 5 Process heat confinement

6 BUILDINGS AND SITES

- 6 1 Lighting
- 6 2 Space heating, cooling and ventilation
- 6 3 Miscellaneous

1 COMBUSTION

1.1 Operational Equipment Efficiency

1 1 1 Boiler air/fuel ratio control
- Adjust/tune burners for optimum ratio
- Monitor boiler efficiency and improve control capability or add automatic controls (oxygen trim)

1 1 2 Hot air for combustion use
- Intake to take hottest air
- Preheat combustion air with waste process heat

1 1 3 Fuel atomization improvements
- Heat oil to proper temperature
- Use air instead of steam for atomization
- Check steam is at correct pressure

1 1 4 Miscellaneous
- Minimize boiler blowdown by monitoring water quality
- Reduce blowdown requirement by better water treatment
- Preheat make-up water with waste process heat
- Install automatic stack damper to reduce stand-by losses

1.2 Equipment Maintenance and Replacement

1 2 1 Boiler maintenance
- Establish boiler maintenance schedule
- Keep boiler tubes clean, both fireside and waterside

1 2 2 Replace and upgrade equipment
- Replace obsolete burners
- Replace obsolete boilers

1.3 Heat Recovery

1 3 1 Heat recovery from stack gases for boiler operations
- Preheat combustion air
- Preheat boiler feedwater

1 3 2 Heat recovery from stack gases for process heat
- Install waste heat boiler to provide direct shaft power
- Generate steam for process use
- Preheat materials going to dryers, ovens, etc
- Preheat process fluids or service hot water

1 3 3 Heat recovery from stack gases for HVAC
- Install waste heat boiler to make steam for space heating
- Recover heat for direct use for space heating

1.4 Heat Confinement

1 4 1 Insulation of boilers, burners, etc

- Repair faulty insulation and refractories
- Install boiler insulation or upgrade to optimum thickness
- Install ceramic fiber insulation (with low specific heat) in cyclic operating furnaces
- Reduce size of charging openings, slots, doors, etc or add moveable covers or doors
- Install automatic stack damper
- Repair walls to reduce air infiltration

2 STEAM

2.1 Steam System Equipment Upgrade and Repair

2 1 1 Steam trap upgrading/repair

- Install steam traps
- Use correct size steam traps
- Use appropriate trap types
- Repair/replace faulty or leaking traps
- Shut off steam traps on sections of unused line

2 1 2 Condensate return system

- Increase the amount returned (repair leaks, replace direct steam heating by indirect systems)
- Cover and insulate condensate storage tanks
- Install, upgrade or repair insulation on condensate lines
- Recover flash steam from condensate for re-use

2 1 3 Steam lines and distribution systems

- Insulate, upgrade or repair steam line insulation
- Insulate valves and fittings

2 1 4 Steam system leaks

- Repair and eliminate leaks in lines and valves
- Repair and eliminate leaks at reducing stations
- Repair and eliminate steam leaks on process equipment

2.2 Steam System Changes

2 2 1 Steam for distillation

- Operate distillation columns at minimum quality requirements
- Operate columns near flooding conditions for maximum separation efficiency
- Determine correct feed plate locations on columns to increase efficiencies
- Consider switching selected steam stripping columns from live steam to indirect heating
- Use reflux ratio control instead of flow control on distillation columns

2 2 2 Use of steam condensate

- Return steam condensate to the boiler plant

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- Flash condensate to produce low pressure steam
- Use steam condensate for non-potable water uses (e g domestic hot water)
- Insulate steam condensate lines
- Replace live steam uses by steam coils where possible, and recover condensate

2 2 3 Steam lines and tracing
- Use minimum steam operating pressure
- Substitute hot water or other hot fluid for steam tracing
- Turn off tracing during mild weather
- Remove or close off unused sections of steam lines

2 2 4 Miscellaneous
- Clean steam coils in process tanks
- Maintain steam jets used for vacuum systems
- Optimize operation of multi-stage vacuum steam jets
- Use automatic temperature control where possible
- Replace steam let down stations by turbine drives
- Replace steam jets by efficient vacuum pumps

3 OTHER UTILITIES

3.1 Electricity

3 1 1 Demand charge reduction
- Reschedule to minimize peaks
- Optimize plant power factor
- Install demand controller, load shedding system
- Install power factor controllers on motors

3 1 2 Reduction of other electricity charges
- De-energize excess transformer capacity
- Check meter calibration and accuracy regularly
- Restructure rate schedules, use alternative tariffs

3 1 3 Efficient use of electric motors
- Optimize motor size according to load, size for peak operating efficiency
- Use multi-speed motors or variable speed drives for equipment with varying loads
- Evaluate the use of high efficiency motors for services operating continuously

3 1 4 Transformers, conductors, and other equipment
- Reduce load on electrical distribution systems to reduce losses (e g increase power factor)
- Increase conductor size to reduce distribution losses
- Consider replacing old or obsolescent transformers
- Take into consideration power losses as well as initial loads and likely growth in the sizing of transformers

3.2 Compressed Air

3 2 1 Reduction in air use

- Reduce the system pressure to minimum
- Eliminate the use of compressed air for cooling products and equipment, or for agitating liquids
- Ensure proper pressure control (avoid excess pressures)

3 2 2 Compressor intake
- Install air compressor intake at coolest point available
- Consider use of heat exchanger or water spraying to cool air to the compressor
- Use interstage cooling on multistage machines

3 2 3 Leaks
- Determine rate of leakage, test for leaks regularly
- Eliminate leaks in lines and valves
- Remove or close off unused lines

3.3 Water

3 3 1 Cooling water reduction
- Use minimum cooling water flow to bearings and seals
- Shut off cooling water when not needed
- Adjust cooling water flow to avoid sub-cooling
- Clean tubes and heat exchange surfaces regularly to improve heat transfer rates

3 3 2 Recovery of water
- Recover and re-use cooling water

3 3 3 Water recycling
- Use a cascade system for rinsing
- Use a pond for ambient cooling of water

3 3 4 Leaks and distribution
- Eliminate leaks in lines and valves
- Remove or close off unused water lines
- Clean lines and remove fouling regularly

3 3 5 Monitoring water use
- Audit water meters regularly for prompt leak detection
- Check meter accuracy
- Install meters and monitor major water users

4 SCHEDULING AND SHIPPING

4.1 Equipment Scheduling

4 1 1 Equipment shutdown
- Shut down process heating equipment when not needed, e g boilers and furnaces at weekends
- Turn off electrical systems and machines when not in use (e g lunch breaks)
- Turn off lights when possible, use maximum daylight

- Turn off conveyors when not in use
- Install reset switches and timers when possible

4 1 2 Scheduling
- Use the most efficient equipment preferentially
- Schedule equipment to run at full load
- Use batch equipment on optimum schedule
- Optimize production batch sizes and inventories
- Where possible, run continually for as long as possible and then shut down, avoid frequent starting and stopping
- Avoid peak use of electrical equipment

4 1 3 Standby equipment
- Reduce temperature of stand by process heating equipment
- Minimize operation of equipment on standby
- If possible shut off pilot flames on furnaces and boilers

4 1 4 Electrical equipment
- Identify contributors to electrical demand and reschedule operations to reduce peak loads
- Recharge batteries during off-peak periods
- Use electric water heaters off-peak and store hot water for later use

4.2 Plant Scheduling

- Consider 3-4 days operation, 24 hours/day, not one or two shifts per day
- Schedule routine maintenance during non-operating hours

4.3 Packing, Shipping, Handling and Transport

4 3 1 Packing
- Use minimum necessary packaging materials
- Examine use of less energy intensive packaging materials

4 3 2 Material handling
- Repair and maintain conveyors, eliminate material losses
- Use gravity feed whenever possible

4 3 3 Truck operations
- Optimize truck routes
- Size trucks for the jobs required, loads carried
- Add air shield to trucks to reduce air resistance
- Shut off truck engine while loading, unloading, etc
- Maintain truck engines regularly for maximum efficiency

5 PROCESS EQUIPMENT AND PROCESS CHANGES

5.1 Equipment Maintenance, Repair and Replacement

5 1 1 Equipment maintenance

- Establish maintenance schedules and record keeping systems
- Improve lubrication practices
- Keep equipment clean, ensure adequate cooling of machinery

5 1 2 Equipment replacement
- Evaluate equipment purchases using lifetime costing
- Upgrade obsolete equipment to best modern standards

5.2 Operation and Process Design

5 2 1 Process Design
- Redesign process flows for minimum material handling
- Evaluate heat transfer systems for optimum heat utilization (e g use process integration techniques)
- Avoid repeated heating and cooling of process materials

5 2 2 Operation modifications
- Where possible, convert batch to continuous operations
- Operate one unit at high throughout (or output) rather than two units at half throughout
- Re-use process waste if possible
- Recycle process scrap at all stages
- Where scrap recycling is high, evaluate the process and reduce the rate of scrap generation
- Operate as close as possible to specification limits (less quality giveaway)
- Relax specifications if possible
- Make optimum use of automatic controls and monitoring instruments

5.3 Process Specific Techniques

5 3 1 Ovens, furnaces, kilns
- Convert from indirect to direct firing (change of fuel may be needed)
- Use hot exhaust gases to preheat furnace/kiln charge
- Recycle exhaust gases for combustion air, in the same or other equipment
- Ensure proper placement of charge in furnaces
- Install high velocity or rapid heating burner systems
- Optimize heating rates, residence times

5 3 2 Textiles
- Improve textile dryers (e g reduce air flows, recycle exhaust gases, raise exhaust humidity)
- Reduce moisture content at dryer inlet using mechanical methods (e g centrifuges, vacuum techniques)
- Install infra-red heaters for residual moisture removal
- Consider "low moisture" processes such as foam dying
- Use hot dye bath exit water for preheating incoming cold water, including hot water storage for subsequent use

5 3 3 Refrigeration, cold stores
- Use optimum thickness for insulation of cold systems

- Ensure good door seals
- Cool smallest space possible for refrigerated storage
- Consider storing "cold" to minimize peak loads and keep compressors running steadily at moderate loads

5 34 Hot water

- Reduce temperature of service or domestic hot water
- Use cold water for cleaning wherever possible
- Re-use cooling water for cleaning

5 3 5 Dryers

- Improve dryer efficiency (e g reduce air flows. recycle exhaust gases, raise exhaust humidity)
- Control inlet and outlet moisture levels
- Use presses, centrifuges or vacuum systems to remove moisture before thermal treatment
- Consider supplementary drying by infra-red equipment
- Utilize hot exhaust gases from other processes

5 3 6 Miscellaneous

- Consider vapor recompression in distillation and evaporation processes
- Convert liquid heaters from underfiring to immersion or submersion heating
- Add temperature controls to steam and heating systems
- Improve process controls to maintain tight product specifications

Annex I
POWER STATION AND DISTRICT HEATING QUESTIONNAIRE

Principal Kazakhstan's personnel contacted during the implementation of subject task

Mukhtar Kembaevich Kembaev, Director Almaty Heating Systems Enterprise "Almaty Energo"
Akhat N Kalendaryov, Chief Engineer, Almaty Heating Plant-2
Vladimir Ilyich Fedorenko, Chief Specialist, Research Designing and Prospecting Institute "Kaznipienergoprom"
Boris O Savadsky, Head of the Production-Technical Department, Almaty Heating Plant-2
B yrlyk E Orazbaev, Director, "Alma-AtaEnergo" Industrial Union Almaty Heating Plant-2
Tatyana Ya Hintitskaya, Technical Director, Small State Enterprise, Technical Center of Kazakhstan
Birles K Aliyarov, Director of Science (Technical) Professor, Kazakh Scientific & Research Institute of Power Engineering
Razgazy K Erekeev, Scientific Secretary, Kazakh Scientific & Research Institute of Power Engineering
Anatoliy Alekseevich Perelevsky, Deputy Chief Engineer, Alma Ata Heating Systems- Enterprise of Alma Ata Energo

A. IDENTIFICATION

1 Plant's Name Phone Number
2 Address
3 Name of Contact, and Position

Phone No Fax No Telex

4 Plant Capacity and Unit Descriptions
- a Number of Units
- b Nominal Plant Electric Output MWe
- c Nominal Plant Thermal Output Gcal/hr
- d Number of Power Boilers
- e Number of Hot Water (District Heating) Boilers
- f Number of Steam Turbines
- g Type of Fuels

B. MODE OF OPERATION

5 Date of Plant Commissioning_____

6 Number of Employees _____ Total _____ Per Shift_____

7 How many hours/day does the plant operate (average)?_____

8 When is the plant shut down for maintenance, and for how long? _____

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9 Is the plant in operation year around? _____ If no, when is it on and when is it off Is the plant base loaded or load cycled? _____

10 Identify problems with major equipment which have contributed to forced outage of the power plant or have required excessive maintenance Also identify equipment items which have contributed to a reduction in plant efficiency Major equipment to be considered include the following

a Boiler and Auxiliaries
b Turbine and Auxiliaries
c Balance of Plant equipment such as main steam, feedwater, and condensate system components
d Precipitator and Flue Gas Desulfurization Plant, if any
e Coal Handling System including coal pulverizers
f Ash Handling System
g Circulating Water System (including Cooling Tower)
h Water Treatment System including Condensate Polishing and Make-up Water System
i Plant Wastewater System

C. HEAT BALANCE

11 Attach diagrams showing the plant design heat balances This should include heat balance diagrams in pure condensing and/or district heating modes at full and part loads

12 What were the major assumptions and bases used in the development of the heat balance such as back pressure, pressure drops, efficiencies, etc?

13 How does the plant actually operate compared to the original design heat balances, assumptions and bases?

D. MAJOR PLANT MECHANICAL SYSTEMS

a Main and Reheat Steam
b Condensate and Feedwater
c Circulating Water (including Cooling Tower)
d Water Treatment (turbine cycle and district heating makeup)
e Air Quality Control (precipitator and scrubber if any) including forced draft and induced draft fans
f Coal Handling
g Ash Handling
h District Heating System
i Industrial Steam Supply System
j Heater Drain System

14 Attach flow diagrams for each of the above systems

15 What were the major assumptions and bases used in the development for each of the above systems?

16 Describe the major pieces of equipment associated with each of the above systems, and provide design and performance data sheets

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17 How does each of the plant systems operate compared to the original design bases and assumptions?

18 Describe which pieces of major equipment in each system have been modified and why, since the plant went into operation List the dates of major modifications

19 Provide Isometric or physical piping drawings for high pressure steam and feedwater piping, and piping material composition

20 Provide a set of General Arrangement drawings showing
a Site Plan
b Turbine Building (Plan & Sections)
c Boiler Building (Plan & Sections)

21 Provide water analysis for Boiler feedwater, Plant Cycle makeup water, District Heating makeup water, and Plant condenser Circulating Water

22 Provide monthly variation of cooling water (circulating water) temperatures

E. CONTROL SYSTEM

23 Describe major design features of the power plant control system

24a Describe briefly each of the plant major control subsystems, e g boiler control, burner management, feedwater, turbine control and supervisory emissions monitoring, etc

24b Describe methods used for space temperature control in Industrial, Commercial, and Residential district heating customers

25 Describe how each of the major control subsystems perform compared to the intended design

26 Describe which control subsystems have been modified and why since the plant went into operation

27 Provide a list of instruments which need to be replaced because they no longer work, or frequently failed

F. ENERGY SUPPLIES AND DEMANDS

28 List all fuels used in the plant, e g natural gas, low Btu gas, coal, lignite, coke, fuel oil, diesel oil

39 How are they brought to the plant? (Pipeline, truck, tank car, rail car, barge, etc)

30 List the relevant specifications for each fuel
Heating Value (HHV & LHV) Kcal/kg (Solid or Liquid)
Kcal/Cu M (Gas)
What is the pressure of Natural Gas at the plant site?

31 For the most recent 12 months, please fill out the table below

32 Are there data available on daily and seasonal variations in electrical load. and district heating and Industrial steam load?

33 What are the desired electrical and thermal outputs for the next 10 years (till 2005)?

34 Provide any available studies and reports regarding present and future expansion and/or rehabilitation plans for

- Steam turbines
- Boilers
- Other (balance of plant) components (feedwater heaters. condensers. district heating condensers, pumps, piping, etc)

G. BOILER INFORMATION

35 Provide the following data for each boiler

- Maker
- Type/Model
- Rated Boiler Capacity
- Final Steam Pressure
- Final Temperature
- Fuel Consumption
- Source of feedwater
- Water treatment used
- Water quality after treatment
- Makeup water quality and flow rate
- Percentage of condensate return
- Peak demand for steam
- How many times was major repair work done?
- Provide the repair history for each boiler?

H. PLANT MAJOR EQUIPMENT HISTORY

BOILERS

	Commissioning Boiler Cumulative						
	1	2	3	4	5	6	7
Commissioning Date							
Boiler Operating Capacity							
Cumulative Hrs of Operation							
Boiler Design and Operating Data for each boiler							
Max Steam Generation Rate							
Superheated Steam Pressure Temp							
Feedwater Temp Upstream of Economizer							
Air Temp Upstream of Air Heater °C							
Air Temp Downstream of Air Heater							
Flue Gas To Downstream of Air Heater							
Co-efficient of Excess Air Downstream of Superheater							
Co-efficient of Excess Air Downstream of Air Heater Co-efficient of Excess Air Downstream of Induced Draft Fan							
Boiler Gross Efficiency							
Boiler Capacity Factor (last 12 months)							
Forced Outage History							

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List of Required Design & Operating Data, Fuel Characteristics, General Arrangement and detail drawings, P&I diagrams, etc

1 Fuel Characteristics

a Original Design Fuel data for a coal fired plant, proximate and ultimate coal analyses, mineral matter elemental analysis, ash feasibility temperatures (initial deformation, softening, hemispherical, flow), Grindability Index (Hardgrove/Russian) For a Mazut/Natural Gas fired plant, both fuels composition For all fuels, higher and/or lower calorific values (kcal/kg)

b Presently Fired Fuel Characteristics as above Note we would like to receive ranges of fuel composition values, e g for coal, moisture content from 18 to 30%, ash content from 21 to 35%, etc , if they are available

2 Boilers and their auxiliaries design documentation

a Boiler Sectional Side Elevation
b Boiler Sectional Plan at the level of the burners
c Feedwater flow line diagram
d Boiler circulating system line diagram
e Saturated/Superheated steam flow line diagram
f Spraywater system for steam temperature control, line diagram
g Combustion air and fluegas flow line diagram
h Firing system line diagram (for a coal fired plant from mill bunkers to mills, to burners, for a mazut/NG fired plant from pumping/heating set to burners)
i Heating surfaces cleaning equipment details, e g number of furnace wall blowers, number of long retractable soot blowers, shot clean equipment components
j Burner assembly (tangential or wall type) details
k Furnace tubewall detail drawing, showing tubes, refractory backing, insulation/lagging, casing, furnace framing (buckstay) system details
l As in (k) but for furnace roof tubewall
m Economizer tube banks, detail drawing
n Design of Operating Manual for each boiler type in the plant, if available

3 Non-destructive (ND)/Destructive (D) Examination capabilities

a Thick-walled pressure parts crack detection equipment (X or Gamma Ray)
b Thick-walled pressure parts replication equipment (creep detection)
c Thick-walled pressure parts DE (e g boat samples taking) equipment
d Boiler tubes thickness (ultrasonic) equipment
e Metallurgical lab equipment e g cameras, microscopes, etc

4 Emission Control Equipment details for each boiler type

a Local, (Kazakhstan or Almaty) emission limits for SO2, NOx particulates
b Emission maxima of SO2, NOx particulates at present
c Annual Capacity Factors for the years 1991, 92, 93
d lan drawing showing space availability near the chimney stacks, for the retrofit of fluegas desulfurization (FGD) equipment The plans should indicate any equipment or structure or building that cannot be relocated
e Induced Draft (ID) fan characteristic curves (flow versus static head, efficiency, power)
f Chemical additives availability confirm that lime/quicklime/CAO is available in the power plant area Estimate the price per ton, delivered to the plant

g Availability of area within the plant for lime storage

h Bottom & flyash disposal methods at present Is a change of method required? Availability of existing/future landfill areas for the disposal of ash and FGD wastes?

i Describe the present method of Wastewater disposal Is a change necessary?

j Particulate collection equipment, existing, details e g venturi type wet scrubber total fluegas draft loss, electrostatic precipitator (ESP) dimensions, specific collection area, particulate collection efficiencies for all types of particulate collection equipment

I. TURBINE INFORMATION

36 Provide data for each turbine

- Maker
- Type/Model
  - Condensing
  - Back Pressure
  - Extraction
- Rating Capacity, MWe
- Date Installed
- Steam Pressure and Temperature
  - At Inlet
  - At Outlet
- By Pass
- Valves
- Description of Major Turbine Modifications and Dates
- Major Repair Work done

37 Regime diagrams for each type of turbine with diagram number

38 Outline and cross sectional drawings of each type of steam turbine generator

39 Technical description of steam turbine generators and auxiliaries (turbine manual, generator manual) for each type of turbine - including turbine generator data sheets showing main parameters, ratings (electrical/thermal), design limits, number of cylinders, blading design, auxiliaries (lube oil pumps, filters, HXs), electric generators, exciter and hydrogen cooler data, etc

40 Turbine actual operating data showing maximum load carried in warmest and coldest weather Minimum electric load required to carry domestic heat load, and calculated heat rate or efficiency for the past 12 months

41 Copies of the latest turbine performance tests reports

42 Turbine steam piping and drain piping schematics including piping materials

43 Reports on historic availability of individual turbine units including forced outage records

44 History of unplanned turbine shutdowns and load reductions and their reasons during the last 10 years

45 A list of items most frequently requiring maintenance in the turbine plant

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46 A list of present turbine operational problems, if any

a Description of equipment and capability for performing destructive and non-destructive (NDE) testing at the plant

b Description of the current inspection and maintenance program for the turbines

c Availability of turbine-generator inspection reports during the last 10 years

d Design data sheets for each of the condensers showing construction materials, and thermal performance data (condenser manual with performance curves, if available)

e Description of any modification to the condensers and dates

f Data on latest actual operating performance (or test reports) on condensers

g Description of outages and reasons for outages of condensers during the past 10 years

h Condenser drawings with cross sections and water circuit schematics showing cooling water and district heating water connections, if any

i Air extraction piping schematic and vacuum pump design and performance data

j Reasons and frequency of excess air inleakage into condensers, if any

k Description of main problems in condensers, if any

J. STEAM TURBINES

	1	2	3	4	5	6
Commissioning Date						
Current Elect Generation Capacity						
RPM						
Cumulative Hrs of Operation						
Electric & Heat Generation Capacities (MWe and GCal/hr)						
Major Repairs Done if any						
Turbine Shaft Vibration Amplitude						
Problem Holding Vacuum?						
Last Major Overhaul Date						
What repairs were performed during last major overhaul?						
Turbine Preventive Maintenance Schedule						
Turbine Forced Outage History						

K. MEASUREMENT AND METERING

47 How is electricity/hot water metered for industrial end user?

58 How is electricity/hot water metered for residential end users?

59 How is electricity/hot water metered for commercial end users?

L. CONDENSATE AND FEEDWATER SYSTEM

(A) No of Condensate Pumps						
Nos Operating/Standby						
Design Flow & Head						
Operating Flow/Head						
Scheduled (Preventive) Maintenance						
Forced Outage History						
(B) Feedwater Pumps						
Nos Operating/Standby						
Design Flow & Head						
Operating Floe/Head						
Scheduled (Preventive) Maintenance						
Forced Outage History						
(C) Feedwater Heaters						
No and Stages of Feedwater Heating						
Design Flow rate pressure and temp for both tube and shell side						
Operating Pressures, temp and flow rates for both tube and shell side at full (100%) plant load						
Forced Outage History						
(D) Preventive Maintenance and Forced Outage History for plant auxiliary equipment including plant surface condensers, circulating water pumps, vacuum pumps and air ejectors, plant air compressors, closed cooling water pumps and heat exchangers, etc						

M. SYSTEM

50 What is management's prediction of the growth of electrical and heating demand in the next ten years?

51 Are there any energy management or energy conservation programs implemented in the last three years? If yes, what are they?

52 Other comments or information that are pertinent to the energy audit of this power plant?

53 What are the critical areas where low cost instruments can make a significant contribution toward efficiency improvement of the system

54 Please indicate the total number of persons and the number of supervisors employed in the plant maintenance group

55 Are any maintenance and/or repair functions contracted to outside companies? Please describe the arrangement

56 How many power stations supply thermal energy to the district heating system? Please describe each one briefly

57 How is the price for electrical and thermal energy established? How often can it be adjusted? Who has the authority to approve a price adjustment?

58 Please describe the types of customers who receive service from the power system?

Private Residential	%
Collective Residential	%
Light Industry	%
Heavy Industry	%
Governmental Agencies	%
Commercial	%
Other	%

59 What are the rates for each group of the above customers?

60 How are the rates derived? Are there cost accountings practiced? If yes, please describe briefly

61 Are each customer's usage metered, and charged according to how much they each consume?

62 Are there any customers to whom steam or hot water is directly supplied by the power plants, without involvement from the district heating system? If so, what are the quantities supplied, and what are the prices charged?

63 Who and what department is responsible for developing and directing energy management and conservation programs?

64 What has been the result of these programs during the past year?

65 What are the most important causes of heat loss in the plant per major mechanical system?

- Water Leakage
- Steam Leakage
- Lack of Sub-Metering
- Piping Layout and Sizes
- Poor Insulation
- Pump Inefficiency
- Lack of temperature regulator for individual customers
- Others (Please Specify)

66 Please estimate the amount of each of the above losses as a percent (%) of total energy delivered to the system

67 What creates such heat losses?

- Lack of maintenance
- Lack of personnel
- Lack of accurate instruments
- Lack of spare parts
- Lack of incentive
- Poor design
- Pipe network too old
- Pumping equipment too old
- Other (Please Specify)

68 Who manages the water treatment and water quality for the system?

69 Please describe the cost of operating the power system Please provide costs as rubles per kW for a typical month during the high demand season and during the low demand season

- Electrical Demand, kW
- Fuel Cost
- Water Cost
- Maintenance Cost
  - Labor
  - Material
- Operating cost
- Depreciation
- Taxes and Insurances
- Administrative Overhead
- Supplies
- Others (Please Specify)

70 What energy-saving projects have been identified that may require capital expenditures

a Projects that would require less than U S $10,000 each

b Projects that would require more than U S $10,000 each

71 Please estimate the annual benefits that would be achieved by each above projects

72 Are computers used in the system?

- For Process Control

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For Data Collection
For Process Monitoring
For Billing and Bookkeeping
For Office and Cost Accounting

73 Please describe briefly the type of computer equipment used and the functions performed

74 Do workers, and managers receive training in energy saving and cost saving? If yes, what are the training programs, and who does the training?

75 Do workers and managers receive bonuses or other financial recognition for energy saving and cost saving ideas? If so, how much and how often?

Annex J
NONFERROUS METALS QUESTIONIONNAIRE

A. Identification

1 Name of Plant
2 Address
3 Name of Person Interviewed/Completing Form
4 Title/Position
5 Telephone
6 Fax (or Telex)
7 Industry in which the factory is classified

Mining	Construction Materials	Paper
Textiles	Mechanical/Electrical	Chemicals
Oil Refining	Food Processing	Steel
Other		

8 Date of factory commissioning

9 Number of Employees

10 How many hours per day does the plant operate (average)? Days per year (average)?

11 Please provide details on plant operation (e g procurement, fabrication, scheduling, inspection, packaging, storage, shipping)

B. Processing Activities

12 Provide a flow sheet of the plant indicating major operations

12a For Mining Operation Describe

Drilling & Blasting
Waste Stripping
Ore Mining
Haulage
Hoisting
Other

13 List the different process units (manufacturing stages), e g boiler, electricity generation, oxygen plant, compressed air

14 Provide a materials and energy balance for such non-process functions as lighting, heating, ventilation, air conditioning (if any), and materials handling

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C. Raw Materials and Product

15 List all major raw materials consumed

Raw Material	Quantity Consumed	Mode of Transport Origin to the Plant Cost

16 List and quantify any recycled or re-used materials

17 Are by-products or waste products of this plant utilized elsewhere?

18 List all major products

Product	Units of Production	Plant Capacity	Annual Production	Actual Value of of Sales

D. Energy Supplies

19 List all energy products used in the plant, e g natural gas. coal, coke. wood. charcoal. petroleum products, electricity, purchased steam. explosives, animal food

20 How are they brought to the factory?

21 What is the current price of each?

/million cubic meters of gas
/metric ton of coal
/metric ton of fuel oil
/kWh of electricity
/kilogram of explosive
/liter of lubricant oil
/liter of grease

22 List the relevant specifications for each

steam pressure, temperature, and rate,
heating/calorific value
contaminants
quantity

23 For processing heat available

Steam	temperature	Degree C
	pressure	
	rate	kg/hr

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Exhaust Gas	temperature rate composition	
Demand		GJ/hr, or GJ/kg of product

E. Energy Utilization

24 What process units/departments are the major consumers of each type of energy?

Process Unit	Type of Energy	Quantity	Efficiency

25 What percentage, approximately, do energy costs represent in relation to total production costs?

26 List any alternative fuels that could be used with or without modification of the plant

27 How much energy is used in heating/cooling buildings?

28 How much energy is used for mechanical handling and transport within the plant?

29 Are fuel oil tanks heated? If so, how are they heated and how is the system controlled?

30 Does the plant encounter energy time of day or seasonal energy demand constraints (especially for electric power and natural gas)?

F. Energy Consumption Data

31 Give the latest annual consumption data

Fuel Type	Current Units	Quantity Price	Total Consumed	Cost

	Current Electricity	kWh Price	Total Consumed	Cost
Purchased Self Generated				

32 What is the overall ratio of energy consumption per unit of plant output (e g GJ/prosuxt unit)?

33 Give specific energy consumption ratios for different fuels used (e g million metric tons of fuel oil/product unit)

G. Electricity Consumption

34 What is the total installed capacity of motors and other equipment (kw)? Specify voltage levels utilized

35 Is electricity generated at the plant?

36 What is the ration of electricity consumption per unit of plant output (e g kWh/product unit)?

37 If yes, what type of generator is installed (e g diesel, gas turbine, steam turbine, waste heat boilers)?

38 What self-generating capacity is installed? (kw)

39 How much electricity was generated by the plant last year (kWh)?

40 Fuels used for Self Generation

Fuel Type	Quantity Units	Heat Content Consumed of Fuel

41 Does any equipment generate power using motor-generators? If yes give details

42 Is self-generation capacity to be increased?

43 Are there data available on daily and seasonal variations in electricity consumption?

44 Give electricity demand peak and average

45 What is the average power factor for the plant?

H. Combined Heat and Power Generation (Cogeneration)

46 Is there a cogeneration system installed at the plant?

47 If yes, provide the following

Level of Heat Energy Production Source (GJ/hr)	Level of Steam and Elec Prod (kw)

48 When was the system installed?

49 Are there plans to install cogeneration systems or to increaser the capacity of an existing system?

a. Boilers

50 Provide data for each boiler

Maker

Type/Model

Capacity

Steam Pressure

Temperature

Normal Consumption of Fuel

Fuels Used

Average Efficiency

b. Dryers

Maker

Type/Model

Capacity

Steam Pressure

Temperature

Normal Consumption of Fuel

Fuels Used

If steam is used 51 - 55

c. Furnaces

Maker

Type/Model

Capacity

Temperature

Normal Consumption of Fuel

Fuels Used

51 What is the source of boiler feedwater?

52 What water treatment is used? What is the water quality after treatment?

53 What percentage of condensate is re-used?

54 What is the consumption rate of water?

55 What is the peak demand for steam?

J. Energy Management and Conservation

56 Provide an organization chart and brief overview of positions, responsibilities, management policy directives, internal accounting policy, and quality assurance policy

57 What instruments/equipment are currently available to conduct energy audit work?

58 Does the plant have adequate information and literature concerning energy conservation and audit procedures?

59 What units of measurement are used? Are the consumption patterns of different forms of energy converted into a common unit of measurement?, e g kilocalories, BTU, or kWh?

60 What action has been taken to educate personnel in energy conservation procedures?

61 Is there a formal system of preventive maintenance? (give details)

K. Ore/Coal Production and Reserves Data

62 Ore/Coal Analyses

In place

As mined

After cleaning, crushing, and concentrating

Waste product, stream 1

Waste product, stream 2

Waste product, stream 3

Waste product, stream 4

Waste product, stream 5

63 Reserves by grade and depth

Annex K
FERTILIZER QUESTIONNAIRE

A. IDENTIFICATION

1 Plant'sName_____PhoneNumber_____

2 Address

_____

3 Name of Contact, and Position

_____

Phone No _____ Fax No _____ Telex _____

B. GENERAL

1 What year was this plant built?

2 The design or process was developed by whom?

3 Any major expansions or modifications? When?

C. PRODUCTION

1 What products do you produce?

2 What is the total quantity or number of units per year of these products?

3 What are your starting materials?

4 Do you produce the same type and amount of products all year long or does it vary?

5 What records or summaries do you have of this production?

6 May we briefly see these records? Can you provide us with a copy of these records?

7 Are your products sold domestically or internationally?

8 What is the percent of each?

9 Does your plant operate around-the-clock, seven (7) days a week or if not, how many shifts per day and per week?

10 How many total days per year does it typically operate?

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11 Are there any factors which cause seasonal effects and what are these?

12 Are products sensitive to environmental factors in storage?

D. ENERGY CONSUMPTION

1 List all energy sources used in the plant, e g natural gas. low Btu gas, coal ignite, coke. charcoal, wood. fuel oil, diesel oil. bagasse, agricultural waste. electricity steam. hot water. etc

2 How are they brought to the plant?
Pipe line, truck. tank car. rail car, barge, high voltage line, etc

3 Is there extra margin of supply of such fuels if the plant chooses to go cogeneration?

If yes, how much?

If gas, how much, and under what pressure?

4 List the relevant specifications for each fuel/energy source

Heating Value (HV&LV)	Kcal/Kg (solid or liquid) Kcal/Cu. M (gas)

Steam pressure, temperature, and rate (Kg/hr)
Gas Pressure, flow rate
Electricity Voltage, and line (transformer) capacity
Hot water pressure, temperature, and rate (Kg/hr)

5 In case of steam or hot water. what is their source. boiler. turbine?

6 What is the current price of each?

/CU Meter of Gas
/Metric Ton of Coal. Coke, Lignite, etc
/Metric Ton of Fuel Oil
/kWh of Electricity FRM the grid
/Metric Ton of Steam, or Hot Water

7 What is the tariff of electricity consumed at the plant?

Demand Charge

Contract Demand Charge	/kW
Max Demand Charge	/kW
Over Contract Penalty	/kW

Demand Constraints

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8 Do they experience power interruptions or shortage?

Rotational Black Out
Brown Out

9 About how much money do you spend per year for energy?

10 Does the amount spent vary much each month?

11 Do you have monthly records of consumption?

12 May we briefly see these records? Can you provide us with a copy of these records?

E. EQUIPMENT/PROCESS

1 What items of equipment are your biggest individual users of energy?

2 What items of equipment contribute adversely to your power factor and demand factor?

3 Do you have equipment specifications, manufacturer's data and/or drawings?

4 Do you have an equipment list?

5 In what language is the above information available?

6 May we briefly see this information?

7 What unit(s) or section(s) of the plant are the biggest users of energy?

8 Do you have drawings showing the processing scheme used in the plant, including instrumentation?

9 Are plot plan drawings available?

10 May we briefly see these drawings?

F. ENERGY CONSERVATION

1 Are there any major energy conservation related problems in your plant that you are currently aware of?

2 Have any steps yet been taken in your plant to try to conserve energy?
What are they?

3 Is there presently any recovery of steam condensate?

4 Do you pay a penalty on your electrical bill for having a low power factor or penalty on demand factor?

5 Does your demand for electricity fluctuate greatly or remain relatively constant?

6 Are there any hot, lines, tanks or other hot surfaces which are not presently insulated?

7 Do you vent any steam to the atmosphere?

8 Do you recover any heat from the hot stack gases leaving your combustion equipment?

9 Is there any monitoring of the excess air in the stack gases from your combustion equipment?

10 Is there manual or automatic trim of the air/fuel ratio?

11 What are your utility section capacities?

Annex L
DISCUSSION OF ALMATY TES-2 POWER PLANT

In November 1994 and January 1995 a delegation of the Project Team performed a series of meetings and plant tours with representatives of the Alma - Atenergo Industrial Union Almaty Thermal Energy Station, Unit No 2 Attending the various meetings and plant tour were the following

Project Team:

Richard Browning, Task Leader
Sal Scardigno, Engineer
Gerald Decker, Consultant
Vladimir Fedorenko, Consultant

Thermal Energy Station 2 Personnel:

Byrlyn Orazbaev, Director
Boris O Savadsky, Chief Engineer
Akhat N Kalendaryov, Chief Engineer
S Sadvacasov, Engineer

The delegation was accompanied by translators who helped to facilitate communication between the American and Kazakhstan personnel The following are the salient items discussed in the meeting, and a description of the TES-2 plant tour

After the general introduction and presentation were made by both delegations, the agenda of the meeting was presented It was stated that the objective of the meeting, and the plant tour, was to collect technical and operational data and information on the TES-2 plant which would be utilized, together with other data and information available, to develop a National Energy Savings Plan for Kazakhstan A detailed technical discussion followed, attended by S Scardigno, V Fodorenko, B Savadsky, and other plant technical personnel Such discussions centered around the technical questionnaires prepared by the Project Team (see Appendix) Each question was reviewed in detail by both teams and a commitment was made by the plant personnel to provide the answers, or to provide the necessary technical documentation from which to obtain such answers From the overall review of the answers provided verbally by the plant personnel to the Project Team it appeared evident that, in general, the plant had some significant problems with prevented it to operate in the most efficient way Foremost of such problems was the fact that the plant was compelled to burn a kind of coal (Borlinsky and Kuu-Chekinsky) for which the boiler was not designed for, instead of the design-type of coal, such as that from Karaganda The difference in characteristics of these two types of coal (see Table A, below) is significant and can account for a significant portion of the problems associated with the operation and efficiency of the TES-2 plant

TABLE A-1

	Karaganda	Borlinsky-Kuu- Chekinsky
Ash content	35%	45%
Moisture content	6-15%	3-5%
Heating Value	3990 Kcal/Kg	3700KCal/Kg

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The coal used to fuel this station is shipped in rail from Karaganda, approximately 1,000 kilometers from Almaty This coal has 45% ash content by weight and has a heating value of approximately 3,00 KCal per Kilogram (KCal/Kg) According to the estimates done by the Ministry of Geology, approximately 700 MT of bottom ash are produced hourly by operational coal boilers in Kazakhstan, out of which, TES-2 share is o 8 million MT of bottom ash each year

Other significant deficiencies impacting on the performance of the plant were associated with the cooling towers and the circulating water system, the lack of, or malfunction of, boiler, turbine, and major equipment controls and measuring devices

The Almaty Thermal Energy Station 2 (TES-2), one of the most well kept and operating power plants in Kazakhstan, can represent a case study for the typical problems facing the Kazakhstan power industry The TES-2 plant , constructed in the 1980's, consists of 7 boilers, with individual capacities of 480 GJ per hour Each of these 7 boilers produce 420 MT of steam per hour at a pressure of 140 atm and 540°C There are also 6 turbines in the facility, 2 with a capacity of 110 MW, 3 with 80 MW, and 1 with 50 MW The total electric power capacity of this station is 510 MW, while its total thermal capacity is 1,000 MW This station produces 5,000 cub meter per hour of hot water at 150°C, by reheating cooling water from the condenser Base-load boiler for TES-2, which generate 40% to 60% of the total thermal output, are also fueled by pulverized coal Mazut or natural gas is burned in the hot water heating boilers, while natural gas is used in the peaking (hot water) boilers The average steam load at this facility is 385 Metric Ton (MT) per hour, with a maximum of 700 MT and a minimum of 624 MT The maximum hot water load is 5,600 cub meter per hour.

From a preliminary investigation of the TES-2 power plant it appears that a significant deficiency exists at this plant (From various discussions with TES-2 plant personnel, such deficiency is much more pronounced at other power plants throughout Kazakhstan) This deficiency deals with the lack, in all such plants, of flue-gas analyzers In fact, significant improvements can be obtained in the plants' analysis of the flue gas and combustion process which would provide vital information on the boiler performance, not only on combustion efficiency, but also on pollution levels If gas analyzers are available, the boilers will considerably improve their efficiency and their ability to save energy and extend their life, and also comply with the environmental regulations The specific area of deficiency, in need of improvement, at the TES-2 plant, are the following

1. COAL QUALITY

The plant is burning a coal type whose chemical and thermal characteristics are different for the design ones This creates significant efficiency and operational problems According to the original plant design, the fuel to be utilized for the plant was the Karaganda coal, with a heating value of 3,390 KCal/Kg and an ash content up to 35% The coal which is presently used, on the other hand, is a mixture of Barlinsky and Kuu-Chekinsky coal with a heating value of 3,700 KCal/Kg and ash content up to 45% That quality of this coal, because of these characteristics, is highly abrasive, and has required a redesign of the coal handling system The boiler productivity has experience a significant reduction from 420 tons/hr to 320 tons/hr, due mostly to the intensive erosion on the heating surfaces of burning such a high level ash content coal in the boilers Internals of 3 boilers are presently being replaced to alleviate this erosion problem It is believed that the high ash content of this coal is also affecting, in addition to the boiler and the coal handling system, also the air conveying coal system, such as the pulverizers, classifiers, coal-air pipes, and burners The rest of the boilers are expected to be modified in the near future In addition, due to the intensive wear of the ash handling system, replacement of affected parts are frequently required

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2 FANS ON COOLING TOWERS

Only 2 out of 12 cooling towers appear to be fully operational The rest have problems with the "NEMA" fans, which do not operate due to electrical (motor) and mechanical (reducers) problems, as well as the lack of qualified spare parts Such deficiency in the proper operation of the fans impact negatively on the performance of the cooling towers and, consequently, of the circulating water system for the plant Hot summer months limit the generation of power and can cause excessive fuel consumption in many Kazakhstans HEPPs (Heat and Electric Power Plants) which are equipped with cooling towers Among the problems encountered, the following are the salient ones

- Wind blocking effect Cooling towers are generally designed to operate in windless weather
- High water- spraying plastic nozzles vulnerable to be damaged
- Failure of spray surfaces (wooden surfaces decay after a short operation period, and asbestos cement surfaces break
- Maintenance problems

3 SO_2 and NO_x EMISSION

The original design of the plant did not include any consideration for the control of SO_2 and NO_x emission from the plant However, due to Kazakhstan's recent adoption of regulations controlling the emission of air pollutants, it has become necessary to modify the pertinent boiler and plant systems to minimize the level of SO2 and Nox pollutants released from the TES-2 plant

4 MISCELLANEOUS DEFICIENCIES

Numerous equipment in the plant appear to have been poorly designed and/or poorly maintained Among these shut off (gate) valves, regulating valves for steam, water, and air systems, lack of spare parts, in general, lack of steam traps, poor insulation, inefficient (absence or irregular) delivery of chemicals, oils, fuels to the plant's systems, antiquate and poorly performing instrumentations

All above inefficiencies, together with those associated with the high ash content coal utilized, result in a degraded boiler efficiency of 84-87%, instead of the designed 90% Consequently, the total (actual) electric power produced by the plant is 407 MW, instead of the design 510 MW The actual thermal production of this plant is 850 MW, instead of the design 1427 MW

It is obvious that the above listed deficiencies prevent the TES-2 plant to operate at design efficiency It can be estimated that, by installing selected instrumentation, as identified below, would contribute to increase the efficiency of the pertinent equipment and system, and, therefore, of the plant

- Install proper instrumentation for monitoring the operation of shut-off and regulating valves
- Install the proper instrumentation for measuring the flow, temperature, and pressure and analysis of the various plant fluids (steam, water, gas) as well as exhaust gas analyzers
- Install the necessary devices for measuring, monitoring, and control the SO_2, NO_x, and ash content of exhaust gases
- Install instrumentation to allow proper and efficient equipment repair and maintenance

Plant personnel are very much aware of the necessity to make modifications to the plant in order to make it more efficient, to increase the reliability of the equipment, end to comply with environmental regulations They have considerable difficulty in having plant's modifications financed, due to the present economic situation of Kazakhstan The results of a study performed recently, with the assistance of some European companies, on the technical and financial considerations involved in upgrading the TES-2 plant to a level of efficiency, environmental compliance and level of safety of a typical modern US plant, indicated that such a plant upgrade and modernization would cost approximately $500 million (USD)

It is estimated that, if all above quick-payback measures are implemented on the TES-2 plant, there could be an increase in plant efficiency of up to 15%, or approximately a maximum increase in production of electricity of 75 MW, and a maximum increase in thermal production of 215 MW

Based on the above, the following program has been developed to upgrade the Almaty TES-2 Plant

Phase I

- Increase the plant capacity to the original design level (Electrical Power and Heat Energy) Make boiler modifications to upgrade its productivity by 420 T/h
- Improve the plant equipment safety, efficiency, and reliability, by
  - Replacing poorly operating valves
  - Installing proper instrumentation and control devices
  - Improve the efficiency of the deaerators
  - Refurbishing the water make-up system, the chemical and water treatment system
  - Modifying the fan system on cooling towers
  - Installing/improving the plant interstation communication equipment and system
  - Installing steam traps where needed
  - Decrease the ash production, the SO2 and NOx emission
  - Change the electrical drives and conveyor's belt
  - Install low NOx burners
  - Refurbish the piping systems on the Turbine Condenser system to assure proper condensation and vacuum capabilities

Phase II

- Automate the systems and processes by introducing modern technology systems and equipment
- Install Selective Catalyst Reduction (SCR) to reduce NO_x emission

Phase III

- Expand the power capacity of the plant by installing the no 7 Steam Boiler

A plant tour was taken by the Project Team under the guidance of TES-2 Chief Engineer Boris Savadsky The overall impression was that the plant was in relatively poor conditions, when compared with a similar facility in the USA Among the most significant deficiencies observed, the following are reported

- Very poor maintenance throughout the plant Such lack of proper maintenance, which was especially evident in the boiler and turbine areas, can reasonably be expected to impact negatively to the plant inefficiency as well as to the plant safety

- Several locations of missing, or poorly attached, insulation around the process piping systems This could lead to energy losses impacting on the performance of the pertinent system

- Lack of steam traps

- Lack of equipment controls and measuring devices, and, if available, in poor conditions and/or antiquated design, resulting in an inefficient operation of the pertinent component or system

- Various locations where either steam or water was leaking out of the system or equipment, resulting in energy's waste and system's inefficiency

- Spare parts, not available and/or not compatible with the original design, were reported to be a significant problem Few disassembled feedwater heaters, without tube bundles, were observed in the vicinity of the boiler proper, in relatively poor conditions

- Most of the fans on the cooling towers were not functioning, this would impact on the circulating water system cooling ability, especially in the summer time

Subsequent to the plant tour, the plant personnel and the Project Team discussed the results of the meeting and the plant tour Reservations were expressed, by the plant Director, on the ability of any outside agency or organization to finance the necessary plant improvements which were identified It was stated that a detailed study had been made previously which concluded that the cost of implementing all changes to bring the TES-2 plant in line with a similar plant in the USA, in terms of performance, safety and environmental compliance, was estimated to be $500 million (USD) Skepticism was expressed about the possibility of having such sum available to implement the modifications, especially due to the fact that (it was known) that the Kazakhstan's government would not provide guarantees to foreign investments in market products which are not Food, Medical or Agricultural related It was also stated that selected modifications to the plant, costing approximately $7-8 million (USD) could be prioritized and would result in some plant improvement which would assure a more efficient plant operation It was stated that there was evidence that some American companies (i e Westinghouse, General Electric) would be willing to make such investments, if they would receive, from the Kazakhstan government, some guarantee that they would be able to recover their investments The meeting between the Project Team and the TES-2 personnel was concluded with a commitment to work together to contribute to the successful implementation of each team's mission, that is the development of the National Energy Savings Plan (for the Project Team), and the investigation of potential alternatives for implementing plants' improvements (for TES-2 team)

Annex M
RUSSIAN GAS DISTRIBUTION REHABILITATION AND ENERGY EFFICIENCY PROJECT (RGDREEP)

The principle objectives of RGDREEP are (a) to increase the efficiency of gas use within Russia by upgrading and increasing the use of customer metering and by supporting investments in more efficient equipment, (b) to reduce gas distribution network costs, and maintain distribution system capacity and integrity, through network rehabilitation, and (c) to support the government's reform program through technical assistance In addition, a companion Global Environment Facility (GEF) project will support initiatives aimed at reducing greenhouse gas emissions including financing a portion of the leak detection component

The rehabilitation of gas distribution systems would be implemented by the gas distribution companies in three cities Ryazan, Volgograd and Saratov It would include installing gas meters and investing in asset preservation and monitoring systems

The project's technical assistance would include (a) providing training and technical assistance to Russian Energy Savings Fund (RESF) staff, focusing on upgrading and expanding the project analysis skills of staff, including investment appraisal and financial planning and control (b) upgrading the current gas industry standards and construction procedures, and (c) preparing an overall plan for gas distribution system rehabilitation

The GEF facility would complement this project by financing studies on gas production, transmission, distribution and utilization to develop an investment program for reductions in greenhouse gas (GHG) emissions It would include assistance in purchasing emissions detection equipment, equipment that could be used to demonstrate the effect of energy efficiency investments (such as heat energy meters and insulation), and in hiring consultants to assist in the implementation of the energy efficiency improvement program

The energy efficiency component would finance the foreign currency portion of investments that are designed to improve energy efficiency for district heating and power utilities It would also provide assistance to end users in evaluating and implementing investments Because there are likely to be a large number of sub-projects and borrowers, administration and management of this component of the project would be handled by the Russian Energy Savings Fund (RESF)[1] with the assistance of consultants, under the supervision of its board RESF would be charged with (a) assisting potential executing agencies in identifying sub-projects and in presenting their technical, economic and financial viability, (b) appraising energy efficiency investments by municipal utilities (district heating) and power plants and advising the Ministry of Finance on the feasibility of financing these sub-projects, and (c) providing assistance and disseminating information to industrial enterprises required to evaluate and access commercial funding for energy efficiency measures The recommended investments for increased efficiency include, inter alia burner replacement and associated controls, boiler replacement at municipal district heating companies, portable diagnostic instrumentation for power plants and municipal boilers so as to facilitate better adjustment of the equipment, automated control systems at boiler plants, and automatic temperature control equipment and heat energy meters at heating substations

1 The RESF is discussed in some detail in both Section 5 2 2 and Annex E

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Other responsibilities of RESF would include (a) the review and approval of detailed sub-project procurement needs (prepared by the district heating companies and local power plants), (b) review and approval of the proposed execution of procurement activities, review of the economic and financial rates of return and of the financial viability of the borrower, and (c) control and review of the technical and financial aspects of sub-project implementation Based on their review, the RESF staff would submit qualifying sub-projects to a loan review committee, which would include the agency's board, supplemented by representation from the Ministry of Finance A separate group would be established within the RESF to implement the energy efficiency component of the project During the initial phases of the project, RESF would be assisted in both project evaluation and implementation by consultants to be financed under the component of technical assistance

RESF would be asked to agree that the primary criteria for the viability of individual energy efficiency projects would be (a) an economic rate of return of not less than 20 percent (real), (b) a financial rate of return of not less than 10 percent (real), (c) a demonstrated ability on the part of the ultimate borrower to finance the local portion of project costs from internally generated funds, (d) the technical feasibility of the proposal, (e) the proposed implementation plan, (f) a debt service ratio of at least 1 2 to demonstrate the ability, on the part of the borrower, to repay the loan to the Ministry of Finance and (g) an environmental assessment which meets Russian requirements