PN-ABX-783

ISN 9760

RESOURCE MANAGEMENT ASSOCIATES
of Madison Inc.

Institutional and Policy Analysis for Ukraine: Conditions For Establishment of a Market For Energy Efficiency Services and Equipment

Prepared for: United States Agency for International Development
Energy Efficiency and Market Reform Project

Under Contract #CCS-0002-C-00-2008-00

Prepared by: Dr. Wesley K. Foell

Resource Management Associates of Madison, Inc.
Madison, Wisconsin, USA

PN-ABX-783

Institutional and Policy Analysis for Ukraine: Conditions For Establishment of a Market For Energy Efficiency Services and Equipment

Prepared for: United States Agency for International Development
Energy Efficiency and Market Reform Project

Under Contract #CCS-0002-C-00-2008-00

Prepared by: Dr. Wesley K. Foell

Resource Management Associates of Madison, Inc.
202 State Street, Suite 303
Madison, Wisconsin 53703 USA
Telephone: (608) 283-2880
Facsimile: (608) 283-2881

Table of Contents

PREFACE ii

SUMMARY AND CONCLUSIONS iii

1.0 INTRODUCTION 1

2.0 ECONOMIC AND STRUCTURAL ISSUES 2
- 2.1 Energy Pricing Reform 2
- 2.2 Economic Restructuring 2
- 2.3 Benefits of Energy Demand Reduction 2

3.0 FINANCIAL ISSUES 7

4.0 ENERGY EFFICIENCY SERVICES AND EQUIPMENT 8
- 4.1 Structure of the Market 8
- 4.2 Energy Efficiency Services 9
- 4.3 Energy Efficiency Equipment Manufacturers and Vendors 9
- 4.4 Establishment of Energy Managers Association 11
- 4.5 Efficiency Programs by Energy Utilities 11

5.0 POLICY OPTIONS FOR IMPROVING ENERGY MANAGEMENT IN FIRMS 12

6.0 UKRAINE GOVERNMENTAL UNIT FOR ENERGY EFFICIENCY IMPROVEMENT 13

NOTES 14

List of Tables and Figures

Table 1. Energy Balance For Ukraine 3
Table 2. Equipment Provided Under the Market Reform and Energy Efficiency Project 10
Figure 1. Projected Primary Energy Intensity 5
Figure 2. Ukraine Official and Bank Projections of Electricity Use, 1992 - 2010 6

List of Appendices

Appendix A
"Potential USAID Energy Efficiency Activities in Ukraine"

Appendix B
Ukraine Energy Policy Recommendations

Appendix C
"Demand Side Management - Ukraine Applications"

Appendix D
Selections from Dr. Wesley Foell and Mr. Charles Fafard's presentations at the Ukraine National Energy Strategy Conference

Appendix E
"Prospective Economic Changes in Ukraine"
"Enhancement of Energy Utilization Efficiency in Ukraine"

PREFACE

The work in this report was carried out within the framework of the Market Reform and Energy Efficiency Project for the Newly-Independent States (NIS) under a contract with the U.S. Agency for International Development (USAID). Resource Management Associates (RMA), as Prime Contractor to USAID, is currently implementing this project in Ukraine, Belarus, and Armenia. This paper is drawn from RMA's work on the policy and institutional aspects of industrial energy efficiency in Ukraine. It has also benefitted from the collaboration of Dr. Yuri Blavdzevich and Dr. Svetlana Komova of the Institute of Energy Saving Problems (Ukraine Academy of Science) who have written a related paper[1] giving their perspective on energy efficiency improvements.

The conclusions and recommendations resulting from this work were presented at the Ukraine National Energy Strategy Conference, held in Kiev from June 14-18, 1993. With sponsorship from USAID, RMA joined the World Bank and the Government of Ukraine in organizing sessions at this conference and presented the results of the work described in this report. This report also includes selected appendices which are related to information presented or developed at that conference.

SUMMARY AND CONCLUSIONS

1. The overall energy intensity (primary energy consumption per unit of gross domestic product) of Ukraine is among the highest in the world. This is caused both by the high share of heavy industry in its economy and by the low energy efficiency of its technologies.

2. A considerable amount of industrial restructuring is in process or imminent. The industrial sector is stagnating and several industries are in a serious decline, in large part due to their noncompetitive operations. Low energy efficiency is one of the factors behind this condition. The government should improve its understanding of the interrelationships among energy demand, energy efficiency and this restructuring in order to assist the transition process.

3. Energy management, as increasingly practiced in the industrialized market economies over the past two decades, has not been widely applied in Ukraine. Highly subsidized energy prices and a dominant emphasis on increasing industrial production have both led to the virtual absence of good energy management practices.

4. The current command and control approaches to mitigating the effects of low energy efficiency are ineffective and likely counterproductive. The allocative quota systems appear to have perverse effects.

5. Energy prices in the household sector are extremely heavily subsidized and in the industrial sector, they only reach one-fourth to one-half of their economic costs. Liberalization of energy prices in both sectors will be a necessary and key factor in the government's efforts to improve energy efficiency.

6. Even with liberalization of industrial energy prices, the rapid implementation of efficiency improvement measures would be seriously impeded by the capital shortages and ownership and financial uncertainties due to the major restructuring of industry and potential privatization of many of the major energy consuming industries.

7. No effective market has existed for energy efficiency services; in the past it was dominated by large state engineering firms or by government institutes. These organizations apparently performed primarily technical evaluations, with little economic analysis. Under the anticipated conditions of restructuring and price liberalization, there will be opportunities for small and medium sized firms to emerge. Donor and lending agencies should provide needed capital and technical assistance to improve to ensure that availability of equipment and quality of service begin to improve.

8. There is a shortage of reliable modern and readily available energy efficiency equipment. Very little of the type of equipment required for the USAID low-cost-no cost measures was available in Ukraine. Donor agencies should foster the development of a domestic capability to provide equipment and software for the developing energy efficiency market. They should also encourage collaboration and joint ventures between western manufacturers/suppliers and Ukrainian firms with the potential to produce energy efficiency equipment.

9. Lack of channels and established market mechanisms for efficient flow of information on energy efficiency needs, opportunities, equipment, services, and programs, is a serious problem. The fragmented efforts are severely hampered by capital shortages and by the great uncertainties due to privatization and restructuring. Highly targeted government and private sector information programs are needed to help initiate a more informed market place.

10. Despite the above problems, the inherent technical skills of existing human resources are high. There are good opportunities for small- and medium-sized firms to be formed, particularly in some type of joint venture with western firms which have experience in providing energy services.

11. To help ensure adequate energy efficiency information to all parties, an organization such as an "Energy Managers Association" should be established to conduct conferences, workshops, and training on energy conservation and to facilitate sharing of information in this area. This will provide an active infrastructure for firms to implement energy efficient technology and energy management practices.

12. Carefully chosen and targeted energy efficiency demonstration projects are recommended in the household, commercial, and industrial sectors. These projects should be designed to create an awareness of the technical, financial, and institutional factors involved in improving energy efficiency in these sectors. These demonstrations will also play an important role in identifying weakness in the emerging market for equipment and services.

13. The public utilities in Ukraine, (most notably suppliers of electricity, gas, and heat) have the potential to play a major role in implementation of efficiency improvement programs. A primary mechanism for this is through so-called Integrated-Resource-Planning (IRP) which is the process of selecting energy generation options, Demand-Side-Management (DSM) measures, and purchases and sales of electricity that enable a utility to meet its customers' energy needs at the lowest overall cost while also minimizing adverse environmental consequences. The government should explore various regulatory mechanisms which will provide positive financial incentives for the utilities to promote effective DSM programs to their customers.

14. The banking system is undergoing a transformation. However, it does not appear that any of the existing banks give special attention to energy efficiency investments. Attention should be devoted to developing new approaches to financing energy conservation measures. Financial institutions should be brought into a cooperative arrangement with the public and private sectors for the development of these approaches. In cooperation with multilateral lending institutions, the banks should explore a mechanism to establish a sizable loan fund to finance energy efficiency projects in the small- to medium-size (e.g. $200,000 to $3,000,000), often neglected by the international institutions.

15. The above recommendations can be summarized as comprising a decentralized market-driven approach to energy efficiency. A public/private sector partnership is needed to foster the establishment of the institutional/financial environment and the specific mechanisms which will bring about the achievement of energy efficiencies corresponding to those in the advanced western market economics. An Energy Efficiency Unit should be created at an appropriate place in the Government to help establish and nurture those of the above-mentioned programs which can benefit from government assistance.

1.0 INTRODUCTION

The former centrally planned economies required on the average between one and one-half and four times the energy per unit of economic output, in comparison to the economies of Western Europe and North America. It is estimated that in 1985 the East European countries used from 50% to 300% more energy than the OECD countries to produce one dollar of Gross Domestic Product (GDP). In Ukraine, according to World Bank figures[2], the energy intensity of GDP in 1990 was estimated to be 1.84 kilogram of oil equivalent (koe) per U.S. dollar, several times higher than in most developed countries with market economies.

There are several key factors which explain this inefficient energy use in Ukraine. One of the most important of these is a pricing system that has for many years systematically and continuously underpriced energy, leading to its mis-allocation and overuse as a factor of production. Changed only infrequently by the price commissions, these energy prices over past years generally failed to reflect even the average historical costs.

A second major reason is the failure of Ukraine to make the post- industrial transition from energy-intensive heavy industry toward more modern industries which require less energy per unit of manufactured output. Additionally, most industrial facilities were constructed to be large high volume enterprises in which specialized production of individual goods supplied a very large fraction of the entire market for the country or even for the entire former Soviet Union. In general many of these large facilities are not able to operate efficiently at much less than 100% capacity and thus use excess energy.

A third likely reason for the low energy efficiency is a failure of Ukraine to incorporate more highly efficient technologies into its energy systems. Part of this may be explained by the lack of appropriate energy price signals received by industrial managers; however our analysis indicates there are also fundamental institutional and market deficiencies which have greatly inhibited the economy from achieving efficiency improvements experienced in market economies in the past two decades.

Energy prices in the household sector are extremely heavily subsidized, and are in general only a tiny fraction of energy costs. In the industrial sector, they only reach one-fourth to one-half of their economic costs[3]. Liberalization of energy prices in both sectors will be a necessary and key factor in the government's efforts to improve energy efficiency. However even the current dramatic industrial energy price increases are likely viewed by many mangers as just another component of production cost to be passed onto consumers. In general, enterprise managers from former centrally-planned economies do not see themselves in a competitive world market situation and are slow to accept investments in energy efficient equipment as an alternative to mitigate high energy costs[4].

2.0 ECONOMIC AND STRUCTURAL ISSUES

2.1 Energy Pricing Reform

Pricing issues are discussed in detail in the Ukraine National Energy Sector Conference proceedings. However, energy price liberalization is the single most important measure leading to the improvement of energy efficiency in the Ukraine. Although in the past year the government has very actively managed the energy prices of all fuels, there is general agreement that the current energy pricing system in Ukraine is quite inefficient. In particular, it is not effectively encouraging energy conservation through appropriate price signals to consumers.

2.2 Economic Restructuring

A considerable amount of industrial restructuring is in process or imminent. Many industrial sectors are stagnating and several industries are in a serious decline, in large part due their noncompetitive operations. Low energy efficiency is one of the factors behind this condition.

A very large share of total industrial production is made up of energy-intensive industries. For example, Ukraine's steel industry in 1990 was responsible for approximately one-fourth of the total final consumption of energy (*Table 1*). According to the World Bank, its energy intensity (22-25 GJ/ton) is 20-40 percent higher than in the countries of the European Community. It was reported in 1992 that there were significant reductions in output for many of these energy-intensive branches of the economy.

The government should improve its understanding of the interrelationships among energy demand, energy efficiency and this restructuring in order to assist the transition process. In addition, in structuring its financial assistance to Ukraine, the international donor community should carefully examine these energy-intensive sectors to assess which segments should and could survive the transition and restructuring process if investments were made in modern energy-efficient technologies.

2.3 Benefits of Energy Demand Reduction

Improvements of energy efficiency should be one of the cornerstones of Ukraine's energy policy. Achievement of major improvements in energy efficiency will enable Ukraine to significantly reduce its dependance on imported fuel and to avoid the costly need for additional electricity generation capacity. The World Bank Energy Sector Review[3] presents energy and electricity scenarios based upon alternative assumptions about future economic growth and projected energy intensity (energy use per unit of Gross Domestic Product).

Table 1. Energy Balance For Ukraine, 1990 (MTOE)

	COAL	COKE	OIL	NATURAL GAS	ELECTRICITY	HEAT	OTHER	TOTAL
INDUSTRY								
Ferrous Metallurgy	1.38504	17.74284	0.54924	12.08328	4.4178	1.71936	5.32524	43.2228
Chemical Industry	0.26268	0.07164	1.38504	7.97592	2.10144	3.24768	0.28656	15.33096
Mineral Industry		0		1.12236	1.4328	1.05072		3.60588
Machine Building Industry	1.76712	1.17012	5.11032	6.28044	1.95816	2.81784	0.09552	19.19952
Construction	0.40596	0.02388	0.40596	0.64476	0.3582	1.48056		3.31932
Other	2.05368	0.40596	5.373	3.60588	3.15216	4.25064	0.02388	18.8652
TOTAL INDUSTRY	5.87448	19.41444	12.82356	31.71264	13.42056	14.5668	5.7312	103.5437
TRANSPORTATION	0.09552	0	14.2086	3.24768	0.9552	0.2388	0.09552	18.84132
RESIDENTIAL/COMMERCIAL	6.71028	0.16716	4.2984	16.3578	3.43872	5.7312	0.7164	37.41996
AGRICULTURE	0.88356	0.02388	7.95204	1.86264	1.71936	0.85968	0.07164	13.3728
TOTAL FINAL CONSUMPTION	13.5638	19.60548	39.2826	53.18076	19.53384	21.39648	6.61476	173.1778

Figure 1 shows the Bank's three alternative paths for energy intensity, relative to the 1990 value. The differences are very significant and will have a major impact on Ukraine's fuel import expenditures as well as on capital expenditures for energy supply systems. A vigorous energy efficiency improvement program is a precondition for the achievement of both the scenarios based on lower energy intensities.

The Government and the Bank have also carried out projections of future electricity use under alternative assumptions of price and consumer responses to price changes. *Figure 2* shows these scenarios for the time period 1992-2010 (Reference 3, Annex 11). The results of the analysis show that achievement of lower electricity generation requirements would greatly reduce capital expenditures as well as fuel and operating costs.

For example, the potential savings in the power industry due to electricity demand differences between the Bank's Medium and Low demand scenarios are estimated at 8.2 billion (thousand million) dollars equivalent between 1993-2010. This indicates that, along with electricity price liberalization, it will be very important to implement an accelerated energy conservation program. Expenditures on improving demand-side efficiency are likely to be a cost-effective way of avoiding major capital expenditures on plant rehabilitation and new plant construction.

Figure 1. Projected Primary Energy Intensity
(1990 = 2505 koe per 1000 US$ GDP)

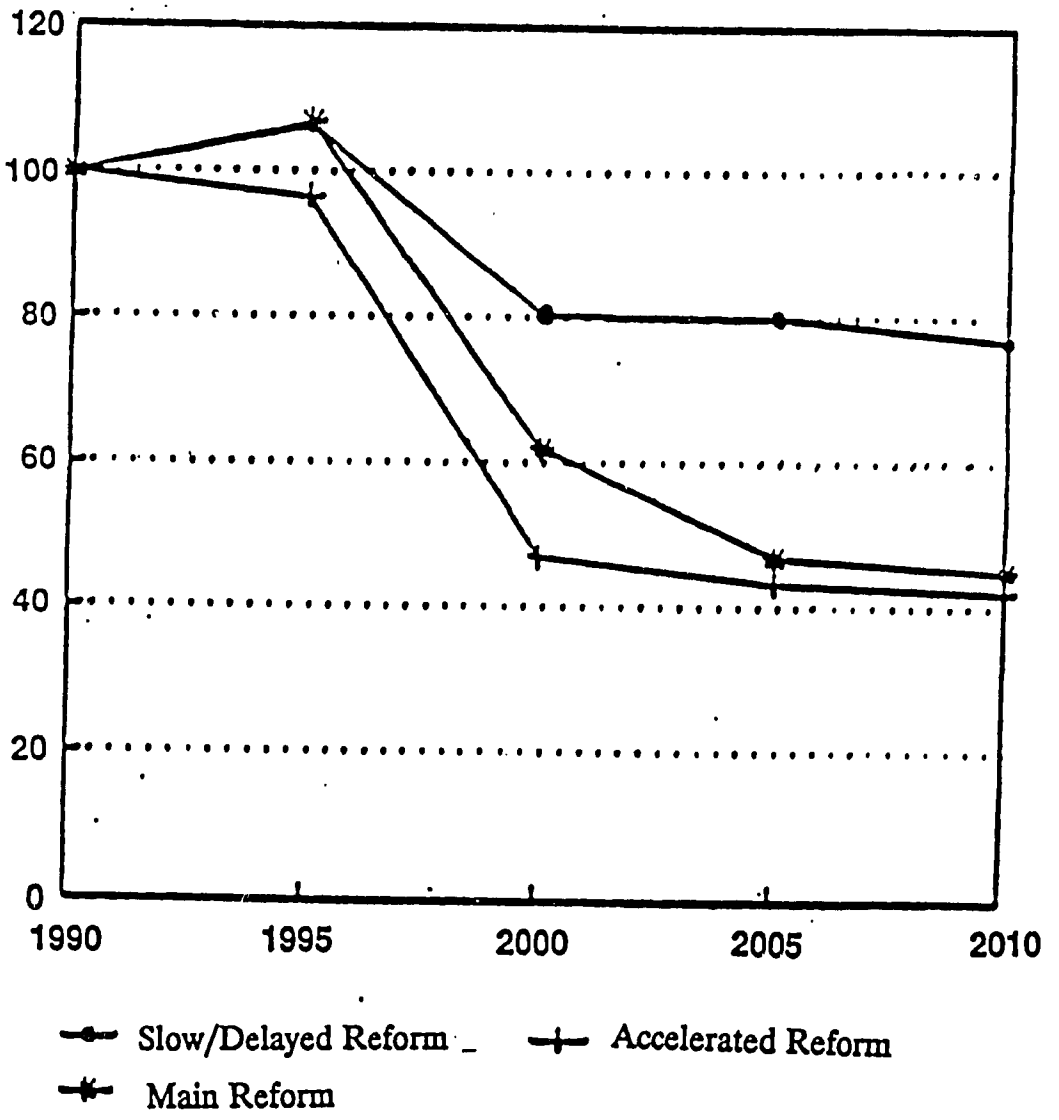
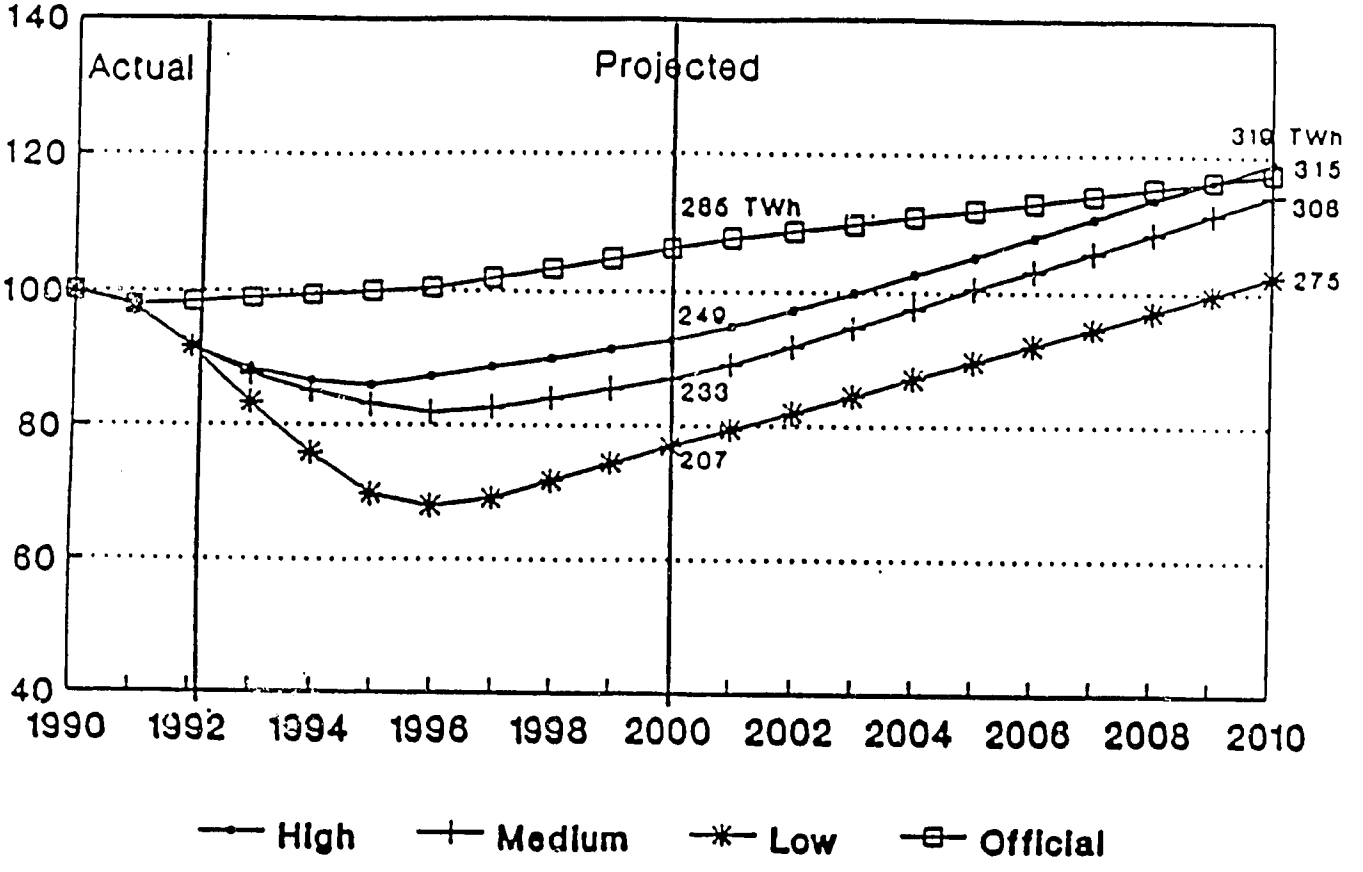


Figure 2. Ukraine Official and Bank Projections of Electricity Use, 1992 - 2010 (1990 = 100)



3.0 FINANCIAL ISSUES

A key policy issue for the government is how to provide investment capital for those enterprises with attractive conservation investment opportunities. It does not appear that financial service institutions such as banks are now providing or intend to provide capital for energy efficiency investments. Attention should be devoted to developing new approaches to financing energy conservation measures. Financial institutions should be brought into a cooperative arrangement with the public and private sectors for the development of these approaches.

The Government of Ukraine should explore with international and bilateral lending institutions the possibility of earmarking for energy conservation investments some of the potential upcoming loans. In particular, a variety of loan programs could be designed to service the commercial and industrial sector in which there are excellent short-payback energy conservation investment opportunities. From RMA's initial explorations and energy audits, we believe that there are a large number of attractive loan packages which could be assembled in the range of $200,000 to $3,000,000. Because these loans are smaller than those typically packaged by multilateral banks, it may be desirable to establish some type of revolving loan fund from which loans of this size could be effectively drawn, along with an appropriate technical assistance program.

4.0 ENERGY EFFICIENCY SERVICES AND EQUIPMENT

4.1 Structure of the Market

Energy efficiency services are critically needed to foster the adoption of modern efficient equipment and management practices. Within a market economy these services are provided by four types of firms, in addition to in-house expertise within the consuming industrial firm. These types of firms are:

i). Architectural and engineering firms which provide technical services in identifying the need for and the equipment requirements for energy efficiency. These firms can provide complete services including audits, feasibility studies, equipment specification, construction oversight, and start-up support. They may also provide services on a selective basis to back up in-house plant staff. Such firms may also provide architectural services related to energy efficiency.

ii). Equipment vendors play a critical role in making industrial plants and the architectural and engineering firms aware of the equipment available as well as providing a source of the equipment in a timely fashion. Vendors also play important servicing roles.

iii). Financial institutions such as banks provide sources of capital for investments in energy efficient equipment and design.

iv). Construction firms provide installation services.

In a fully functioning free market, there is competition in each of these areas, with competitive bidding being a common technique used to compare the firms' offerings of services in each area.

Each of these services is present in the Ukraine economy at the present time. The services have been provided in the past, however, thorough state organizations with little if any competitive forces at work. The service organizations have also not had available modern technology, measuring capability, and management techniques. Thus there is a critical need for private firms to emerge to provide these services. There are many knowledgeable and skilled professionals in the labor force who can provide much of the service needs at the present time and who are clearly capable of assimilating the knowledge necessary to bring the organizations into existence.

The process of creation of these organizations would be greatly benefitted by an acceleration of the economic restructuring process, a dynamism in the formation of small firms and entities, and an atmosphere positively conducive to western investment and joint ventures. Private services in this area can be acquired in Ukraine at the present time, although considerable searching is required. In the present very uncertain atmosphere for

large scale privatization, it is difficult to determine how rapidly a private market could develop in the energy efficiency services area. However we believe that the process would be greatly benefitted by a number of energy efficiency demonstration projects and by government and donor efforts to stimulate the demand for these services.

4.2 Energy Efficiency Services

The high energy intensity of the industrial sector indicates that there is room for profits to be had in the field of energy efficiency services, in particular as the price liberalization occurs and energy prices reach border prices. Existing organizations have focused attention on technical/engineering issues, leaving economic and policy matters alone. With the advent of privatization and international competition in the industrial sector Ukraine firms will need to become and remain competitive, both in terms of price and quality; energy efficiency will be a vital component in any success achieved. Thus there is great potential for energy efficiency services and investments to yield high returns.

In RMA's work for USAID in the Energy Efficiency Project, we have found very significant opportunities for low-cost no-cost projects which yielded extremely high return[5]. *Table 2* summarizes the equipment costs and energy savings for demonstration projects which we carried out during the past year in Ukraine. For example, the application of portable combustion analyzers to a major heat\power station in Ukraine has recovered the investment in a matter of days. We believe that these projects could be highly replicated throughout Ukraine in a process that can significantly improve the energy efficiency of the country and lead to major reductions in energy import requirements. International and bilateral donors and lending institutions should work with the government to extend these audit/demonstration programs to accelerate the replication and expansion of these efforts to improve efficiency.

4.3 Energy Efficiency Equipment Manufacturers and Vendors

Very little or none of the type of energy efficiency equipment installed by RMA in USAID's technical assistance program in the Ukraine is domestically manufactured in country. By western standards, much of the equipment produced in the country is out of date. To assist this market to develop there is a great need to improve information about the potential in this area for joint ventures with western business partners. In a parallel session in the present World Bank Energy Sector Conference, RMA is organizing discussions and demonstrations of energy efficiency equipment, jointly with western vendors and manufacturers. However this type of activity needs to be nurtured and greatly expanded.

Table 2. Equipment Provided Under the Market Reform and Energy Efficiency Project

Action/Plant	Equipment/Management	Cost	Estimated Annual Savings	Type of Savings	Energy Savings (TOE)	Mazut (Tonnes)	Natural Gas (1000 m3)	Electricity (MWh)	Distrib. Steam (1000 BTU)
Heat and Power Station #5	combustion analyzers	$9,400	$2,403,533	mazut&gas	13,843	623	14,727		
	in-situ O2 instrumentation	$46,000	$2,403,533	mazut&gas	13,843	623	14,727		
	flow meters	$27,000	$2,403,533	mazut&gas	13,843	623	14,727		
	computer	$3,300							
subtotal		$85,700	$7,210,599		41,528	1,869			
Telopset Peaking Boiler	combustion analyzers	$4,700	$76,021	natural gas	508		565		
subtotal		$4,700	$76,021		508		565		
Housing Peaking Boiler	combustion analyzers	$4,700	$76,021	natural gas	248		276		
subtotal		$4,700	$76,021		248		276		
Kiev Opera and Ballet	temperature control valve	$9,100	$16,457	dist steam	55				2,194,444
	thermostatic control valve	$950	$5,952	dist steam	20				793,651
	heat meter	$3,300							
subtotal		$13,350	$22,409		75				2,988,095
Railway Building	temperature control valves	$9,100	$976,128	dist steam	33				1,301,587
	heat meter	$3,300							
subtotla		$12,400	$976,128		33				1,301,587
Kiev Apartment Building	heat meter	$3,300							
	pressure regulator	$1,000	$3,006	dist steam	10				400,794
subtotal		$4,300	$3,006		10				400,794
Kiev Book Factory	ventilation control	$1,100	$4,256	dist steam	14				567,460
subtotal		$1,100	$4,256		14				567,460
		$126,250							
	Sub-Total Plant Equipment	$104,150	$5,812,865		27,818				
	Sub-Total Low-Cost Measures								
	Sub-Total Energy Services Eqp	$22,100	$2,555,575		14,599				
	GRAND TOTAL	$126,250	$8,368,440		42,417				

Source: Resource Management Associates, Equipment Provided Under the Emergency Energy Projects in Eastern Europe and the Energy Efficiency Projects in Central Europe. Sponsored by USIAD, Washington, DC. June 10, 1993. p 6.

A recommended activity for international support would be the organization of an intentional "Energy Efficiency Business Week" in Ukraine. Domestic and foreign suppliers of efficiency equipment and services would gather for a trade fair, seminars, demonstrations, and business discussions. Such events have recently been held in some other former centrally-planned economies, with quite encouraging results.

4.4 Establishment of Energy Managers Association

To ensure adequate and effective information to all parties, organizations such as an energy managers association should be established to conduct conferences, workshops, and training on energy conservation and to facilitate sharing of information in this area. This would help provide an active infrastructure surrounding energy efficient technology implementation and energy management practices. It is recommended that bilateral or international donors assist the development of such an organization, in collaboration with similar entities which have operated with considerable success in market economies.

4.5 Efficiency Programs by Energy Utilities

Industrial organizations can best serve as the backbone of movement toward energy efficiency improvements. However, experience in western market economies has shown that energy utilities are also able to play a key role in promoting and helping to implement efficiency improvements in all sectors of the economy. In particular, the utilities are in a key position to interact on a continuous basis with energy users and to provide incentives for the customers to undertake appropriate efficiency measures.

A primary mechanism for the utilities to achieve this is Integrated Resource Planning (IRP), the process of selecting energy generation options, demand-side-management (DSM) measures, and purchases and sales of electricity that enable a utility to meet its customers energy needs at the lowest overall cost while also minimizing adverse environmental consequences. The government should explore various regulatory mechanisms which will provide positive financial incentives for the utilities to promote effective DSM programs to their customers. A companion paper[6] describes experiences with DSM in the United States.

It is recommended that the Government of Ukraine establish DSM programs in at least two of its power utilities. Although it is likely that major structural changes will be occurring in the Ukraine power system in the coming few years, these initial pilot DSM programs would provide extremely valuable insight and experience with DSM. The utilities of Kievenergo and Donbassenergo, with their strong residential/commercial and industrial customer bases, respectively, would be excellent candidates for such pilot programs.

5.0 POLICY OPTIONS FOR IMPROVING ENERGY MANAGEMENT IN FIRMS

As indicated earlier, the technical skills found in industrial plants in Ukraine were observed to be very high. Engineering managers and plant engineers had excellent technical backgrounds and generally had a good understanding of their facilities. In several of the facilities visited in the former Soviet Union, including Ukraine, we observed a number of systematic deficiencies in energy management, leading to the following observations and recommendations for improvement.

- Energy management, in the form practiced in the advanced industrialized countries, does not appear to have been replicated in central Europe or the CIS over the past two decades. Plant management has little experience in conducting energy/economic evaluations in the plant and especially at the process level. With the anticipated advent of higher prices, there is a need for training in energy economics to optimize the utilization of energy and to minimize costs.

- The management structure found in typical firms in western countries appears to be lacking in many of the plant studies. Managers at the plant level to not yet have a good understanding of the decision-making process and are reluctant to accept the responsibility. For example, an energy manager should be trained in identifying energy efficiency projects, conducting economic analysis, and convincing top management to make the appropriate investments.

- In order for industrial firms to make energy conservation investment decisions, they must have adequate information on the technologies available, including their cost effectiveness. Information dissemination in the United States and other market economies is typically provided by interested parties at all levels, including the government, industry associations, A&E firms, vendors/suppliers, energy service companies and financial institutions. These institutions must be developed in Ukraine to provide a sustained awareness of the importance and benefits of energy efficiency improvements.

6.0 UKRAINE GOVERNMENTAL UNIT FOR ENERGY EFFICIENCY IMPROVEMENT

This paper has discussed and recommended a number of measures to stimulate the implementation of energy efficiency improvements and to help create the necessary environment for the establishment of a market in energy efficiency services and equipment. Most of the measures are based upon the presumption of near-term liberalization of the energy prices in the Ukraine. They also rely heavily on the active participation of an emerging and increasingly active private sector which can begin to provide services and equipment.

However we believe that this market-driven approach would benefit from the establishment of a unit within government which could play an important coordinating policy role in this transition. Such a unit could continue work on the existing Ukraine draft legislation on energy conservation, coordinate international assistance programs in this area (including some of the above-mentioned demonstration programs), and help ensure that the emerging energy regulatory designs would incorporate energy efficiency concerns into their design. In summary, this government unit would play an important transitional catalytic role in a decentralized market-driven approach to energy efficiency in Ukraine.

NOTES

1. Blavdzevich, Y. and S. Komova, (Institute for Energy Saving Problems) "Potential for Energy Efficiency Improvement in Ukraine," Paper Presented at Ukraine Energy Sector Review Conference, Kiev, June 1993.

2. World Bank Development Report, World Bank, Washington, D.C., 1992.

3. World Bank Ukraine Energy Sector Review, Country Department IV, World Bank, Washington, D.C. April, 1993.

4. Foell, W.K., "Energy Management in Eastern Europe: Economic and Environmental Opportunities," Columbia Journal of World Business, Fall/Winter Issue, Columbia University, New York, 1992.

5. Resource Management Associates, "Equipment Provided Under the Emergency Energy Projects in Eastern Europe and the Energy Efficiency Projects in Central Europe: Armenia, Belarus, Ukraine, Romania, Czechoslovakia, Lithuania," Resource Management Associates, Madison, Wisconsin, June 1993.

6. Fafard, C. (Resource Management Associates), "Demand Side Management - Ukraine Applications," Paper Presented at Ukraine Energy Sector Review Conference, Kiev, June 1993.

APPENDIX A

"Potential USAID Energy Efficiency Activities in Ukraine"

RESOURCE MANAGEMENT ASSOCIATES
of Madison, Inc.

520 University Avenue
Suite 300
Madison, WI 53703 U.S.A.

Telephone: 608/283-2880
Facsimile: 608/283-2881
Telex: 469 453

POTENTIAL USAID ENERGY EFFICIENCY ACTIVITIES IN UKRAINE

Following are several suggestions for future work that could be part of the NIS contract. This includes technical training opportunities, institutional building, and technical assistance.

1. Boiler Efficiency Training. Computer software, (such as PEPSE) could be purchased that tracks boiler efficiency, and allows for a systematic approach for comparing the performance boiler systems to each other. Training programs could be presented at several locations, with hands-on activity to demonstrate the program to boiler operators.

2. Thermal/Electric Metering. One of the drawbacks within the district heating/electric system is the absence of metering for most customers. Monthly charges are not based on consumption, but rather estimates based on theoretical calculations or size of the facility. The existing system does not provide nor allow for an incentive to conserve consumption. A program could be developed to provide electronic meters to demonstrate the capabilities of metering, along with encouraging conservation to lower monthly bills. As an alternative to electronic metering, meters with local read outs could be installed, and meter readers could be hired to obtain the monthly data.

3. Energy Efficiency Improvements in Malleable and Ductile Iron Production. The cast iron sector consumes a significant percent of the energy used by Ukrainian industry. The attainment of suitable properties comes about through heat treatment, sometimes for as long as 36 hours at 1000°C. This project would assess several areas in which considerable energy saving could be achieved. These include:

- Heat treat cycle efficiency
- Furnace insulation characteristics
- Melting practice
- Materials handling (ingots, etc.).
- Substitution of ductile iron for malleable
- Scrap recovery efficiency

Specific activities:

- Assess industry overall
- Pick prototype or typical foundry for audit (medium-size)
- Develop programs for specifications and implement two energy efficiency improvements

4. DSM Programs. A demonstration program could be implemented to distribute/sell standard DSM programs. For instance, an industrial motor program could be implemented, where the industry would exchange existing motors for new high efficiency motors. Residential programs could also be implemented based on lighting improvements.

5. Temperature Controls. A program to provide additional building controls to adjust building temperatures with changes in outdoor temperature could be developed. This program could be developed for all types of buildings. For residential buildings, the controls could be based on the residents forming a building association, and the association contributing towards the purchase of the controls.

6. Weatherization Program. A weatherization program could be demonstrated similar to that being conducted in Armenia. Materials could be sent from the U.S. to install materials and demonstrate their benefits. Start up funds could also be provided for an industry to locally produce weatherstripping, etc. Based on the amount of start up funds, the first quantity of products could be given away free, along with installation brochures. This should produce enough interest to insure a demand for the weatherization materials.

7. Combustion Analyzers. A program could be instituted among the major power plants where they would each receive a portable combustion analyzer, plus receive sensors and calibration/service for several years. This could involve a rotating service that could be based in a counterpart's office or the Ministry. They could have a stock of analyzers, assuming that 2 or 3 might have to be sent away for service at a time. This program might purchase 100 combustion analyzers, with an equipment cost of approximately $50,000. Another $10,000 a year could provide maintenance, annual service, and replacement sensors.

8. Utility Planning. A training program dealing with establishing rate structures could be developed and presented to the various agencies such as Kievenergo. The training could emphasize establishing rates, such as time of use, that encourage conservation.

APPENDIX B

Ukraine Energy Policy Recommendations

Selections from

Proceedings of the Ukraine National Energy Strategy Conference
Kiev, Ukraine
June 14-18, 1993

These Recommendations for a Ukraine Energy Policy were submitted at the Ukraine National Energy Strategy Conference, held in Kiev June 14-18, 1993. Resource Management Associates of Madison, Inc. organized sessions 3 and 6 of the Conference, the proceedings of which are included in this Appendix.

The process by which these policy recommendations were derived included: 1) fact finding mission; 2) discussions and recommendations from the Institute of Energy Saving Problems in Kiev; 3) analysis of these discussions; 4) a preliminary policy paper; and 5) the policy sessions at the Conference.

SELECTED PROCEEDINGS

UKRAINE NATIONAL ENERGY STRATEGY CONFERENCE

KIEV, JUNE 14 16, 1993

A PUBLICATION OF THE GOVERNMENT OF UKRAINE AND THE WORLD BANK

- 20

I. INTRODUCTION

A conference on the energy sector of Ukraine was held in Kiev on June 14-18, 1993. The purpose of the conference was to assist the Government of Ukraine in the formulation of a National Energy Strategy. The conference, organized by the Government of Ukraine and sponsored jointly by the World Bank and the European Bank for Reconstruction and Development, was attended by energy experts from Ukrainian government agencies, enterprises, academic institutions and non-governmental organizations. In addition, a large number of foreign governments, bilateral donor agencies and international organizations sent their representatives to the conference.

The work of the conference was organized in three plenary sessions and twelve working groups. The program, including a complete listing of the presentations made at the plenary sessions and the working groups, is attached at the end of this publication. Sections II to IV below contain the full text of the opening statement by the Prime Minister of Ukraine, the summary statements of the chairmen of the twelve working groups and the presentations made by the representatives of five foreign organizations.

II. OPENING STATEMENT BY MR. LEONID KUCHMA, THE PRIME MINISTER OF UKRAINE

Dear participants of the conference, ladies, and gentlemen.

I would like to express my deep gratitude to all of you for meeting here to discuss a problem which, it can be said without exaggeration, is of vital importance for the peoples of Ukraine and for Ukraine as a whole.

As I was preparing today's speech, I acquainted myself with the World Bank study examining the existing problems in the energy sector of Ukraine. I want to express my deep gratitude to the World Bank officials for the work done.

The energy crisis that has broken out in Ukraine has several specific features.

Firstly, it was caused by political processes associated with the dissolution of the Soviet Union and the independence gained by Ukraine. Energy, specifically the most important forms, such as oil, gas, and nuclear fuel, has become for Ukraine imported goods, and the energy purchasing problem has been converted at once into a problem of balancing our external payments account, *i.e.*, a financial solvency problem. I think that you already know about this given the speech made by Boris Yeltsin, the president of Russia, last Saturday. Hence, it follows that we must set ourselves on the urgent task of finding ways to save energy. This has become not only an economic task, but also a political one, and I must emphasize this point: this is both an economic and a political problem. Therefore, from the political point of view, it is very important for us in Ukraine to engage in alternative energy markets.

Under these conditions, the most important task facing us is constructing the oil-receiving terminals on the Black Sea coast and creating, to a certain extent, an oil tanker fleet and other projects.

Secondly, the energy crisis is being brought about by a transition to world market prices on energy. In addition to all my previous statements on this matter, today I want to emphasize again that such a jump to world market prices by Russia will have a pernicious effect on the whole economy of Ukraine. It goes without saying that the energy crisis is closely connected with a crisis in the whole industry, particularly with a crisis in energy-consuming industries. A world market price for energy is based on very high efficiency of their processing and utilization. But it is impossible for us since we inherited obsolete oil-processing technologies and power-intensive production processes, specifically in metallurgy and chemical industry.

At a number of our plants, refineries in particular, a feedstock value expressed in the world market prices exceeds their product value in world market prices. An unambiguous result is that the Ukraine should acquire the advanced and efficient Western methods of oil refining and the energy-saving production processes. Foreign investments could be very prominent in this respect.

I would also like to note that the transition to the world market prices for energy will make it efficient to explore and recover oil and gas on the territory of Ukraine proper, including the Black Sea shelf. This can open up new vistas for international cooperation and foreign investments on a mutually beneficial basis.

Thirdly, the energy crisis has also some 'inland' features. A new parity of prices on energy seems to be formed now, hence the structure of our energy balance can be changed as well. What would be the optimal structure of the energy balance of Ukraine? The Conference is likely to answer this question, as it is of paramount importance. Nowadays, however, we cannot reach the optimal energy balance in

practice because of high-level disproportions still existing between the home prices on energy and coal extracted in the Ukraine and the world market prices on other power resources.

In Ukraine, a country suffering from the consequences of the Chernobyl tragedy, particular importance should be attached to the elaboration of an adequate strategy of nuclear power development.

Ultimately, the abovementioned problems associated with the development of the energy sector in Ukraine resolve themselves into general aspects of the strategy of the structural reorganization of the national economy.

I believe that our Conference will be a success and wish all participants good luck and prosperity.

Thank you.

24

Working Group No. 3: "Potential for Energy Savings and Efficiency Improvements"

After discussing the problem of enhancing energy efficiency in Ukraine, participants of the working group:

1. would like to thank the members of the World Bank mission for their analysis of the problem of energy conservation in Ukraine and for their proposals concerning energy efficiency improvements;

2. express their support for the recommendations of the World Bank concerning measures which promote the improvement of energy efficiency, including the implementation of energy audits, the development of efficiency standards for energy consuming equipment, and the use of economic incentives aimed at higher energy efficiency;

3. agree with the proposal of the World Bank to increase energy prices up to a level comparable to prices in market economies international level. However, the increase of prices should be a gradual process;

4. agree with the World Bank that there is no need for a new State Committee of Energy Savings and believe that the task of cross-sectoral coordination of energy savings activities can be solved within the existing structure of economic management;

5. consider that a temporary commission needs to be formed to manage the provision of technical assistance by the World Bank and other international organizations to Ukrainian enterprises, institutions and associations with the purpose of increasing the efficiency of the use of energy resources.

25

Working Group No. 6: "The Market for Energy Efficiency Services and Equipment"

1. This session emphasized the recognition that the breakdown of the former Soviet Union has brought about an urgent need for restructuring of the energy sector in the Ukraine, leading to a great improvement in the efficiency of energy supply systems. In addition, there needs to be a major effort to improve the efficiency of end-use energy consumption in Ukraine, a process that will be greatly enhanced through the development of an effective market system for energy efficiency equipment and services. The policies of the appropriate ministries and departments should establish energy policies that are consistent with this need.

2. Although it was agreed that Ukraine has sufficient scientific and technical human resources and industrial capability to carry out the above, there is an urgent need for the development of those industries and sectors of the economy that will bring about energy efficiency improvements. The first part of the working group focussed primarily on economic, technical, and institutional measures to achieve this. Although energy price liberalization is a cornerstone of this effort, industries and businesses need to restructure or establish enterprises to produce and market modern energy equipment for controlling monitoring and operating their energy consuming systems.

3. Joint ventures with western firms, the establishment of new energy service companies, innovative financing programs by domestic and multilateral banks, demonstration projects, demand-side management in the power and heat sectors, and the establishment of energy efficiency standards (at international norms) were discussed as important mechanisms to be developed Particularly important is the encouragement and fostering of collaboration between western manufacturers/suppliers and Ukrainian firms with the potential to produce energy efficiency equipment. There was discussion of the government's need to establish an energy efficiency unit that could play a key intersectoral role in these efforts.

4. There was considerable discussion of the need to convert and modernize several sectors of the machine-building and military production industry, both with the purpose of improving efficiency domestically and with increasing the export capability of Ukrainian industry. Areas in which it was believed there was significant potential include boilers, gas turbines, power engineering and control systems, non-conventional energy supply systems, turbines, generators, and equipment for enhanced ore- and coal production.

5. In addition, there was discussion of the need that the above policies and development be made consistent with the environmental problems and constraints facing Ukraine, and that national and multilateral assistance help ensure this.

26

Talk by W.K. Foell at Closing Plenary Conference

Cooperation between Ukraine and the U.S. Agency for International Development (USAID)
"USAID Activities in Energy in Ukraine"
Wesley K. Foell[1]

Good morning ladies and gentlemen.

The United States government and President Clinton are very aware of the energy problems in the former Soviet Union and have listed energy and privatization as the two most important sectors for our assistance program to the NIS. As I will explain to you, USAID is planning a serious energy assistance program for Ukraine.

As we have discussed at this conference, it is increasingly recognized that for the Ukraine to develop a successful economy, it must make an enormous shift from energy waste to energy efficiency in all sectors of its economy. Such a shift would allow Ukraine to cut its energy use by half, sharply cut energy imports that it cannot afford, improve the competitiveness of its industries and exports, and sharply reduce environmental damage. Therefore, the United States has chosen energy efficiency improvements and market reforms as the cornerstones of its energy assistance programs in Ukraine.

USAID (usually referred to as AID) is a government organization that is responsible to Congress for administering the US foreign assistance/aid to other countries. AID programs are appropriated on an annual basis by the US Congress and approved by the President. Total yearly funding for economic and humanitarian assistance is close to US$10 billion, of which the NIS is becoming a major recipient. AID administers programs in 80 countries worldwide. In the design, implementation, and evaluation of its programs, AID draws heavily on the experience and expertise of AID private businesses, such as my company, RMA, and volunteer organizations. Occasionally, AID also draws on the technical expertise of US government organizations.

The focus of most AID assistance is on the transfer of US experience, technology, and expertise rather than capital development. Investment capital is available through the international financial institutions such as the World Bank, EBRD, and others. It is AID's polity to collaborate and coordinate assistance with the international financial institutions. We catalyze World Bank, EBRD, and other donor investments by providing technical assistance support to their efforts. I want to stress one important difference between AID assistance and World Bank and EBRD assistance: AID funds are grant funds and not loans. You don't have to repay the money.

---

1 Wesley Foell is the President of Resource Management Associates (RMA), an international energy and environmental consulting firm located in Madison, Wisconsin, in the United States. RMA is very active in Ukraine, working on a variety of energy efficiency projects under contract to the United States Government. Dr. Foell spoke on behalf of Mr. Edvard Markeset, Manager of Energy Projects in the Office of Energy, Environment, and Technology for the NIS Task Force in the United States Agency for International Development (USAID). Due to special travel demands, Mr. Markeset could not speak at the closing session. Any inaccuracies in the speech concerning USAID's energy activities are the responsibility of Dr. Foell and not that of USAID.

- 27

US assistance to the former Soviet Union began in 1989 following the Armenia earthquake and has seen a significant increase since the disintegration of the former Soviet Union in being provided with assistance including housing, agriculture, health, privatization, training, and democratic initiatives.

AID's NIS program is managed by a special administrative unit in Washington called the NIS Task Force. We now have four offices, so-called "missions," in Kiev, Moscow, Alma-ata, and Yerevan. Responsibility for the energy and environmental programs rests with the Energy, Environment, and Technology (EET) office. Little by little as the missions become fully staffed, they will start taking over the implementation of some of the programs, including the energy programs.

The EET office has an authorization to plan for energy programs for the NIS a total funding of US$250 million over four years. AID receives an appropriation every year; in 1992 we had US$40 million, and in 1993, we should get about US$60 million. Overall I believe that NIS Task Force has received about US$700 million for FY92 and 93.

Geographic concentration has been on Russia, which receives about 50 percent, Ukraine 30 percent, Kazakhstan, Kyrgyzstan, Belarus, and Armenia. These six countries were selected when the NIS energy program started in April of last year. Other countries are now asking for assistance.

Recognizing the critical importance of energy in the NIS, the energy program, together with the privatization program, are considered the two most important activities of the NIS Task Force. The Energy Efficiency and Market Reform Project (EEMRP) is the central vehicle for supporting energy reform and for responding to requests for technical assistance and training in the energy sector. It has a goal to (1) improve the efficiency of energy production and consumption in the NIS; (2) support energy sector privatization and market reform; (3) reduce the safety risks of Soviet-designed nuclear power plants; and (4) stimulate joint ventures between US and NIS firms. The project focusses on four areas:

1. ***Energy Efficiency and Performance Improvements.*** Improve the energy efficiency in electric power, district heating, refineries, industries, and buildings. this phase is well underway and focusses on demonstration improvements in electric power generation and in district heating systems. Refinery efficiency will be getting underway this month in Kazakhstan and Ukraine.

2. ***Energy Pricing Policy and Institutional Reform.*** Introduce a market-driven approach for energy supply-demand balance in the NIS republics: in other words, introduce US energy market economy. This activity is underway in Belarus, Russia, Kazakhstan, and Kyrgyzstan. This activity will also focus on the familiarization of NIS energy sector policy makers, managers, and specialists with energy sector aspects of the US market economy.

3. ***Production and Delivery Systems.*** Improve production for existing facilitates, development of additional capacity, and through conservation and efficiency, bring about reduction in demand. This activity is focussed on improving the efficiency of coal, oil and gas, and power generation sectors through improved production, conservation, rehabilitation, and through interventions to balance supply and demand. Selected equipment needed for monitoring, metering, and improved operations will be procured. Successful results should allow for shut-down of some unsafe nuclear power plants.

   Ongoing programs in this sector include the PIER (Partners in Economic Reform) Project, which focusses on coalminers' safety, institutional training, and management training; and the USEA

Program, which seeks to establish business relationships between the public and private leadership in the region and US private companies with needed technology and resources.

4. *Nuclear Power Safety.* Reduce risk of accidents in aging civilian nuclear power plants. This component is probably the most important and most urgent activity of the project, and involves an inter-agency approach to assisting with reducing the high risks posed by unsafe nuclear power plant reactors in the NIS.

Two basic options are being considered to reduce or eliminate the safety risks of operating nuclear power plants:

- Improve the operation and maintenance of on-line nuclear power plants and enforcement of regulatory reforms.

- Reduce or eliminate the need to continue operating the most unsafe nuclear power plants through improved efficiency, reduction in demand, and enforcement of energy pricing policies. Funding levels for this nuclear activity in the Ukraine are US$13 million in 1992 and US$18 million in 1993. The activity is being implemented by the US Department of Energy and the US Nuclear Regulatory Commission.

Finally, I would like to identify (and in some cases give levels of financial support) for on-going and future USAID projects in Ukraine:

Current Projects:

1. District Heating: US$1.2 million

2. PIER Project: US$2.4 million

3. Nuclear Safety: US$25 million

4. US Energy Association: Training, exchanges, and business development

5. K & M (US firm):

   (i) Opportunities for energy sector projects with private sector participation.

   (ii) Identification of high-priority environmental retrofit projects for existing thermal-fired plants and co-generation facilities.

Future Projects:

1. FY93 nuclear safety work to continue: US$31 million.

2. Refinery technical characterization (begins in July).

3. Cooperative agreement with IBRD for US$800,000 for coal project in Donbass.

29

4. Considering a US Department of Energy project on an Energy Efficiency Center in Ukraine: US$450,000.

5. Training Program conducted by Institute for International Education (IIE): US$5 million over 3 years, of which 36 percent would be allocated to Ukraine.

6. Atlantic Council: Energy policy analysis project with US executives visiting Ukraine: US$200,000.

On behalf of AID, I want to extend my sincere thanks to the World Bank and our counterparts in Ukraine for organizing this conference and to Laszlo Lovei and Tom Kearney for their personal inputs. In particular I would also like to express my appreciation to Deputy Minister Zinoviy Butzyo for his gracious hospitality extended to me and my colleagues during this visit. I very much look forward to a continuing productive working relationship with Ukraine. Thank you for your attention.

Conference Hall

Working Group 3: Potential for Energy Savings and Efficiency Improvements

Chair: **V.P. Parkhomenko**, Department Chief, Ministry of Economy

Current Issues in Energy Conservation Policies: the Chemical and Metallurgical Industries
V.S. Novitskiy
First Deputy Minister, Ministry of Industry

Findings and Recommendations of the District Heating Energy Efficiency Project
C. Farfard
Team Leader, Resource Management Associates (USA)

Fundamental Directions in Energy Conservation in Municipal Services Sector
L.N. Didenko
Deputy Department Chief, State Committee on Housing and Municipal Services

The Situation and Perspectives in Energy Consumption in Ukraine
V.E. Tonkal
Director, Energy Conservation Institute, AS Ukraine

Energy Efficiency in Ukraine: Lessons from the European Community Experience
B. Böhm
Vice President, Siemens AG Power Generation Group KWU (FRG)

Organizational Measures for Implementing Energy Conservation Policies
V.P. Parkhomenko
Chief, Department for Energy Economics and Conservation, Ministry of Economy

Energy Conservation Measures in Ukraine: The IEA Perspective
David Rubin
Administrator, Energy Efficiency Division, International Energy Agency (OECD)

Energy Efficiency in Ukraine
Mr. Roger Millican
Co-Director, EC Energy Centre KIEV

The Situation in Electricity Use in Ukraine
B.N. Bondarenko
Deputy Department Chief, Energy Inspectorate, Ministry of Power and Electrification

31

WEDNESDAY, JUNE 16

9:00-12:30 Working Group 6: The Market for Energy Efficiency Services and Equipment

Room 201 *Chair:* **N.N. Tkachenko**, Deputy Minister, Ministry for Machinebuilding and Military Conversion

Conditions for the Establishment of a Market for Energy Efficiency Services and Equipment in Ukraine
Wesley Foell
President, Resource Management Associates (USA)

Raising the Efficiency of Energy Use in Ukraine
Yu.G. Blavdzevich, Department Chief, Energy Conservation Institute, AS Ukraine
S.K. Komova, Senior Specialist, Energy Conservation Institute, AS Ukraine

Demand Side Management Programs in the United States: Lessons for Ukraine
Charles Farfard
Team Leader, Resource Management Associates

Problems of Machinebuilding in the context of Clean Ecology and Energy Efficiency
S.V. Yatskevich
Deputy Chief, Department for Scientific and Technological Progress and Ecology, Ministry of Power and Electrification

The Market for Energy Efficiency Services in Ukraine
W. Schemenau
Vice President, Power Plants and Process Technology, Asea Brown Boveri (ABB)

Subroutines in the Development of Energy Machinebuilding
M.A. Virchenko
Chief Engineer, Turboatom Enterprise, Kharkov

Subroutines in the Development of Machinebuilding for the Oil Extraction Industry
S.P. Leshchinskiy
Department Chief, UkrNIInefti

Subroutines in the Development of Machinebuilding for Intensive Mining and Coal Extraction
Yu.S. Remkha
Deputy General Director, NIIPI Rudmash Enterprise, Krivoy Rog

Creation of New Generation Transformers for the Ukrainian Electric System
I.Yu. Meleshko
Director, Transformatorproekt Institute, Zaporozhia

Power Semiconductor Equipment and New Elemental Bases in Regulation Systems
P.D. Andrienko
Deputy Director NII Priobrazovatel, Zaporozhia

Guaranteeing the Quality and Endurance of Transformer Technology
B.V. Kuzmin
Chief Construction Engineer NII Electrotyazhmash, Kharkov

New Directions in the Creation of High-voltage Electrical Apparatuses
B.P. Borisov
Deputy Director, Electrodynamic Institute, AS Ukraine

Use of Polyenergetic Gas Turbines for Producing Highly-Efficient Electricity
V.Ya. Grigorenko
Deputy Director, Ukrainian Ecological Association "Green World"

Problems of Initial Processing in the Development of the Fuel-Energy Complex of Ukraine
G.G. Schastlivyi
Department Chief, Electrodynamic Institute, AS Ukraine

APPENDIX C

"Demand Side Management - Ukraine Applications"

by Charles Fafard
Resource Management Associates of Madison, Inc.
Madison, Wisconsin USA

Presented at:
The World Bank Energy Strategy Conference
Kiev, Ukraine
June 14-18, 1993

APPENDIX D

Selections from Dr. Wesley Foell and Mr. Charles Fafard's presentations at the National Energy Strategy Conference

Resource Management Associates
of Madison, Inc.

Energy Efficiency Seminar

Kiev, Ukraine

Заключение, выводы и рекомендации

Summary, Conclusions, and Recommendations

I. Общие выводы

I. General Conclusions

1. Интенсивность энергопотребления на Украине очень высока, по причинам структуры промышленности и не эффективности технологии

Ukraine Energy Intensity is Very High,
Caused by Industrial Structure and by Inefficient Technology

2. Приближаются изменение в промышленнои структуре. Правительству следует определить взаимоотношения в области энергии и влияние на будущие требования

Industrial Restructuring is Imminent
Government Should Identify Energy Relationships & Impact onFuture Energy Requirements

3. Улучшения энергоэффективности обеспечат важные финансовые сбережения в системе энергоснабжения

Improvements in Energy Efficiency Will Provide Important Financial
Savings inEnergy Supply System

II. Управление энергопотреблением

II. Energy Management

1. Современное энергоуправление не практикуется на Украине; по причинам низкои стоимости энергии и основного внимания на промышленное производство

Modern Energy Management is not Practiced inUkraine
- Caused by Low Energy Prices and emphasis on Industrial Production

2. Метод распределения квот на энергию имеет негативныи эффект для управления энергопотреблением

Allocative Energy Quota Method has Negative Effect on Energy Management

III. Ценообразование в области энергии

III. Energy Pricing

1. Цены на энергию в ЖКС сильно субсидируются и цены на энергию в промышленном секторе составляют только от ¼ до ½ экономическои стоимости

   Household Energy Prices are Very Heavily Subsidized and Industrial Sector Energy Prices are only One-Fourth to One-Half of Economic Costs

2. Либерализация цен на энергию - ключевои фактор в деле улучшения энергоэффективности

   Liberalization of Energy Prices is Key Factor in Improvement of Energy Efficiency

3. Быстрое внедрение улучшения эффективности находится под серъезнои угрозои в связи с недоостатком капиталов, хозяев и неопределенностью в финансировании

   Rapid Implementation of Efficiency Improvement is Seriously Impeded by Capital Shortages and Ownership and Financial Uncertainties

IV. Улучшение рынка услуг в области эффективности и оборудования

IV. Improvement of Market For Efficiency Services & Equipment

1. При изменении структуры малые и средние компании будут иметь хорошие возможности в промышленности по энергосбережению. Донорским и кредитующием агенствам следует выделять начальныи капитал и техническую помощь для этих фирм.

In Restructuring, Small & Medium-Sized Firms Will Have Good Opportunities in Energy Service Industry. Donors & Lending Agencies Should Provide Startup Capital and Technical Assistance to These Firms

2. Донорским и кредитующим агенствам следует поощрять разработку отечественного энергоэффектовного оборудования и компьютерных программ на Украине.

Следует поощрять совместные предприятия с западными фирмами.

Donors & Lending Agencies Should Foster Development of Domestic Energy Efficient Equipment & Software in Ukraine. Joint Ventures with Western Firms Should Be Encouraged

IV. Улучшение рынка услуг в области эффективности и оборудования

IV. Improvement of Market For Efficiency Services & Equipment

3. Украина испытывает недостаток в каналах и рыночных механизмах для получения эффективного потока информации по энергоэффективному оборудованию, услугах и программам.

Ukraine Lacks Channels and Market Mechanisms for Efficient Flow of Information on Energy Efficiency Equipment, Services &Programs

Необходимы правительственные и частные информационные программы.

Government and Private Sector Information Programs are Needed

4. Следует создать ассоциацию *Энергетических Менеджеров*

An "Energy Managers Association" Should Be Established

V. Демонстрационные проекты

V. Demonstration Projects

Демонстрационные проекты в области энергоэффективности следует создать для жилищно-коммунального сектора (ЖКС), коммерческих и промышленных секторов

Energy Efficiency Demonstration Projects Should Be Established in Household, Commercial, and Industrial Sectors

VI. Общая методология

VI. Institutional Measures

1. Сектору общественных услуг (электроэнергия, газ, тепло) следует создать систему интегрированного планирования ресурсов (ИПР) и программы планирования управления потреблением (ППУП)

   Public Utilities (Electricity, Gas, Heat) Should Establish Formal Integrated Resource Planning (IRP) and Demand-Side-Management (DSM) Programs

2. Правительству следует создать позитивные финансовые побудительные мотивы для создания (ППУП)

   Government Should Create Positive Financial Incentives for Utilities to Establish DSM Programs

3. Вместе с банковским сектором новыи подход должен быть разработан для финансирования инвестиции в область энерго эффективности

   With the Banking Sector, New Approaches Should be Developed to Provide Financing for Energy Efficiency Investments

4. Правительством должно быть создано подразделение энерго эффективности (ПЭЭ) для форсирования программ в области энерго эффективности

   An Energy Efficiency Unit (EEU) Should Be Established inthe Government to Foster the EnergyEfficiency Programs

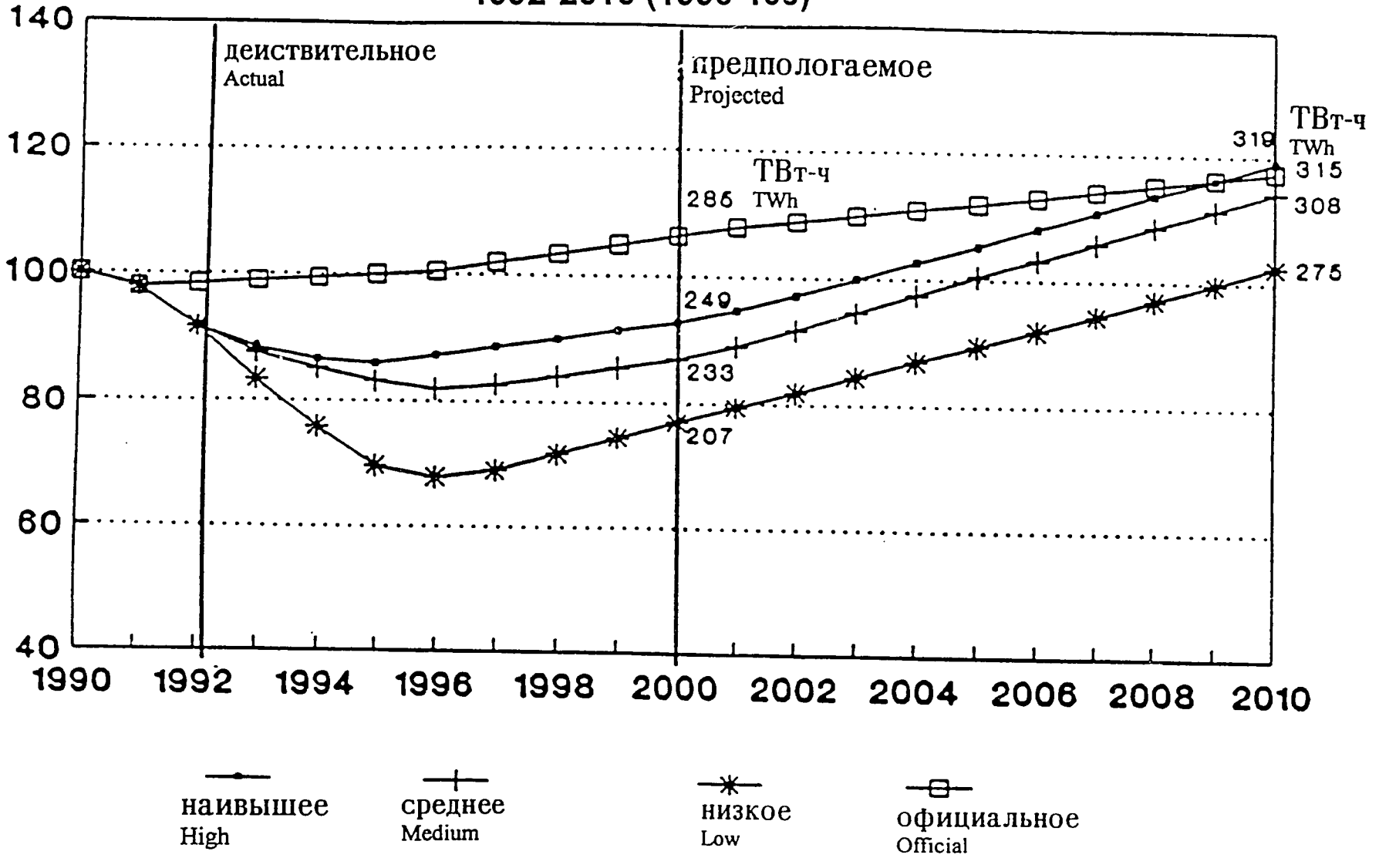
Международное сравнение
International Comparison

1990г страны 1990 Figures Country	энергопотребление на душу населения Energy Con/cap (koe)	с.о.п. мил. дол. GDP (Mill$)	население (тыс.) Population (thousands)	с.о.п./чел. (дол.) GDP/cap ($)	энер потр/с.о.п (кое/дол.) En. Cons/GDP (koe/1000$)
Аргентина/Argentina	1801	93260	32300	2887	624
Болгария/Bulgaria	4945	19910	8800	2263	2186
ПольшаPoland	3416	63590	38200	1665	2052
Чили/Chile	887	27790	13200	2105	421
Венгрия/Hungary	3211	32920	10600	3106	1034
Югославия/Yugoslavia	2409	82310	23800	3548	697
Чехословакия/Czechoslovakia	5081	44450	15700	2831	1795
Ю. Корея/South Korea	1898	236400	42800	5523	344
Ирландия/Ireland	2653	42500	3500	12143	218
Невая Зеландия/New Zealand	4971	42760	3400	12576	395
Велико-британия/United Kingdom	3646	975150	57400	16989	215
Нидерланды/Netherlands	5123	279150	14900	18735	273
Бельгия/Belgium	4852	192390	10000	19239	252
Австрия/Austria	3503	157380	7700	20439	171
Франция/France	3845	1190780	56400	21113	182
Дания/Denmark	3618	130960	5100	25678	141
Западная Германия/W. Germany	3491	1488210	62000	24003	145
Швеция/Sweden	6347	228110	8600	26524	239
Финляндия/Finland	5650	137250	5000	27450	206
Украина/Ukraine	4600	130000	52000	2500	1840

Источник: Расчёты персонала банка по Украине, Отчёт по Мировому Развитию (1987) для других стран.
Source: Bank Staff Estimates for Ukraine, World Development Report (1992) for other countries
* (кое) ≈ 0,01 Гкал. - (килограм-эквивалент жидкого топлива)

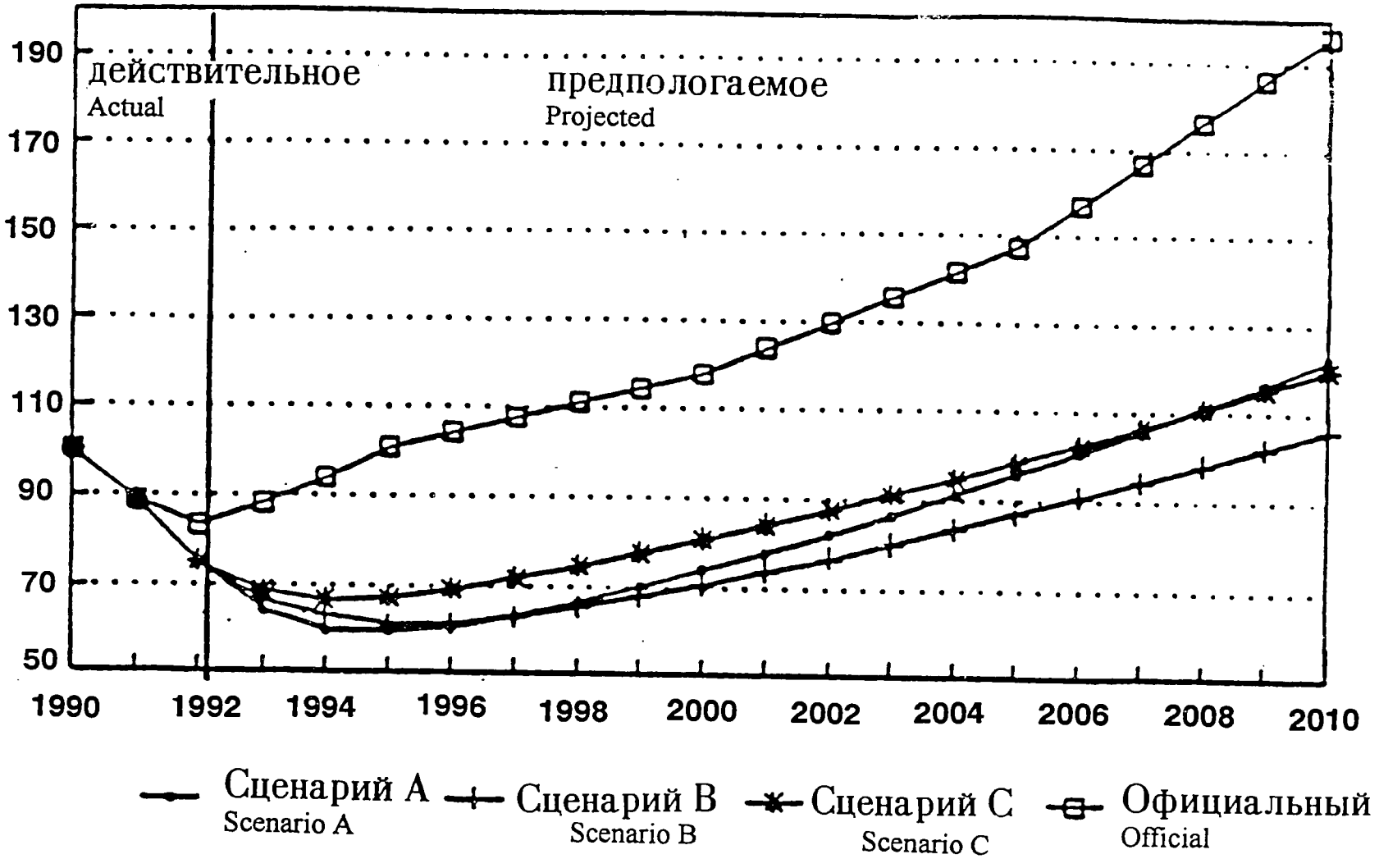
Украина: официальное и предлогочаемое банком использование электроэнергии в 1992-2010 гг.

Ukraine: Official and Bank Projections of Electricity Use 1992-2010 (1990-100)



Украина: официальные и предпологаемые банком значения совокупного общест- венного продукта (с.о.п.) 1992-2010

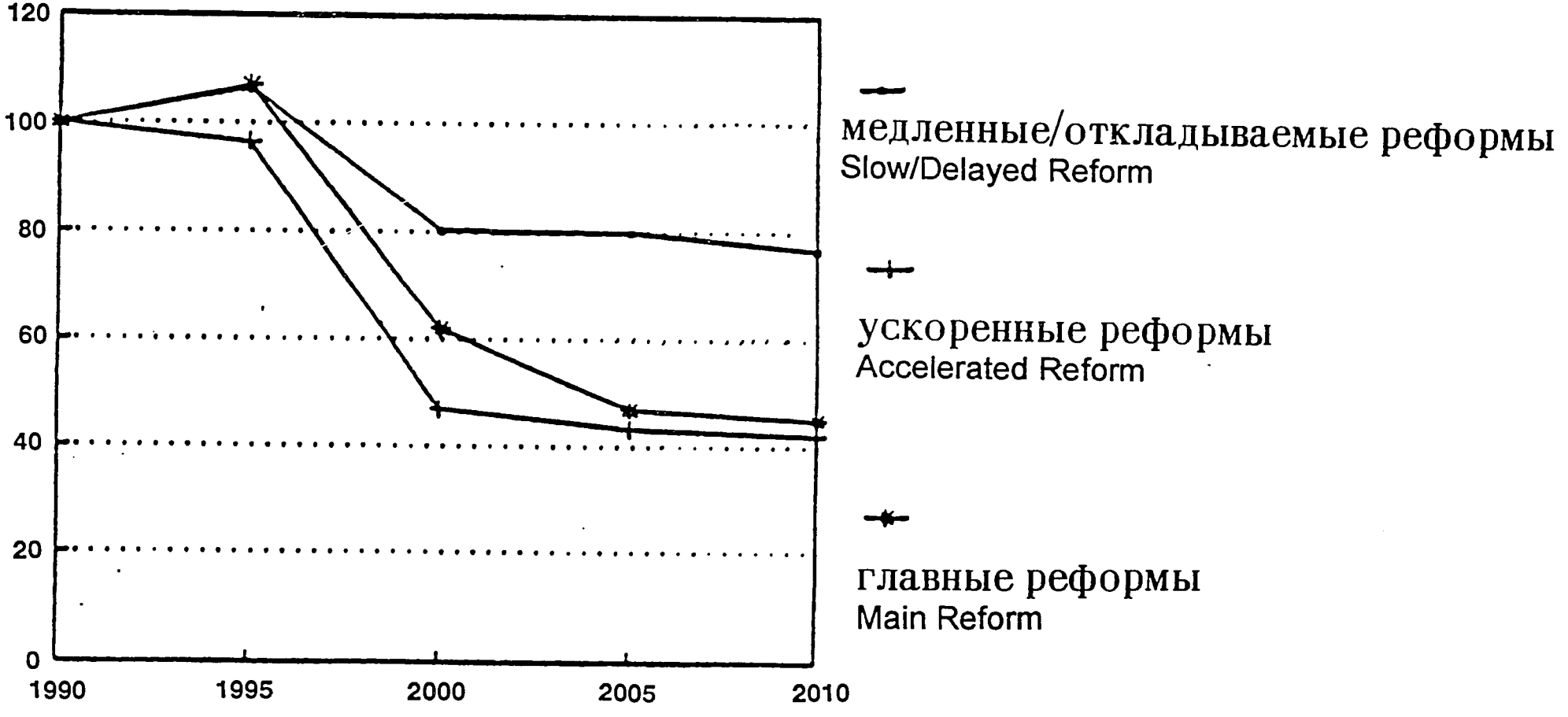
Ukraine: Official and Bank Projection of GDP, 1992-2010 (1990=100)



Предпологаемая первичная энергоинтенсивность (1990 = 2503 кое на 1000 дол. С.О.П.)

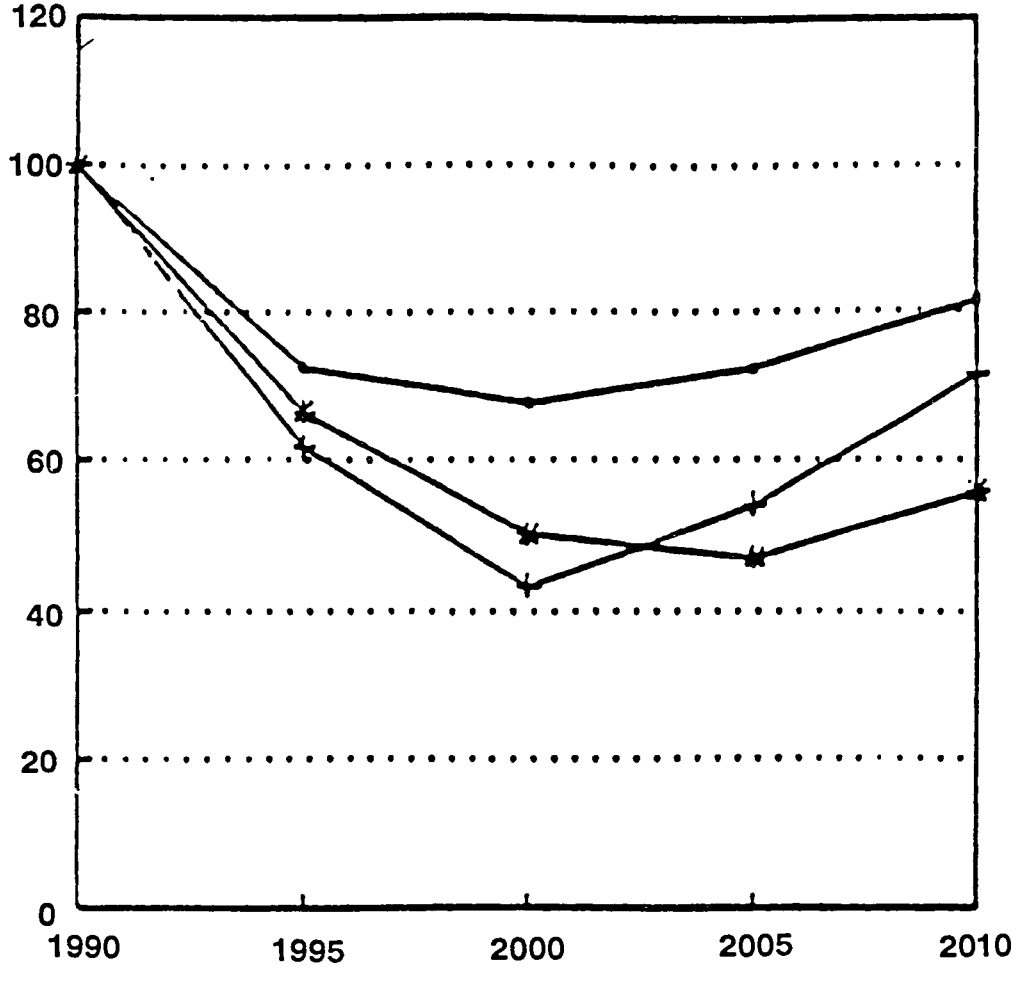
Projected Primary Energy Intensity

(1990-2503 koe per 1000 US$ GDP)



Первоначальная предпологаелая потребность (1990=239,1 мтое)

Projected Total Primary Energy Demand (1990= 239.1 mtoe)



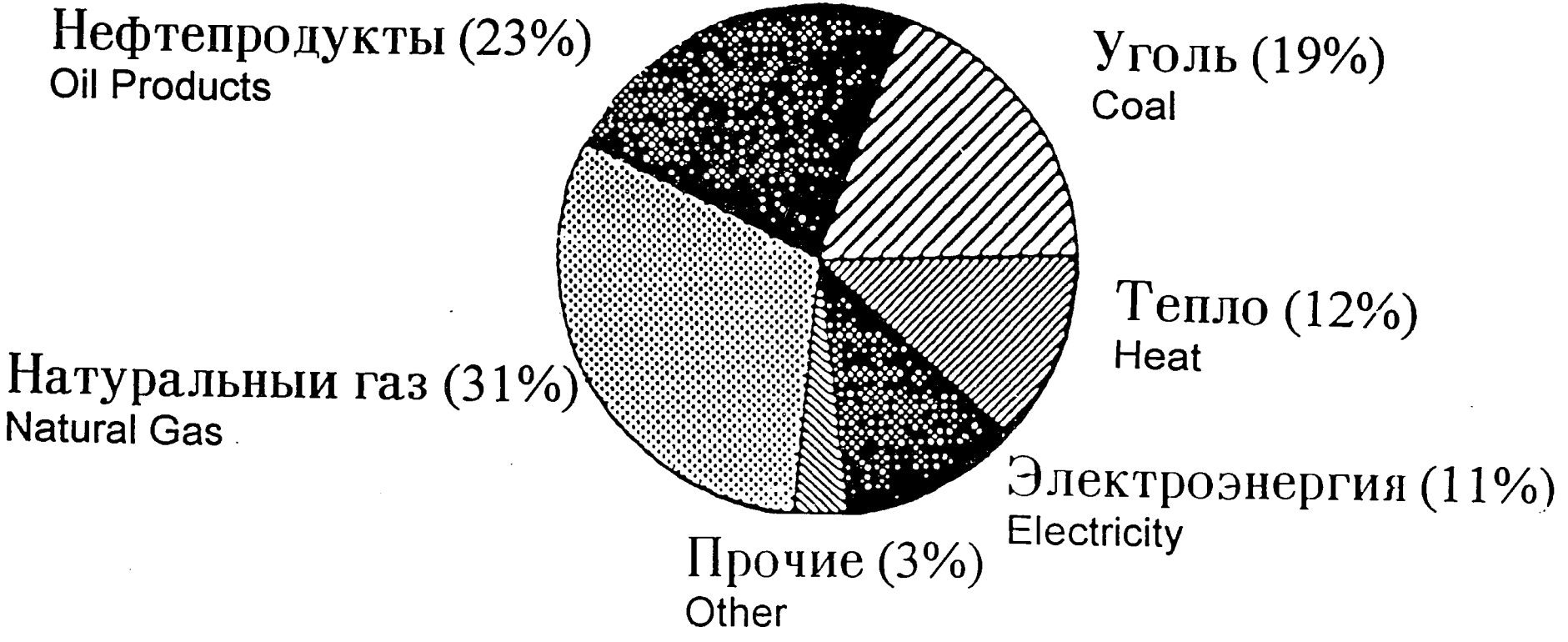
медленные/откладываемые реформы
Slow/Delayed Reform

ускоренные реформы
Accelerated Reform

главные реформы
Main Reform

Составляющие конечного энергопотребления: 1990=173,2 мтое *

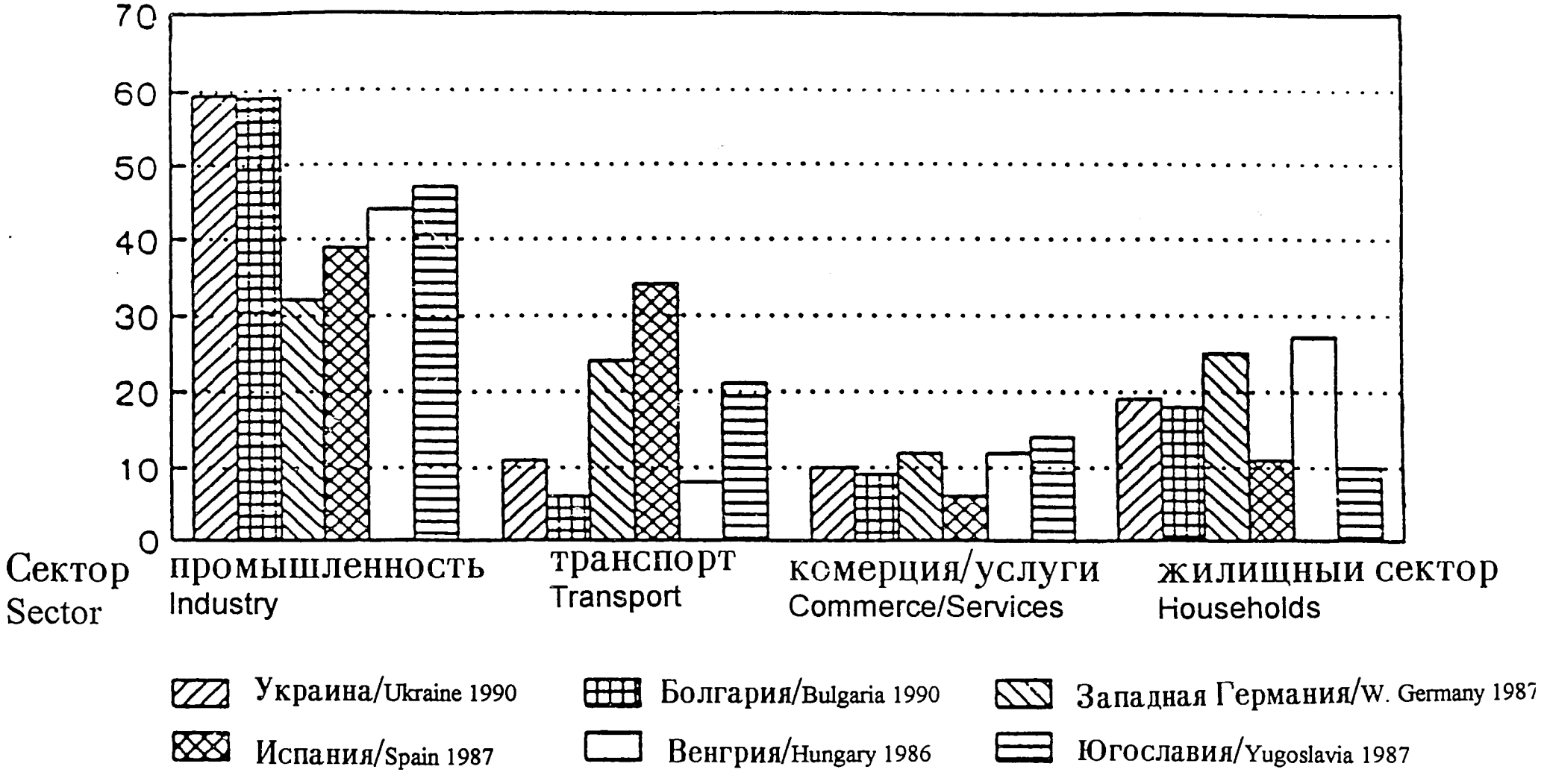
Composition of Final Energy Demand



* (Mtoe) - миллионов тое или миллиардов кое

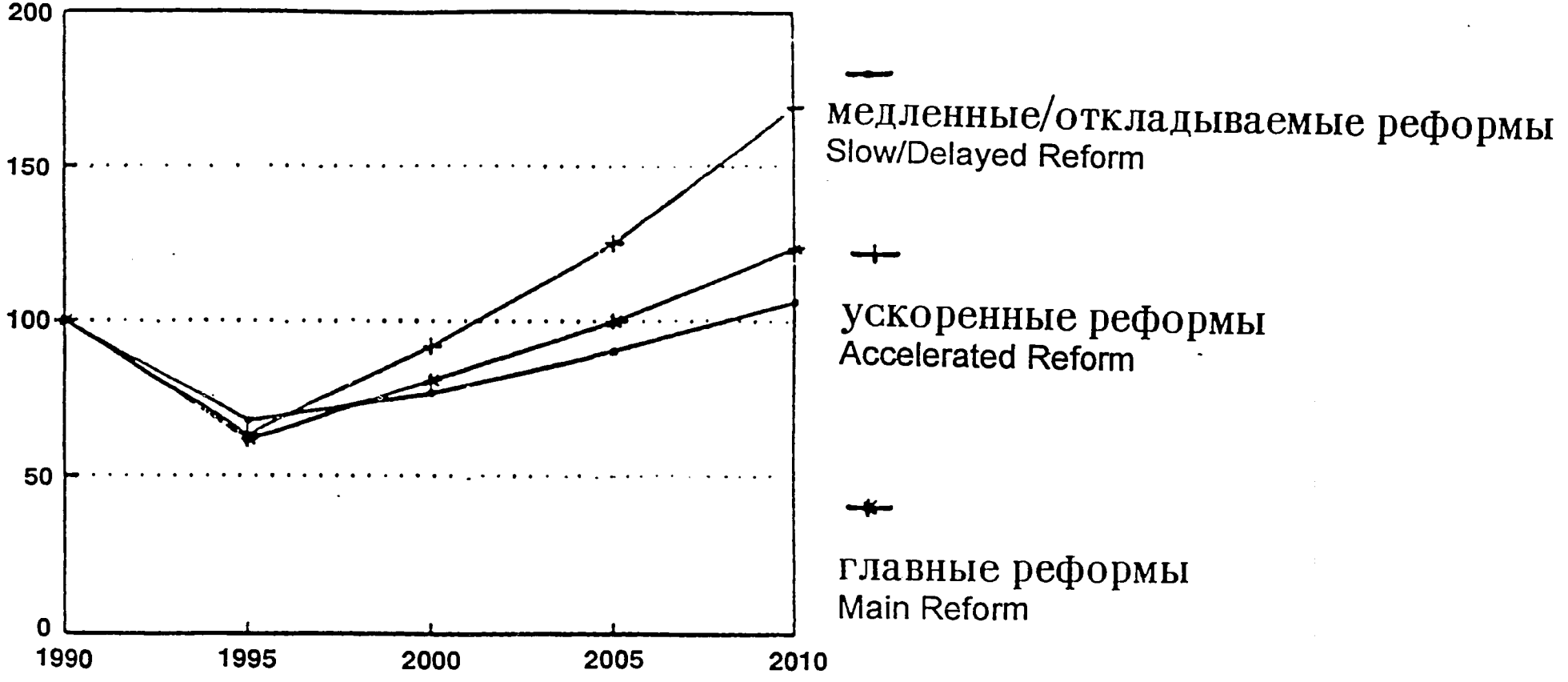
Энергопотребления по секторам

Final Energy Demand by Sector (% shares)



Долгосречный прогноз С.О.П. (1990 С.О.П.=130 миллиардов дол. США)

Long Run GDP Forecasts (1990 GDP = 130 billion $US)



Энергопотребление по отношению к С.О.П.

Данные по 1990-г - Украина и 19 стран

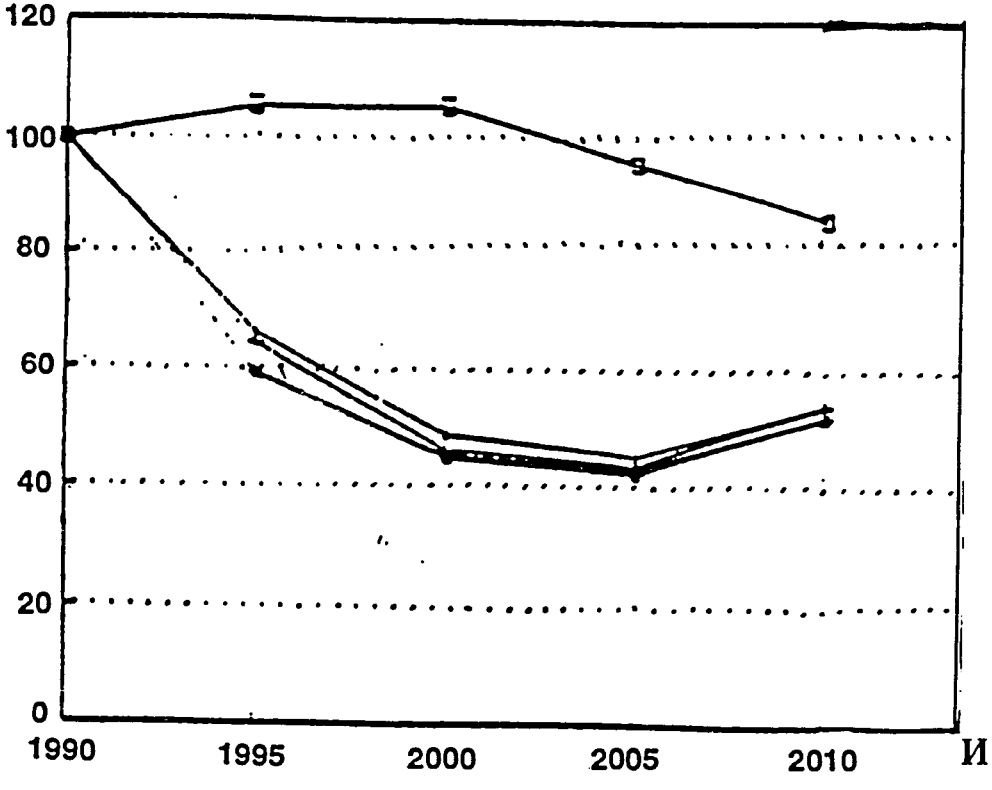
Energy Consumption vs GDP: 1990 Figures - Ukraine & 19 Countries

Источник: Отчет по международному развитию 1992 г. (О.М.Р. табл. 1 и 5): Расчеты персонала банка по Украине.

Source: World Development Report 1992 (WDI Tables 1 and 5) Bank Staff Estimates for Ukraine.

Составляющие первичного энергопотребления: основные реформы

Components of Primary Energy Demand: Main Reform



уголь
Coal

газ
Gas

первичная электроэнергия
Primary Power

нефть/нефтепродукты
Oil/Oil Products

и: уголь 65,9 мтое; газ 97,8 мтое;

1990 первичная потребность в энергии: уголь 65,9 мтое; газ 97,8 мтое;
Нефть 59,8 мтое; эл. энергия 14.8 мтое
1980 Primary Energy Demand: Coal 65.9 mtoe; Gas 97.8 mtoe; Oil 59.8 mtoe; Power 14.8 mtoe

Энергетический баланс по Украине в 1990г (10^{15} Дж)

Energy Balance for Ukraine, 1990 (PJ)

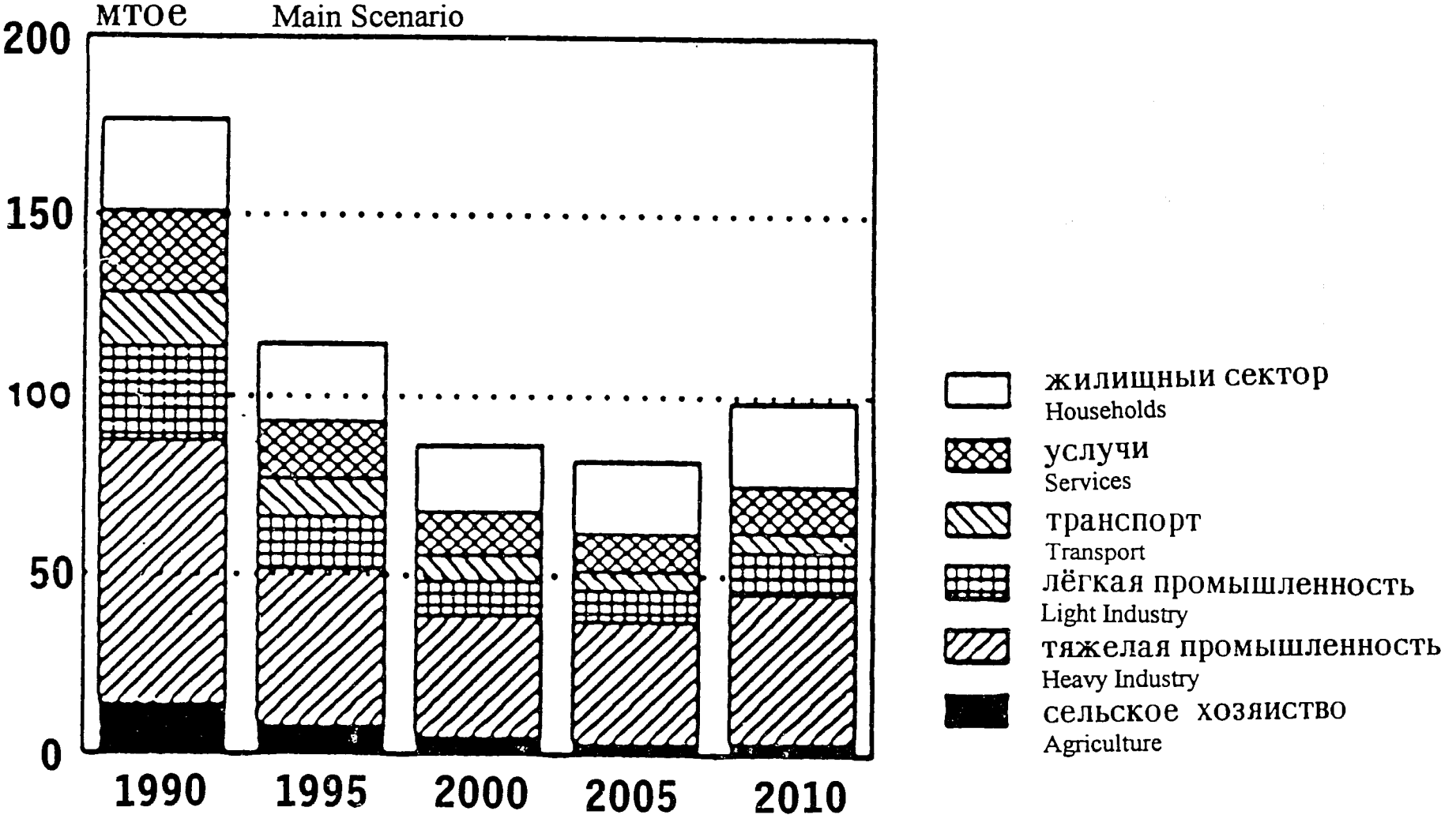
		уголь брикеты COAL	кокс COKE	сырая нефть OIL	натуральный газ NATURAL GAS	эл. энергия ELECTRICITY	тепло HEAT	прочее OTHER	TOTAL
	INDUSTRY								
Черная металлургия	Ferrous Metallurgy	58	743	23	506	185	72	223	1810
Химия	Chemical Industry	11	3	58	334	88	136	12	642
Добывающая промышленность	Mineral Industry		0		47	60	44		151
Машиностроение	Machine Building Industry	74	49	214	263	82	118	4	804
Строительство	Construction	17	1	17	27	15	62		139
Прочие отрасли	Other	86	17	225	151	132	178	1	790
Всего промышленность	TOTAL INDUSTRY	246	813	537	1328	562	610	240	4336
Всего транспорт	**TRANSPORTATION**	4	0	595	136	40	10	4	789
ЖКС/Комерческии	**RESIDENTIAL/COMMERCIAL**	281	7	180	685	144	240	30	1567
Сельское хозяиство	**AGRICULTURE**	37	1	333	78	72	36	3	560
Общее конечное потребление	**TOTAL FINAL CONSUMPTION**	568	821	1645	2227	818	896	277	7252

Предпологаемая конечная потребность в энергии

Projected Final Energy Demand

Главныи сценарии

Main Scenario



Энергетический баланс по Украине в 1990 г (мтое)
Energy Balance for Ukraine, 1990 (MTOE)

		уголь брикеты COAL	кокс COKE	сырая нефть OIL	натуральный газ NATURAL GAS	эл. энергия ELECTRICITY	тепло HEAT	прочее OTHER	TOTAL
	INDUSTRY								
Черная металлургия	Ferrous Metallurgy	1.39	17.74	0.55	12.08	4.42	1.72	5.33	43.22
Химия	Chemical Industry	0.26	0.07	1.39	7.98	2.10	3.25	0.29	15.33
Добывающая промышленность	Mineral Industry		0.00		1.12	1.43	1.05		3.61
Машиностроение	Machine Building Industry	1.77	1.17	5.11	6.28	1.96	2.82	0.10	19.20
Строительство	Construction	0.41	0.02	0.41	0.64	0.36	1.48		3.32
Прочие отрасли	Other	2.05	0.41	5.37	3.61	3.15	4.25	0.02	18.87
Всего промышленность	TOTAL INDUSTRY	5.87	19.41	12.82	31.71	13.42	14.57	5.73	103.54
Всего транспорт	TRANSPORTATION	0.10	0.00	14.21	3.25	0.96	0.24	0.10	18.84
ЖКС/Комерческии	RESIDENTIAL/COMMERCIAL	6.71	0.17	4.30	16.36	3.44	5.73	0.72	37.42
Сельское хозяиство	AGRICULTURE	0.88	0.02	7.95	1.86	1.72	0.86	0.07	13.37
Общее конечное потребление	TOTAL FINAL CONSUMPTION	13.56	19.61	39.28	53.18	19.53	21.40	6.61	173.18

Общие рекомендации

Institutional Recommendations

- Необходимо автоматическое измерение тепло и электропотребления
  Need for Automatic Metering of Thermal Heat and Electricity Consumption
- Необходимы тарифы, отражающие потребление
  Need for Tariffs to Reflect Consumption
- Необходимо распространение философии и практики энергосбережения
  Need for Promotion of Conservation Philosophy and Practices
- Необходимо иметь в каждом здании ответственного за энергопотребление
  Need for Each Building to have an Energy Manager
- Необходимо разработать методологию технического обследования энергоиспользования
  Need for Development of Technical Expertise in Energy Auditing

GENERAL RECOMMENDATIONS:

POWER PLANTS:

- PROVIDE ADDITIONAL COMBUSTION ANALYZERS FOR ALL MAIN POWER PLANTS AND BOILERS
- PROVIDE ACCURATE INSTRUMENTATION FOR POWER PLANTS

DISTRIBUTION:

- IMPROVE DISTRIBUTION PIPING INSULATION
- PROTECT DISTRIBUTION PIPING FROM GROUND WATER

END USERS:

- NEED TO DEVELOP ENERGY AUDITING EXPERTISE
- NEED FOR EACH BUILDING TO HAVE AN ENERGY MANAGER
- PROVIDE AUTOMATIC CONTROLS FOR BUILDING HEAT
- PROVIDE THERMOSTATIC RADIATOR CONTROLS
- PROVIDE AUTOMATIC METERING FOR HEAT ENERGY AND ELECTRICITY

Table 1. Ukraine Energy Conservation Opportunity Summary

Energy Conservation Opportunity (ECO)	No. of Units	Est. Energy Savings 10^3 Gcal/Year	Est. Energy Savings 10^3 Rubles	Est. Energy Savings (Dollars)	ECO Cost (Dollars)	Payback Local Prices (Years)	Payback World Prices (Years)
Combustion Analyzers							
Power Plant #5	2	1,100 +	22,625.4	215,480	9,400	0.04	<0.01
Teploset Peakers	1	4.5	927.2	8,830	4,700	0.53	0.10
Housing Peakers	1	2.2	463.6	4,415	4,700	1.09	0.19
Computer	1	N/A	N/A	N/A	3,300	N/A	N/A
Flow Meters	6	1,100 +	22,625.4	215,480	27,000	0.13	0.02
In-Situ Oxygen Instrumentation	10	1,100 +	22,625.4	215,480	46,000	0.21	0.04
Temperature Control Valves							
Opera	1	0.553	501.9	4,780	9,100	1.9	0.55
Railway Bldg.	1	0.328	297.7	2,835	9,100	3.2	0.93
Thermostatic Control Valves							
Opera	27	0.2	15.8	150	950	6.3	1.84
Heat Meters							
Opera	1	•	•	•	3,300	•	•
Railway Bldg.	1	•	•	•	3,300	•	•
Housing	1	•	•	•	3,300	•	•
Ventilation Control	1	0.143	295.2	2,813	1,100	0.4	0.26
Pressure Regulator	1	0.101	4.2	40	1,000	25.0	0.34
	Totals	3,308.0	70,381.8	670,303	126,250		
					Average Payback	0.19	0.04

• There are no direct energy savings resulting from the installation of the heat meters. However, the use of the meters is necessary to allow end-users to document the energy savings. These savings are included with the appropriate other technologies above.

+ These three technologies are projected to save 3300×10^3 Gcal/yr in total. Since they will be used together in the Power Plant, projected energy savings have been divided evenly between them.

Resource Management Associates of Madison, Inc.

APPENDIX E

"Prospective Economic Changes in Ukraine"

"Enhancement of Energy Utilization Efficiency in Ukraine"

by Dr. Yuri Blavdzevich and Dr. Svetlana Komova
Institute of Energy Saving Problems
(Ukraine Academy of Science)
Kiev, Ukraine
1993

PROSPECTIVE ECONOMIC CHANGES IN UKRAINE

The short- and long-term strategies of economic development of Ukraine consist in the strengthening and development of market relations. Fundamental principles of social and economic development set forth in the new Draft Constitution of Ukraine, Declaration of the country's independence, and in the Law of Ukraine "On economic independence of Ukraine" are also oriented towards the implementation of these objectives.

The need to make a transition to the market economy is all too obvious. Simultaneously, active measures are being put in place to stabilise the economic situation in Ukraine. New Vice Prime Minister V.K. Simonenko has assumed office in August 1992. He believes the improvement of the economic situation in Ukraine may be expected to occur during the current year.

The Draft indicative (recommendatory) plan of social and economic development of Ukraine in 1993 prepared by the former Government headed by V.P.Fokin envisages the stabilisation of economy. To this end, dramatic measures are planned to be put into effect, the main of which are:

- property reform aimed to denationalise, privatise it, and to form the multistructural economy;
- demonopolization of production;
- making the economy open to foreign investments, attraction of foreign capital;
- price liberalisation, transition to free pricing;
- establishment of economically advantageous relations with other countries;
- setting up joint ventures;
- opening the market to foreign commodity producers;

- offering better protection of foreign investments.

WHAT REGION-SPECIFIC (IN THE CIS AND UKRAINE) ECONOMIC AND POLITICAL DEVELOPMENTS AFFECT THE CONDITION OF NATIONAL ENERGY AND FUEL PRODUCTION SECTORS ?

Comprehensive integration of production cycles and economic interdependence are the main feature of the economic complex of the former Soviet Union and of its ex-republics.

Ukraine depended and depends on Russia for 90 per cent of all oil consumed, 85 per cent of gas, 60 per cent of timber, for all precious metals, many rare earth metals, etc. Ukraine had a negative balance of exchange operations, and the annual debt to Russia varied between 10 and 15 billion (b) rubles (R). However, this indebtedness was made for due to deliveries of commodities and materials to other republics of the former USSR.

Decay of the Soviet Union and transition to market relations in Russia and other republics have aggravated the economic crisis. Thus, the reduction of oil production in Russia has had an adverse effect on oil deliveries to Ukraine and these will make some 40 million (m) tons as against 55m tons in preceding years. Decline in the volume of deliveries is also likely in subsequent years. This is attributable to the character of the general situation observed in the oil production industry where the shrinkage of mining capacities is not compensated for through the commissioning of new facilities. Positive changes have take place in the development of relations between the subjects of foreign aconomic activities of Ukraine and foreign partners since early this year. These are due to the increase in the number of foreign economic activity subjects which has doubled this July and reached 21.4 thousand (ths). Due to the activities

of foreign trade enterprises, the State budget has gained the revenue of 349.6m R vs 26.5m R during the relevant period of 1991.

Modification of Ukrainian legislation has appreciably motivated the growth of joint ventures and of the number of contracts signed with foreign partners.

ECONOMIC INFRASTRUCTURE IN MARKET ECONOMY

Formation of market infrastructures and facilitation of their operation through the creation and implementation of legal and institutional-economic conditions are key to the development of the economy of Ukraine at the present stage.

The formation of commodity exchanges in Ukraine proceeded in a relatively easy way. By the end of 1990, there were as many as 44 fommodity exchanges in Ukraine. Some three thousand broker's offices came into being in addition to 26 commodity-raw material procurement companies, 2170 middleman and distribution organizations and 17 commercial centers. To date, these companies collect and accumulate data on demand and supply, and support deals struck be an enormous number of participants of the commodity circulation processes. However, these companies are still in their infancy and do not fully comply with their designation.

In the longer term, Ukraine will orient its economy towards the setting up a limited number of dedicated exchanges. The rest of exchanges will be transformed into the regional departments of major exchanges or fair complexes or zonal wholesale trade centers.

At the moment, Ukraine faces the task of creating the system of stock exchanges and streamlining their operation, forming the market of securities, and organising insurance companies. Of course, Ukraine will not be able to dispense with the assistance of foreign partners. The Government is in for a onerous period of hectic activities to create the dedicated communications system, transport and information support of commercial operations, business centers in Kiev and regions, and to upgrade the existing and build new hotels and other services industry projects.

The forthcoming privatisation of state property, housing and land and creation of labour markets in the longer term will call for the creation of specific market entities, the objective which is paid special attention to. Ukraine also needs the experience of foreign countries in this area badly.

The Government of Ukraine has declared that by the end of 1992 the country will have got its own currency called "grivna". However, the money reform will not succeed unless and before the Government manages to eliminate the budget deficit and create the stabilisation fund required to support the convertibility of the new currency unit. Under the circumstances,implementation of both objectives is a problem.

Vice President of the World Bank Mr. L. Summers was quite sceptical about the likelihood of the speedy introduction of grivna owing to the budget deficit, poor efficiency of tax system, slow momentum of privatisation, absence of structural changes in the industrial sectors, inefficiency of conversion, independence of transformations of the banking system.

PROSPECTS OF PRIVATIZATION IN THE ECONOMY OF UKRAINE

The reform of property relations aims to create in Ukraine a stratum of non-state proprietors as a basis of the diversified socially-oriented economic system. At the moment, state property is dominant in Ukrainian economy. Early in 1992, the percentage of state-owned assets in the overall volume of funds was 93 %, and in the industrial sector 89 %.

Privatization is planned to be implemented in two phases: the first phase between 1992 and 1993 will cover largely the "small-scale" privatization measures, and will pave the way for "large-scale" privatization; during this phase, the government will create a legal framework for privatization and put in place the normative and methodological basis; during the second phase in 1994-1996, the privatization will involve most of medium-, and large-sized enterprises. In the end, the share of the non-state sector is to reach some 54 per cent.

Conducting the privatization is made complicated by certain peculiar features of social-political and economic development of Ukraine, such as:

- absence of market environments and the need to conduct privatization measures under conditions of state monopolism and absence of competition;

- population at large is devoid of free assets that could be channelled to privatization;

- privatization has to be effected along with the restructuring of economy, its demilitarization, and reorientation towards the production of consumer goods;

- industrial assets subject to privatization are significant-

ly worn out and the new owners will need to invest in the re-equipment of production facilities and their renovation;

- valuation of property to be privatized, especially with participation of foreign investors, is a problem.

Improvement of conditions for privatization calls for:

- providing incentives for acquisition of property by workers of enterprises to be privatized;

- providing opportinities to act as founders in converting enterprises to joint-stock partnership, consumers associations, related enterprises, commercial structures, foreign investors in addition to the State property fund;

- simplification of the enterprise privatization procedure;

- speedier development of a package of normative and guidance documentation and creation of market infrastructure to support the existence of securities and real extate market and facilitate the circulation of privatization certificates.

Privatization of energy industry entities is probable during the second phase, i.e. after 1994.

ECONOMICS

1. Economic structures and state departments in charge of economic policy-making and adoption of legislation, including banks

Functional ministries of Ukraine

Ministry of economy

Ministry of finance

Ministry of state reserves

Ministry for foreign economic relations and trade

Ministry of statistics

Ministry of justice

Ministry of labour

Ministry for property nationalization and demonopolization of production

Functional committees

State committee for material reserves

Customs committee

State committee for facilitation of small-sized enterprises and entrepreneurship

State committee for standardization and metrology

State committee for science and technology

State inspectorate for prices control

Banks

Ukraine has 114 banks operating nation-wide; the main of these are:

Ukrainian joint stock commercial industrial-investment bank	Kiev, per. Shevchenko, 12
Republican joint stock-commercial agroindu-	Kiev, per. Rilskogo,8

strial bank "Ukraina"	
Republican joint stock commercial social development bank "Ukrsocbank"	Kiev, ul.Kovpaka, 29
State specialized commercial savings bank of Ukraine	Kiev prospect Nauki,7
State export-import bank of Ukraine	Kiev, Kreshchatik, 8
Ukrainian joint stock innovation bank "Ukrinbank"	Kiev, ul.Oktyabrskoi revolutsii, 12a
Sectoral commercial bank "Energobank"	Kiev, ul.Zankovetskoi, 9/9
Commercial bank "Energiya"	Odessa region, g. Ilyichevsk, ul.Aleksandriyskaya, 6

Energy reform program

No officially approved program for development of power industry in Ukraine is available.

Consequent upon the assignment of the Ministry of Energy of Ukraine in 1992, a number of Ukrainian R&D institutions have developed the Draft Program for energy industry development as part of the "Integrated program for modernization and development of fuel and energy industry of Ukraine for the period up to the year 2010". This projects has not been officially approved.

On the availability of energy services market

Energy services market is absent under conditions of monopoly on the generation and distribution of electricity.

Effect of state economic organizations on the pricing for fuel and energy, import and export legislation, and distribution of energy anf fuel resources

Prices of energy anf fuel in Ukraine are wholly determined by the prices of energy resources supplied from Russia. Production, distribution and pricing of oil and gas are subject to state monopoly. The world price of Russian gas is $33/1000 cu.m and 2048 R/1000 cu.m in making settlements among the CIS countries. Ukraine will receive some 100 billion cu.m gas from Russia and Turkmenia in 1992. The country's own production of gas amounts so about 24 billion cu.m and will meet only 24 % of the requirement of Ukraine for gas.

Supplies of oil and oil products to Ukraine are also a problem. The domestic requirements for oil and oil products are met at the expense of supplies from Russia, and only 6 per cent of the demand is supplied using Ukraine's own oil resources. In accordance with the intergovernmental agreement, Ukraine has been granted a quota for 40 million tons of oil supplies, but the expected supplies will not exceed 30 million tons. The world price of 1 t is 120-130 USD and 2.000 R/t for domestic settlements.

Energy resources import and export operations are performed in Ukraine by state organizations - State Committee for oil products ("Goscomnefteproduct") and the concern "Ukrgasprom". They are responsible for realisation of agreements with other countries and provide the supplies of oil and gas to individual consumers. The Goscomnefteproduct and Ukrgasprom report to the Cabinet of Ministers of Ukraine. Energy resources bmay be supplied to consumers based on direct agreements bypassing these organiza-

tions.

The Government of Ukraine is very concerned about the current energy resources supply situation where Ukraine receives energy resources from one source (and one more source in terms of gas supplies - Turkmenia), therefore it seeks to sign agreements for oil and gas imports from abroad, including the countries of Middle East, Africa, and Europe. Relevant scientific validations have been elaborated for these supplies.

Economic mechanism for coordination of foreign economic activities of Ukraine and CIS conunries

In the proterty relations domain: Working out reliable legal guarantees for effective functioning of all property patterns and development of diverse entrepreneurship activities; reorganization of foreign trade capital taking into account the interests of labor collectives interlinked by common property (setting up joint ventures, associations, cooperative enterprises and other ownership entities).

In the taxation domain: Pursuing progressive tax policies to privide a close link between revenues and end results of the activities of enterprises in the foreign economic area; development of the mechanism to establish the procedures for and sums of deductions to national budget followed by the calculation of profits due to the working collectives.

In the funding area: Allocation of target-oriented funds, credits and loans of Vnesheconombank, as well as creation of special reserves of the fund for development of foreign economic activities.

In addition, it is necessary to provide for preferential funding of new products, subsidies to enterprises to conduct ventu-

re R&D activities, retooling of the existing production facilities, environmental protection; and meeting the social requirements in the process of production.

In the pricing area: Gradual expansion of the scope of contractual and free market prices with the implementation of market relations; raising and lowering the levels of prices of the imports depending on their quality and competitiveness on the CIS markets; elaboration of mechanisms to control pricing processes.

In the economic links area: Entry of Ukraine into the common market of the ex-USSR states and fulfilment of interstate economic agreements.

There have to be two phases in addressing these issues:

- determination of regulators for interstate economic relations in transition to market economy;

- determination of regulators for interstate economic relations under market economy conditions.

The general pattern and sequence of moves to coordinate the activities of government agencies of Ukraine in the interstate relations area may be presented as follows:

- interstate economic relations are a component of horizontal economic links between enterprises and are maintained by enterprises themselves with the minimal assistance from government agencies (state requirements). Government agencies regulate this exchange of economic methods to bring about progressive changes in the material production domain;

- Ukrainian enterprises, whatever their ownership patterns, establish horizontal links either independently or via the agency of middleman organizations and conclude agreements about which they inform relevant state bodies. This information is required

for obtaining aggregate data on the fulfilment of interstate-level agreements;

- if enterprises do not handle the issues of supply from other states of the ex-USSR, they conclude agreements with other state bodies on the provision of paid services to them concerning the supplies of the required products from other states, and the obtained orders of enterprises are generalised in terms of product line and for each state;

- Ukrainian government conducts preliminary negotiations with other governments and specifies the range of mutual deliveries, determining the barter and worth exchange to be included in economic agreements with the states;

- potential for meeting the requirements of other states for deliveries of products from Ukraine is determined and the negotiations of the Government agencies with the producers of these products conducted;

- proposals are finalised for negotiations and signing the interstate economic agreements;

- final calculations are made and the commodity exchange balance analysed followed by its coordination with each state for the next year. On this basis, measures are planned for restructuring of material production to bring down the dependence of Ukraine on foreign economic links in the future (where unprofitable for the state);

The suggested mechanism for organization of foreign economic activities will stimulate:

- the imports of commodities and services the socially required production costs of which in Ukraine are higher than those related to imports;

- the import of commodities not produced in Ukraine;

- the imports of commodities and services fully supplying the demand of Ukraine whose prices allow outlays to be reimbursed and profits obtained;

- production of competetive goods, development of international trade, obtaining positive import-export balances.

Characterisation of legislation affecting:

Provatization

Privatization actions in Ukraine are regulated by the Laws on "Privatization of property of state enterprises", "On provatization of small state enterprises", "On privatization certificates".

The Law "On privatization of property of state enterprises" has the most relevance to the privatization of energy industry entities.

In keeping with the Law, energy industry enterprises are subject to privatization. The subjects of privatization may include: state privatization agencies, buyers (also foreign representatives and middlemen). The privatization procedures envisage the submission of an application, decision-making on the entity privatization, publishing information on the privatization of an entity, setting up a privatization board, approval of privatization plan for the state-run enterprise property, implementation of privatizations actions. Projects may be privatized through sales, corporatization, buyout of property under leaseholding agreeements. Privatization of state-run enterprise property is based on a relevant agreement.

Electricity production

The Law of Ukraine "On the property", "On entrepreurship", "On enterprises", "On prices and pricing", "On the state tax sys-

tem", "On foreign investments", etc.

The Law "On enterprises" is key to privatization activities in the energy industry sector. It determines the types and organization patterns of enterprises, rules for their setting up, registration, reorganization and dissolution and the structural mechanisms for enterprise activities. The Law creates equal conditions for activities of an enterprise irrespective of its ownership pattern and organization form. Moreover, the Law also stipulates the rights of enterprises and their liabilities in connection with economic activities and regulates the relations with other legal entities.

ECONOMY SUPPORT PLANS OF INTERNATIONAL FINANCIAL ORGANIZATIONS

This April, the IMF, the World Bank and affiliates thereof have passed the decision on admitting Ukraine to these prestigious financial organizations at the request of the Ukrainian Government.

The Supreme Council of Ukraine has passed a relevant Law of Ukraine "On Ukraine's joining the International Monetary Fund, International Bank for Reconstruction and Develpment, International Finance Corporation, International Development Association and the Multilateral Agency for Investment Guarantees".

The Commission of European Communities extends the technical assistance worth 54m ECU to industry and agriculture to facilitate the realisation of the indicative Program by Ukraine. These funds will be disbursed for the priority development of energy industry and, particularly, for improvement of the safety of nuclear power plants. Other areas funded at the expense of the CEC money will include the conversion of the armaments industry, and the re-equipment of transport systems.

ELECTRIC ENERGY GENERATION SECTOR IN UKRAINE

Ukraine boasts a powerful potential for electricity production which until recently enabled the country's demand for electric energy to be satisfied in full and a certain quantity of electric energy to be exported. To date, economic recession has affected the electric energy industry too. Energy production volumes feature a declining trend during the last two years because of the reduction of electric energy consumption levels by industri-

es, decline in fuel deliveries to steam power plants, and as a result of the moratorium imposed on the commissioning of new nuclear power plants and their additional units.

In the absence of a conceptual plan for the development of national economy of Ukraine, working out the energy policies of this country proves to be a highly stupendous task. Meeting the requirements of national economy for electricity and thermal energy has to take place in the transition of Ukrainian economy, individual enterprises and organization to market relations and economic independence. The situation is made worse owing to the absence of full-scale production of some auxiliary equipment for power plants, abrupt rise of prices of energy carriers, shortage of the country's own energy resources, complicated environmental situation, absence of accumulated capital, including currency reserves, to upgrade the fixed assets of the energy sector.

Therefore, the electric energy industry's development strategy should be oriented towards the reductionof energy supply rates at the expense of the stabilization of the operation of energy-intensive production facilities, cutting down their number; it should involve active measures aimed at energy saving with account of specific factors that impede, to that or another extent, the development of electric energy generation industry.

Two stages may be singled out in the future development of electric energy industry: the short-term (before 2000) and the long-term (before 2010) stage.

Tables 1-4 demonstrate the energy consumption prospects in Ukraine.

Compensation for system loads is performed by electric power plants under the Ministry of Energy of Ukraine (steam power plants, SPP, and hydroelectric power plants, HPP), UKRATOMENERGOPROM (nuclear power plants, NPP), and by commercial power plants of other ministries and departments (Table 5).

No state energy generation program is available in Ukraine. Energy saving projects are developed by various R&D institutions, and also by the Ministry of Energy of Ukraine, for example, "Target integrated program for modernization and development of the fuel and energy industry (electricity generation sector)". In addition, the Scientific and Technological Union of Energy Engineers and Electrical Engineers of Ukraine suggest that the Cabinet of Ministers and State Duma of Ukraine support the development of the following projects:

1. National program for creation and development of energy mechanical engineering and electrical engineering sector;

2. National program to further the development of nuclear energy industry of Ukraine;

3. National program for energy saving in Ukraine;

4. Research and development program to modernize the energy complex of Ukraine and to provide servicing and maintenance of the equipment.

Electric energy intensity of the GNP and national income in Ukraine amounted to 1033 and 2525 kW.h/ths R in 1991 and 1992, respectively.

Table 1

Projected levels and structure of electricity consumption in Ukraine

Description	billion kW.h					%				
	1990.actual	1991.act.	1995*	2000	2010	1990.act.	1991.act.	1995	2000	2010
Electricity consumption (gross)	270.4	264.4	268.2 / 270.4	287.3	336.8	100	100	100 / 100	100	100
Industry	148.1	139.7	141.9 / 144.0	149.7	164	54.8	52.8	52.9 / 53.3	52.1	48.7
Civil engineering	3.9	3.7	4.1 / 4.1	4.2	7.1	1.4	1.5	1.5 / 1.5	1.5	2.1
Transport	14.5	13.6	14.6 / 13.2	15.2	23.5	5.4	5.2	5.4 / 4.9	5.3	7.0
Agriculture	28.5	30.6	30.5 / 38.6	35.1	45.0	10.5	11.6	11.4 / 14.3	12.2	13.4
Consumer services industry	35.1	36.8	38.6 / 31.1	42.0	52.2	13.0	13.9	14.4 / 11.5	14.6	15.5
Process requirements of the sector "electric energy generation"	40.3	40.0	38.5 / 39.3	41.1	45.0	14.9	15.1	14.4 / 14.5	14.3	13.3

* The numerator shows: projections for electricity consumption levels in 1995 obtained with the expert system "electric energy-intensity developed in 1990 by the IPE of Academy of Sciences of Ukraine

History and structure of industrial electricity consumption in Ukraine

Description	billion kW.h				%			
	1990,act.	1991,act.	1992	1993	1990,act.	1991,act.	1992	1993
Industry - total (w/o electrical energy industry), including:	148.1	133.7	138.2	137.1	100	100	100	100
Fuel industry	17.4	16.5	15.7	15.6	11.8	11.8	11.5	11.4
Ferrous metallurgy	51.5	47.7	44.4	43.9	34.8	34.1	32.4	32.0
Non-ferrous metallurgy	6.8	6.8	6.5	6.5	4.6	4.9	4.7	4.7
Chemical industry	19.0	18.3	18.6	19.3	12.8	13.1	13.6	14.1
Mechanical engineering and metal treatment	24.6	23.5	22.9	22.5	16.6	16.8	16.7	16.4
Pulp and paper industry timber and wood-working industry	2.3	2.2	2.7	2.9	1.6	1.6	2.0	2.1
Construction materials industy	7.3	6.2	7.4	7.5	4.9	4.4	5.4	5.5
Consumer industry	3.6	3.4	3.4	3.4	2.4	2.4	2.5	2.5
Food industry	7.7	7.2	7.5	7.6	5.2	5.2	5.5	5.5
Other industries	7.9	7.9	7.7	7.9	5.3	5.7	5.7	5.8

Table 3

Projected levels and structure of thermal consumption in Ukraine

Description	million Gcal					%				
	1990.act.	1991.act.	1995	2000	2010	1990.act.	1991.act.	1995	2000	2010
Thermal energy consumption - total	411.3	416.4	441.4	462.2	531.9	100	100	100	100	100
Industry	256.6	256.5	272.8	280.0	308.0	62.4	61.6	61.8	60.6	57.9
Building	9.8	9.4	10.4	11.2	14.5	2.4	2.3	2.4	2.4	2.7
Transport	8.6	8.7	9.0	9.2	9.9	2.1	2.1	2.0	1.9	1.9
Agriculture	13.8	14.5	16.9	20.0	20.9	3.3	3.5	3.8	4.4	3.9
Consumer services industry	106.0	110.1	114.5	112.5	156.6	25.8	26.4	25.9	26.5	29.4
Other sectors of national economy	16.5	17.2	17.8	19.2	22.0	4.0	4.1	4.1	4.1	4.2

Table 1

History and structure of industrial heat consumption in Ukraine

Description	million Gcal				%			
	1990.act.	1991.act.	1992	1993	1990.act.	1991.act.	1992	1993
Industry - total	256.6	256.6	258.4	259.2	100	100	100	100
Electric energy industry	5.7	5.8	5.9	6.0	2.2	2.3	2.3	2.3
Fuel industry	23.5	21.6	22.6	23.0	9.2	8.4	8.7	8.9
Ferrous metallurgy	35.5	32.9	32.2	32.1	13.8	12.8	12.5	12.4
Non-ferrous metallurgy	4.1	4.3	4.3	4.3	1.6	1.7	1.7	1.7
Chemical industry	56.5	58.0	58.2	59.5	22.0	22.6	22.5	23.0
Mechanical engineering and metal treatment	38.5	40.7	39.7	36.5	15.0	15.9	15.4	14.1
Pulp and paper industry timber and wood-working industry	11.5	12.3	12.7	13.5	8.1	4.8	4.9	5.2
Construction materials industy	20.8	21.2	21.3	21.5	4.5	8.3	8.2	8.3
Consumer industry	9.7	8.7	9.1	9.4	3.8	3.4	3.5	3.6
Food industry	44.7	44.5	45.8	46.6	17.4	17.3	17.7	17.9
Other industries	6.1	6.5	6.6	6.8	2.4	2.5	2.6	2.6

Table 5

Projected levels and structure of electricity consumption in Ukraine

Description	1990.act.	1991.act.	1995	2000	2010
1. Energy consumption, b kW.h	268.3	262.4	268.2	287.3	336.8
2. Maximum load utilization time, hrs	6529	7016	6705	6681	6873
3. Overall compensated-for maximum level - total, m kW	46.7	41.2	40	43	49
maximum load	41.1	37.4	40	43	49
power transmission abroad	5.6	3.8	-	-	-
4. Installed capacity of electric power plants by the end of year - total, m kW	53.4	53.3	52.2	60.0	65.9
Stream power plants	32.6	32.6	33.3	36.0	36.2
Hydroelectric power plants	4.7	4.7	5.1	6.7	7.8
Nuclear power plants	13.8	13.8	10.8	10.8	10.8
Steam and gas power plants	-	-	0.8	4.0	8.1
Commercial power plants	2.2	2.2	2.2	2.2	2.2
Alternative energy sources	-	-	-	0.2	0.8
5. Capacity not utilized to compensate for the load, m kW.h	5.6	6.5	4.2	5.5	2.2
6. Available power generation capacity of the energy system, m kW	49.1	48.7	48.0	54.9	63.7
Electric power plants, m kW	47.8	46.8	48.0	54.9	63.7
Power obtained from other energy systems of the CIS	1.3	1.9	-	-	-
7. Standby capacity, m kW	2.4	7.5	8.0	11.5	14.7
%	5.1	18.2	20.0	26.7	30.0

83

Energy tariff rates

Ukraine has introduced a system of energy tariff rates. At present, electricity and heat tariff rates are based on the price list No. 09-01-1990/2-02 worked out by the Main Administration for Price Policies with the Ministry of Economy of Ukraine and approved by the Resolution of the Ministry of Economy (No.14 of 04.15.1992) and Cabinet of Ministers of Ukraine (No.193 of 04.15.1992).

The present Price list is a complement to the Price list No. 09-01 brought in as of Jan.1,1991 in compliance with which all consumers have been broken into 9 tariff categories:

I - industrial and the comparable consumers with the connected capacity of 750 kW h and higher;

II - industrial and comparable consumers with the connected capacity of up to 750 kW h;

III - wholesale consumers-resellers;

IV - commercial agricultural consumers;

V - electrified railway transport;

VI - city electric transport;

VII - non-commercial consumers;

VIII - population;

IX - residential locations.

The Price list for the first consumer category specifies payments per 1 kW of maximum load and 1 kW h of electricity consumed (double-rate tariffs) for each power grid of Ukraine.

It is important that the Price list No.09-01 introduced as of January 1, 1992 was virtually not applied because of the significant rise in prices of energy resources used in the generation of energy and changes in the economic situation. Regulation

of tariff rates throughout 1991 was based on the factor determined by tariff rate increase vs the Price list according to "Provisional regulations on the state control of electricity and heat tariffs rates for consumers connected to electric grids and heat supply networks". The tariff rate increase factors were determined for all categories of users in each power grid. For example, Kievenergo - 1.29, Odessaenergo - 1.4, Crimeaenergo - 1.6, and the rest of the grids - 1.15.

The existing system of tariff rates provides for discounts and surcharges on electric energy to make for the reactive power capacity and energy. These discounts (surcharges) compensating for reactive power capacity and energy are determined using the instruments that record reactive power capacity and energy and are charged in the form of payment for 1 kVAr of maxiuum load and 1 kVAr h of the energy consumed.

This price list attempts for the first time to provide incentives for individaul goups of consumers to save electricity. Thus, in the case of category VIII (population) settlements are made in terms of time period-differentiated tariff rates provided there is a separate recording of energy consumption depending on the time of the day as follows:

0.5 of the price per 1 kW h - during the period of nighttime minimum of electric loads (from 23.00 to 7.00);

1.4 of the price per 1 kW h - during the rest of day's time.

Day time-differentiated tariff rates are applied to the electricity consumed by electrical boilers and other electrical heaters for heating and hot water supply of industrial and communal services buildings. These tariff rates are not applicable to

industrial demands of agricultural consumers and household needs of population using the same devices.

Table 6 shows the variation of tariff rates on the electric energy.

Table 6

Analysis of the variation of electricity tariff rates in Ukraine

Consumer category	Tariff rate for 1 kW h/kop.			
	1991		1992	
	Average tariff rate			
	Donbass-energo	Vinnitsa-energo	Donbass-energo	Vinnitsa-energo
1. Commercial and the like consumers with the connected power capacity of 750 kVA	3,I0	6,I7	II5	I54,6
2. Commercial and the like consumers with the connected power capacity of up to 750 kVA	4,53	5,02	99	I22,6
3. Electrified railway transport	3,43	3,79	II2	I24,2
4. Electric city transport	4,0	5,03	I03	II2,2
5. Non-commercial consumers	4,58	4,97	98	I04,3
6. Commercial agricultural consumers	I,I5	I,25	47	50,8
7. Population:	3,80	3,57	20	I7,I
-urban residents				
-rural residents	I,35	0,98	II	9,3

Structural-functional scheme of organizations participating in energy generation

Electricity is generated by power plants of the Ministry of Energy of Ukraine, State concern "Ukratomenergoprom", other ministries and departments (block-units).

Electric energy is distributed by enterprises of electric grids of industrial energy associations.

Industrial association "Ukrenergo" is in charge of electricity purchase and sale.

Heat is produced by combined heat and power plants (CHPP) and district boiler rooms of the Ministry of Energy of Ukraine, CHPPs of industrial enterprises, for example, of sugar mills, intended for production of process steam, as well as boiler rooms of the Goskomzhilcommumhoz meeting the demand of the housing and communal sector for steam and hot water.

The principal producers of electric and thermal energy in Ukraine are shown in Fi ures 1 and 2.

Production, import and delivery of fuels are provided by state-run organizations (committees), e.g. "Gosugleprom", "Goskomnefteproduct" (coal and oil products), concern "Ukr gazprom" (gas).

By direct agreements energy resources may reach the consumers bypassing the above organizations.

Electricity is exported by the Association "Interenergo" of the Ministry of Energy of Ukraine.

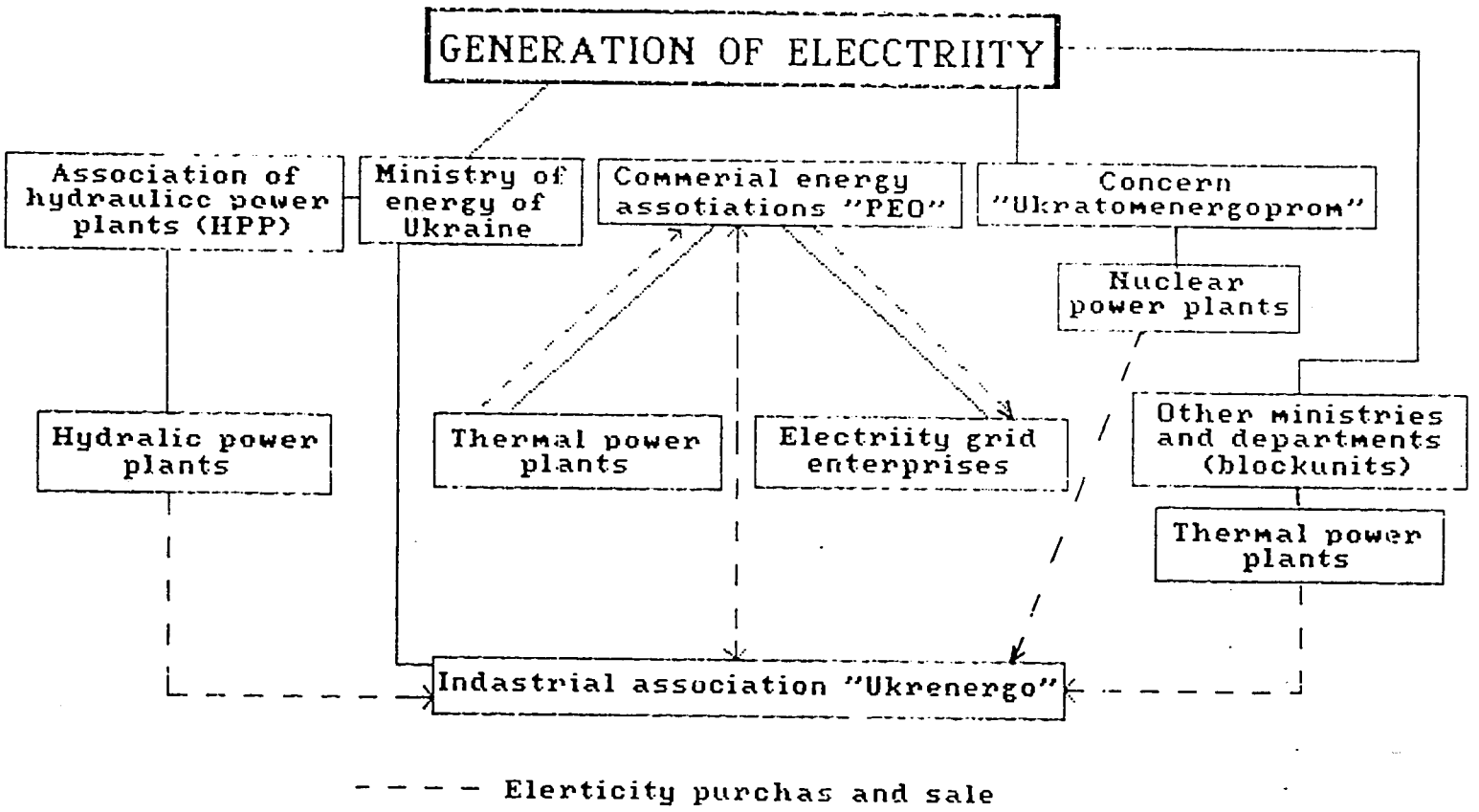


Fig.1 Organization for electricity production in Ukrain

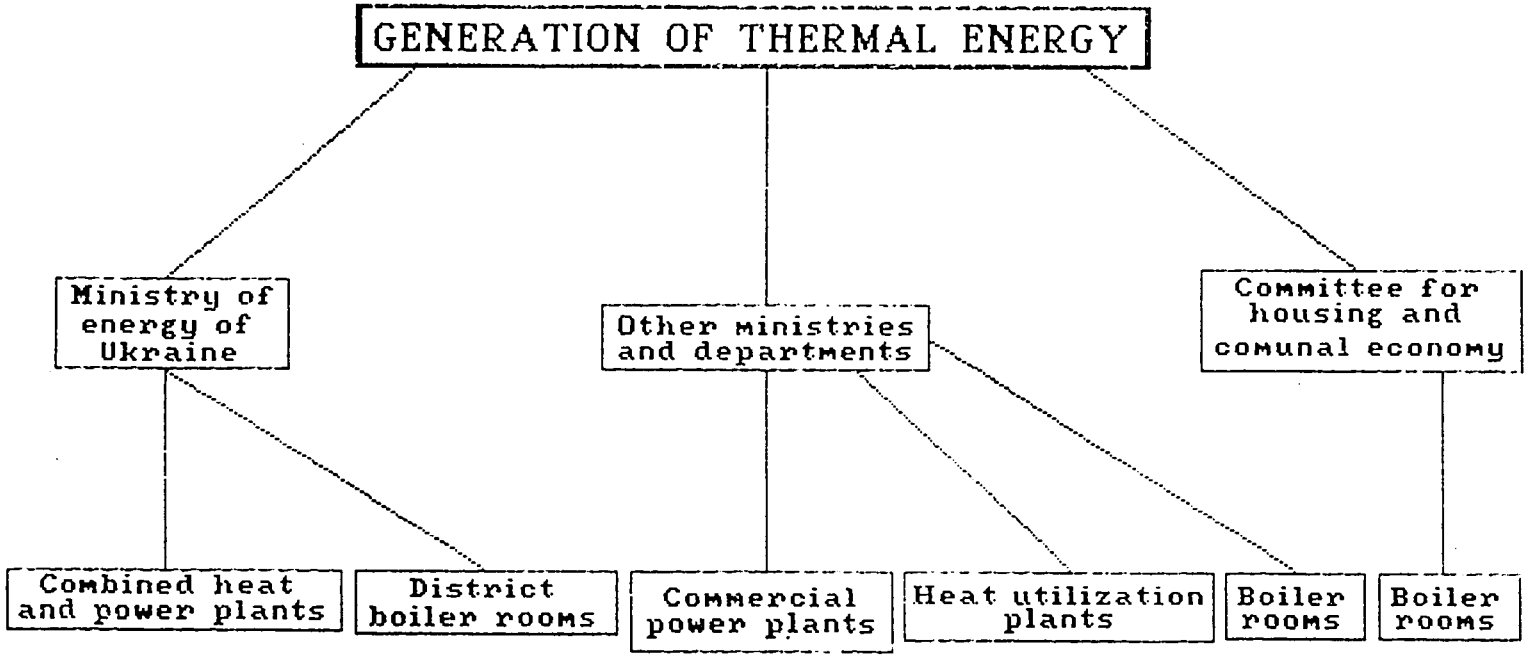


Fig.2 Organization for generation of thermal energy (steam and hot water) in Ukraine

List of principal energy generation enterprises of Ukraine

Power plant type	Installed capacity, ths kW, as of 1.1.92	Units	Unit power capacity, MW	Date commissioned
1	2	3	4	5
1. Modular-equipment thermal power plants				
Ladizhinskaya SDPP*	I800	6	300	I970-I97I
Pridneprovskaya SDPP	I740	4 4	I50 285	I960, I96I I969
Krivorozhskaya SDPP	2820	I0	282	I965-I973
Zaporozhskaya SDPP	3600	4 3	300 800	I972-I973 I975-I977
Starobeshevskaya SDPP	I750	I0	I75	I96I-I967
Luganskaya SDPP	I400	8	I75	I96I-I963, I967-I969
Uglegorskaya SDPP	3600	4 3	300 800	I972-I973 I975-I977
Slavyanskaya SDPP	I520	I I	720 800	I968 I97I
Zuyevskaya SDPP	I200	4	300	I982, I986, I988
Kurakhovskaya SDPP	I460	I 6	200 2I0	I972 I973-I975
Tripolskaya SDPP	I800	6	300	I969-I972
Burshtinskaya SDPP	2300	I2	I95	I965-I969
Dobrotvorskaya SDPP	300	2	I50	I963-I964
Zmiyevskaya SDPP	2I50	6 4	I75 275	I960-I965 I967-I969
Kievsky CHPP-5	500	2	250	I974-I976
Kievsky CHPP-6	500	2	250	I982-I984
Kharkovsky CHPP-5	250	I	250	I990
2. Hydroelectric power plants (HPP)				
Dnestrovsky complex HPP	702	6	II7	I98I-I987
Kremenchugsky HPP	625	I2	57,2	I959-I962
Dneprodzerzhinsky HPP	352	8	44	I963-I964
Dneprovsky HPP-1	650,6	9	72	I932-I939
Dneprovsky HPP-2	887,6	2	I04,5	I974-I98I
Kakhovsky HPP	35I	6	58,5	I955-I956

90

1	2	3	4	5
Kievsky HPP	36I,2	4 I6	I6,3 I8,5	I964-I968
Kievsky hydroelectric pumped storage power plant (HEPSPP)	22I,7	3 3	33,4 4I,5	I970-I974
Kanevsky HPP	444	24	I8,5	I972-I974
3. Nuclear power plants				
Rovensky NPP	I8I8	I(VVR-1000) 2(VVR-440)	I000 409	I989 I980-I98I
Chernobyl NPP (with unit 4 put out of operation as a result of the accident in 1986)	3000	3(RBMK-I000)	I000	I977-I978, I983
Yuzhno-Ukrainskaya NPP	3000	3(VVR -I000)	I000	I982-I985, I989
Zaporozhskaya NPP	5000	4(VVR -I000)	I000	I984-I989
Khmelnitskaya NPP	I000	I(VVR -I000)	I000	I987

* State district power plant

Scheme of the national energy system of Ukraine

The overall length of grids for all voltage classes amounted to 1005237 km as of 01.01.1992.

The length of the 750 kV grids was 4167 km by 01.01.1992.

In Ukraine there operates the d.c. power transmission line Volzhskaya HPP-Mikhailovka with the voltage of 800 kV and length of 247 km.

The technological consumption of electricity during its transport in the grids was 8.98 % (1991).

The characteristic of a.c. transmission lines with the voltage of 750 kV is given in the Table.

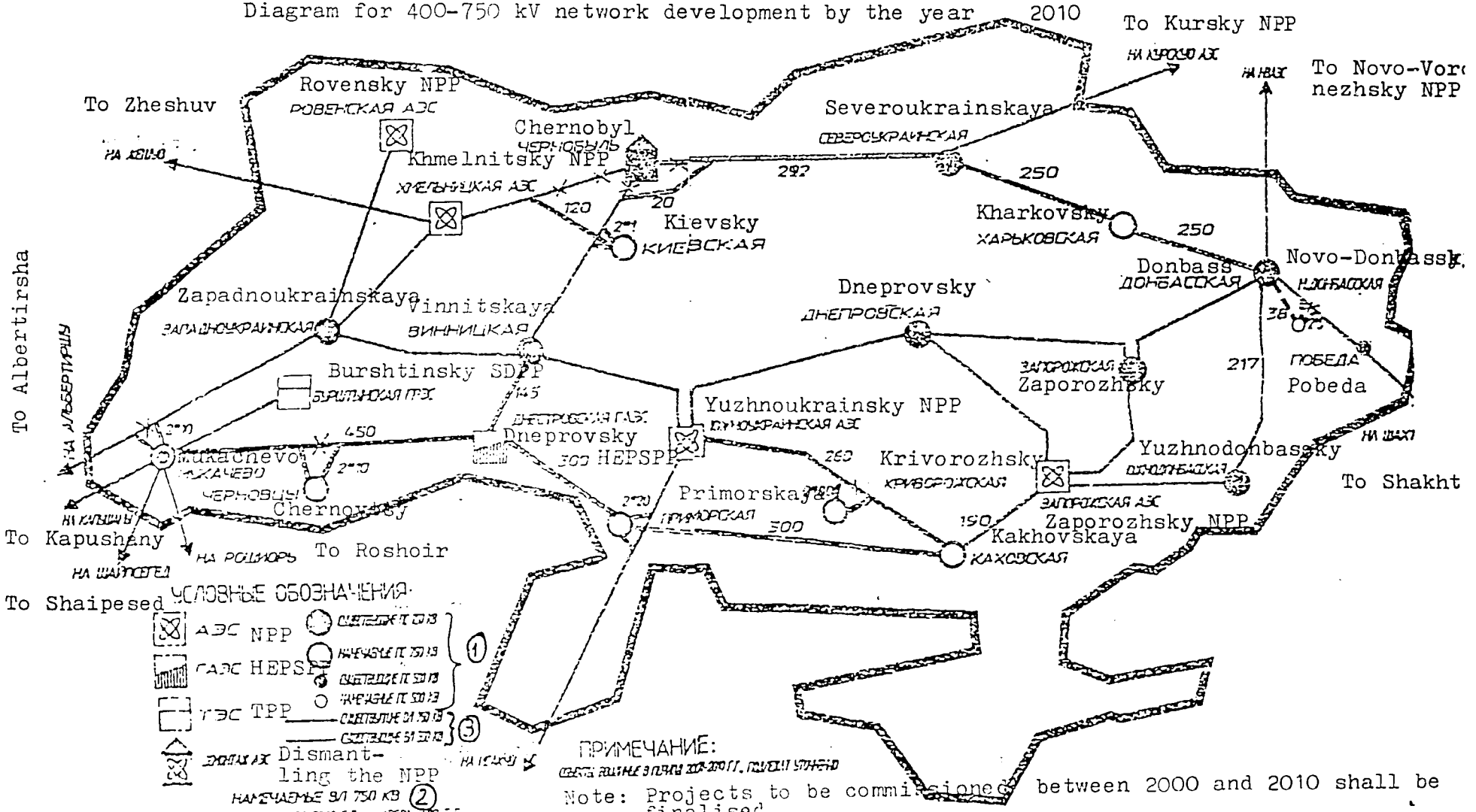
The diagram shows the development of power distribution network for 400-750 kV by the year 2010.

Analysis of the operation of power transmission lines for 750 kV (±) in 1991

Ukraine, PTL name	1991	
	Operating hours	Electricity transmission, million kW h
Donbasskay-Zaporozhskaya	87I6	25I7,7
Zaporozhskaya-Dneprovskaya	8633	I764,4
Zaporozhskaya-Zaporozhskaya NPP	8645	7573,7
Zaporozhskaya NPP-Yuzhnodonbasskaya	6303	4257,9
Zaporozhskaya NPP-Dneprovskaya	8648	I0593,8
Dneprovskaya-Yuzhnoukrainskaya NPP	8669	3I90,6
Yuzhnoukrainskaya NPP-Isancha	7342	6686,3
Yuzhnoukrainskaya NPP-Vinnitskaya	8427	2898,9
Vinnitskaya - Chernobyl NPP	8I98	5065,3
Vinnitskaya - Zapadnoukrainskaya	8680	2270,8
Zapadnoukrainskaya-Albertirsha	8I69	5430,7
Zapadnoukrainskaya-Khmelnitskaya NPP	8697	4436,8
Khmel itskaya NPP-Zheshuv	42I2	I549,3
Khemlnitskaya NPP-Chernobyl NPP	8445	336I,9
Kurskaya NPP-Severoukrainskaya	855I	4324,5

СХЕМА РАЗВИТИЯ СЕТИ 400-750 КВ НА ПЕРИОД ДО 2010 Г.

Diagram for 400-750 kV network development by the year 2010



In Ukraine, it is suggested that the joint stock energy industry and electrification company be created with the state-owned majority shareholding of stocks of each energy company performing the following functions:

- creation of appropriate institutional and economic prerequisites for reliable supply of consumers with electricity and heat and the development of energy system of Ukraine;
- centralised current and process control under conditions of full business independence of joint stock companies;
- pursuing integrated investment policies to attract additional funds for the development of the energy sector, including foreign capital;
- pursuing uniform R&D policy and implementation of advanced facilities and processes;
- diversification of cooperation between related enterprises, preservation of the existing and setting up new economic links;
- employment policies;
- creating the system for market control of state property, implementing concerted measures for privatization in the energy sector providing the trouble-free electricity supply to national economy.

Ukrainian energy industry is closely linked to the energy sector construction activities. At present, this sector is a component of the electric energy complex without which it is impossoble to develop, reequip and renovate energy equipment and networks.

Energy industry construction complex projects will be priority privatization entities. It is practical that we assume that an entity to be privatized should refer to the category of the association, trust, construction administration as integrated structures capable of carrying out a definite type of specialized works.

P R O P O S A L S

on electric energy sector structure for market environment

1. Transformation of eight utilities into eight joint stock companies.

2. Creation of independent energy companies on the basis of power plants separated from the utilities (PEO):

2.1.	Uglegorsky SDPP	- 3600 MW
	Krivorozhsky SDPP	- 3000 MW
	Ladizhinsky SDPP	- 1800 MW
		8400 MW
2.2.	Zaporozhsky SDPP	- 3600 MW
	Burshtinsky SDPP	- 2400 MW
	Tripolsky SDPP	- 1800 MW
		7800 MW

3. For HPPs - create the Hydroelectric company (Hydroenergo).

4. Set up an independent national electric company (NEC) including main transmission lines, substations, and attendant maintenance facilities.

5. The following subsidiaries should be created within energy industry joint stock (territorial) companies:

Distribution network companies

Power plant companies (Energo)

Utilities

R&M companies (heating networks, energy repair enterprises, grid maintenance enterprises, auxiliary and services companies).

These companies should have a legal entity status and enterprises within their structure should be regional affiliates.

The future of nuclear energy industry

There exist three versions for the development of nuclear energy industry in Ukraine: zero, conservative, and long-term version.

In the case of the zero version, the moratorium on the construction and commissioning of new NPPs is retained for an indefinitely long time, and the generation of electric energy by the Ukrainian NPPs will remain unchanged until 2010 whereupon all the currently operating NPPs will have been shut down by 2020 if no solutions are found to prolong their lives.

The conservative version implies maintaining the installed capacity of the Ukrainian NPPs at the level of 1990, i.e. at 13818 MW. To this end, it is necessary to cancel the moratorium and to commission three units with a high degree of commisioning readiness (Unit 6 at the Zoporozhsky NPP, Unit 4 at the Rovensky NPP, and Unit 2 at the Khmelnitsky NPP). It will be necessary to provide for the commissioning of new power Units to replace Units being shutdown beginning from 2010. Taking into consideration the realistic construction times (8 to 12 years), relevant works have to be started in 1998 at the latest and the exploration and design works - not later than 1995. The implementation of the conservative version is possible subject to the fulfilment of the following conditions:

1) maximum utilization of the available NPP sites, i.e. attaining design capacity at each site;

2) orientation towards the use of modernized reactors of the VVER type;

3) selection of two new sites to accomodate power units after 2010.

The long-term version presupposes the creation of prerequisites for commissioning 1000 MW installed capacity every year after 2010 due to the development of the country's own nuclear industry. Implementation of the long-term version is possible only within the framework of the national program for nuclear power industry development whose final objective consists in attaining energy independence of Ukraine due to the dramatic reduction of the share of fossil fuels in the energy generation.

Whatever version is adopted on the conceptual basis at the present stage of national economic development and consolidation of the country as a sovereign state, Ukrainian NPPs may continue to be operated provided that:

1) NPPs are supplied with nuclear fuel (production of fuel assemblies for the VVER-type reactors in Russia with participation of Ukraine. As an alternative, fuel assemblies may be supplied from Czechoslovakia);

2) safe storage of radioactive wastes (solution of this problem within the territory of Ukraine because the Law of the RF "On protection of environment" prohibits the import of radioactive wastes and materials to Russia);

3) research, development and design support of the NPP operation (these works have to be oriented towards ensuring operational safety, upgrading and reconstruction of existing NPPs, development of methods and processes for putting the NPP out of operation, and for production of equipment and materials required for the operation and reconstruction of NPPs with the VVER reactors. Most of this equipment is turned out in Russia).

4) training personnel for the NPPs, R&D institutes;

5) creating the government agency for management of nuclear power industry (it is necessary to create the integrated agency - the Committee for utilization of nuclear energy under the Cabinet of Ministers of Ukraine to administer and fund the activities in the nuclear energy area. Supervision and nuclear regulation agencies reporting to the President of Ukraine should operate independently of the Committee. It is practical to set up the National council for utilization of nuclear energy headed by the President's advisor in order to facilitate the development of nuclear power industry).

REFERENCE MATERIAL
ON FUEL AVAILABILITY IN UKRAINE

1. Services market in the fuel procurements area

At present, the fuel supply problem is addressed in Ukraine in the following manner. The Ministry of Economy of Ukraine specifies, via the sectoral consumer Ministries, the long-term (5-15 years into the future) and the current (for 1 year) demand for fuel resources. The Ministry of Economy determines then the probable output of fuel resources in the Republic in the long-term and for the next calendar year as well as the conditions to be met in attaining the target figures (volumes of capital investments, other relevant resources, prices, etc.). Next, volumes and sources of import-export deliveries are determined and relevant contracts on state deliveries signed.

Enterprises of both the suppliers and consumers of fuel resources (FR) are now using two categories of prices of FR, namely, state order prices and contractual prices (free, market prices). Contractual prices are much higher (sometimes 5-7 times) than the state order prices, therefore, the enterprises-suppliers tend to sell the maximum part of the produced FR at contractual prices. The volume of the state order in Ukraine for 1992 amounted to 85 per cent for coal, 95 per cent for fuel oil, around 25 per cent for natural gas, The rest of the FR (coal - 15 per cent, fuel oil - 5 per cent, and gas - 75 per cent) were delivered at contractual prices. There are reasons to assert that in 1993 these proportions will vary towards the increase in the share of the state order (especially so for natural gas). Moreover, ministries, associations and enterprises have been granted the right to sign direct contracts for deliveries of FR. In this case settlements will be made on the basis of contractual (free)

prices. The FR suppliers are normally all monopolists. The antimonopoly legislation is invalid in Ukraine. To date, the fuel procurements system is governed by the virtually distributive central economy system. Formally, there exist a few exchanges distributing FR, but their contribution to the overall balance is negligibly small (much below 1 per cent). Therefore, the market of fuel delivery services needs to be formed yet.

2. Effect of state organizations on fuel pricing, d stribution of fuel resources, imports and exports (see also Item 1)

The prices of fuel to be delivered as part of state order (see Item 1) are formed by the Cabinet of Ministers of Ukraine (Ministry of Economy, sectoral ministries and committees). It is important that not infrequently the Government buys FR from industrial associationa and in importing countries at prices much higher than wholesale prices offered to consumers (the state extends substantial subsidies to coal industry, services industry, agriculture etc.). Contractual (free) prices are established in the process of negotiations between the suppliers and consumers. Item 4 characterises the values of FR prices for 1990-92. The general scheme of FR distribution is described in Item 1. Pricing, distribution of FR, imports and exports in Ukraine are performed mainly using the centralised economy patterns.

3. Reference material on projects to save the energy and upgrade the efficiency of energy economy

A significant number of programs to implement energy-saving eeasures has been put in place in Ukraine. The most effi-

cient of these are:

1. Development and reconstruction of the electric energy system of Ukraine on the basis of the energy-saving equipment for the period till the year 2010. Developers: the Institute of Evergy Saving Problems of the Academy of Sciences of Ukraine, the Ministry of Energy of Ukraine.

2. The energy-saving enterprises' complex in the ferrous metallurgy. Developers: the Institute of Energy Saving Problems of the Academy of Sciences of Ukraine.

3. Increasing the share of dry production of cement. Developers: The Institute of Energy Saving Problems of the Academy of Sciences of Ukraine, Kiev Polytechnical Institute.

4. Application of three-layered wall panels with fixed and flexible layer bonds, Developers: Kiev Civil Engineering Institute, Institute of Energy Saving Problems of the Academy of Sciences of Ukraine.

5. Implementation of energy-saving facilities in power engineering (controlled electric drive, gate-controlled motors in electrical household appliances, compensators, electric energy converters in production processes etc.). Developers: the Institute of Energy Saving Problems of the Academy of Sciences of Ukraine, Institute of Electrodynamics of the Academy of Sciences of Ukraine, Ministry for Electrotechnical Industry).

6. Application of energy-saving light sources. Developers: Institute of Energy Saving Problems of the Academy of Sciences of Ukraine, Leningrad Polytechnical Institute.

7. Creation of the computer-aided recording, monitoring and control systems for energy consumption. Developers: Institute of Energy Saving Problems of the Academy of Sciences of Ukra-

ine, Kiev Polytechnical Institute, Ministry of Energy industry.

8. Upgrading the use of secondary energy resources in energy-intensive industrial sectors. Developers: Institute of Energy Saving Problems, Council for the Development of Productive Forces with the Academy of Sciences of Ukraine, Institute of Bioorganic Chemistry of the Academy of Sciences of Ukraine, Institute of Gas of the Academy of Sciences of Ukraine.

9. Improving the efficiency of gas-fuelled transport and electric energy generation facilities through their interaction. Developers: Institute of Energy Saving Problems of the Academy of Sciences of Ukraine, VNIPITransgas Institute.

4. Sector-specific fuel prices

FR prices have been differentiated depending on fuel quality and grade and relevant price lists are available. Table 1 gives the averaged prices of FR

Table 1

Prices of fuel in Ukraine, R/t

---

1 - resource; 2 - year; 3 - note; 4 - coal; 5 - calculated price; 6 - wholesale price; 7 - oil; 8 - fuel oil; 9 - gas, R/1000 cu.m; 10 - wholesale price 1380 prior to April 1, 1992; 11-contractual prices; 12-before; 13 - from

The calculated price of coal in Table 1 stands for the price at which an enterprise-supplier coal mine, association) sells coal to the state. The wholesale price denotes the price at which the state sells coal to consumers. Table 1 demonstrates that during 1990-1992 the coal industry of Ukraine was heavily subsidized. Differentiation of FR prices also exists across various economic sectors. The differences among prices are determined basically by the amounts of state subsidies. The number of the subsidized sectors is small.Thus, natural gas delivered to the housing and communal sector, and namely to the organizations of "Obltorggas"(Regional gas distribution company) in accordance with the price list 4.03, was priced at 132 R/1000 cu. m before July 1, 1992, as opposed to wholesale price of 4129 R/1000 cu. m. Subsidies also exist in respect of motor fuel sold to the agroindustrial sector enterprises. State prices of FR are basically the same for the majority of economic sectors of Ukraine.

6. The balance of fuel resources of Ukraine for 1990.

Table 2

1-kind of fuel; 2 - consumption; 3 - domestic production; 4 - imports; 5 - exports; 6 - energy coal; 7 - gas; 8 - furnace fuel oil; 9 - other kinds of fuel; 10 - total; 11 - million t (m t); 12 - billion cu.m (b cu. m); 13 - m t of oil equivalent; 14 - transit

Table 2 determines the percentages for all kinds of FR as a function of consumption volumes. Abbreviation "t o.e." stands for the "ton of oil equivalent". The figures for the volumes of gas transit via the territory of Ukraine are given for reference purposes and these figures were not included in the overall exports indicator.

7. Requirement of Ukraine for FR

Table 3

Energy resources' consumption in Ukraine in 1990 by economic sectors

1-resource; 2-measurement unit; 3 -total resources; 4-industry; 5-agriculture; 6-transport; 7-communal and consumer services; 8 - construction industry; 9-coal; 10-gas; 11-natural gas; 12-electricity generation by electric power plants; 13-heat; 14-m t; 15-b cu. m; 16-b kW·h; 17 - m Gcal;

Consumption of energy resources in Ukraine in 1991

Table 4

1-resource kind; 2-measurement unit; 3 - total; 4 - coal; 5-oil; 6 - fuel oil; 7 - natural gas; 8-electricity generation by elecric power plants; 9 -heat; 10-m t; 11-b cu.m; 12-b kW.h; 13-m Gcal

Projected requirements of Ukraine for energy resources

Table 5

1-resource kind; 2-measurement unit; 3 - boiler and furnace fuel; 4 - electricity; 5 - heat; 6 - m t.o.e; 7 - b kW·h; 8 - m Gcal

Table 1

Resource \ Year	1990	1991	1992	Note
Coal calculated price	40	93	2928	
wholesale price	24	31	2577	Before 1.04.92 whol.price1380
Oil	30	70-80	5000-7000	contractual prices
Fuel oil	24	56-64	4000-5600	
Gas R/1000 cu.m	44-52	61		Before 1.07.92 429 Before 1.09.92 2230 From 1.09.92 1711

Table 2

Kind of fuel		Consumption	Domestic production	Imports	Exports	
Energy coal	m t	133.9	134.2	17.7	18	
	%	100	100.2	100	13.4	
Gas	b cu.m	114.5	27.3	87.2	118	
	%	100	23.8	76.2	103	tran-sit
Furnace fuel	m t	22.2	24.85	-	2.65	
	%	100	111.9	-	11.9	
Other kinds of fuel	m t of oil eq	12.2	12.2			
	%	100	100	-	-	
Total	m t of oil eq	194	129.3	76.9	12.2	
	%	100	66.6	39.6	6.2	

107

Table 3

Resource	Measurment unit	Total resources	Industry	Agriculture	Transport	Communal & consumer services	Construction industry
Coal	m t	133.9	108.5	0.32	0.12	5.63	0.03
Oil	m t	68.5	68.4			0.07	0.03
Natural gas	b cu. m	114.5	98.4	0.39	0.41	3.26	0.07
Electricity generation by electric power plants	b kW*h	297.2	165.7	17.74	12.84	15.69	3.76
Heat	m Gcal	408	255.1	15.6	4.06	4.06	5.84

Table 4

Resource	Measurement unit	Total
Coal	m t	115.6
Oil	m t	45.6
Fuel oil	m t	22.1
Natural gas	b cu. m	111.8
Electricity generation by electric power plants	b kW*h	278.7
Heat	m Gcal	397.4

Table 5

Resource	Measurement unit	1995	2000
Boilar and furnace fuel	m t.o.e.	198	211
Electricity	b kW*h	298	326
Heat	m Gcal	458	504

List of abbreviations:

IPE - Institute of Energy Saving Problems
AN - Academy of Sciences
SOPS - Council for Development of Productive Forces
KPI - Kiev Polytechnical Institute
KISI - Kiev Civil Engineering Institute
IED - Institute of Electrodynamics of th e Academy of Sciences
LPI - Leningrad Polytechnical Institute
m - million
b - billion
t.o.e. - ton of oil equivalent
FR - fuel resources
act. -actual
ths - thousand

ENHANCEMENT OF ENERGY UTILIZATION EFFICIENCY IN UKRAINE

1. Present Situation

Ukraine has a significant production potential. In 1990 its share in the gross national product of the former USSR amounted to 28.9%, and in consumption of energy resources, to 14,7%. In the electric power generation in 1990, Ukraine was the 7 th among industrially advanced countries of the world, and the 5th, of Europe. At its territory are concentrated the largest thermal power stations with unit-type equipment, operating with high and supercritical steam conditions,as well as nuclear power stations that accounted for 22% of the total electric power generation at nuclear power stations of the former USSR.

Such a considerable energy potential of Ukraine has practically provided its national economy with the electric power. The largest consumers of energy resources are such economy sectors as the industry, agriculture, and public utilities.

The Ukraine's economy is at present experiencing a deep economic crisis. The production recession, whose first symptoms appeared in 1990, intensified greatly in 1991 and acquired a large-scale character in 1992. The gross national product in 1992 declined below its level in 1991 (in comparable prices) by 4.4%. Accordingly, the national income in 1992 decreased by 16% as compared with 1991. The decline in the national income in 1992 resulted first of all from a more than 9-% drop in the industrial output, which took place in all sectors and regions. A particularly severe situation has formed in the machine-building, ferrous and nonferrous metallurgy, chemical, petrochemical, food, and building-material industries.

2. Energy Policy

Problems of meeting the growing energy demands at limited organic fuel reserves and worsening environmental state are at present in many countries being solved by conducting the energy-conservation policy in all spheres. Principal lines of the energy policy at the present stage include:

(1) provision for a reliable energy supply of the country by forming a market of energy resources and enhancing the dependability of energy facilities;

(2) environmental protection;

(3) enhancement of the efficiency of utilization of energy resources;

(4) enhancement of the quality of energy conservation;

(5) rational structure of energy prices for minimizing users' expenses for it;

(6) reorganization of national power and fuel industries;

(7) propaganda of energy conservation for achieving a social understanding and support of the national energy policy.

The energy conservation conception elaborated at the Institute for Energy Conservation Problems of the Academy of Sciences of Ukraine for the nearest future contemplates:

(1) reduction of the energy intensity of the gross national product by introduction of energy-conserving technologies;

(2) progressive reduction of the share of energy-intensive industries in the structure of the economy;

(3) reduction of energy losses and enhancement of efficiency of energy utilization by the existing equipment;

(4) economic stimulation of energy conservation at producers and users of energy.

3. Typical difficulties (barriers) in pursuing the energy-

conservation policy, which apply also to Ukraine, are caused by the following:

(1) due to state subsidies, prices for energy for consumers fail to represent the energy generation and distribution cost;

(2) lack of trained personnel having the modern political and technical knowledge;

(3) absence or an inadequate volume of manufacture of measuring instruments, control devices, energy-efficient equipment;

(4) lack of specialized organizations and firms, capable of implementation of energy-conservation projects;

(5) capital investments in energy generation are being continued instead of financial support of energy conservation programs.

Solution of the above-listed problems should be regarded as top-priority prospective tasks of the energy policy of Ukraine.

4. Energy Efficiency Potential

4.1. National Economy

The analysis of utilization of energy resources (fuel, electric and thermal power) in the national economy on the whole, industry and its sectors at the present economic situation demonstrated the following.

The energy intensity of the gross national product in Ukraine in 1992 amounted to 1.23 coal equivalent tons (c.e.t.)/thous. Ukrainian karbovanetses (URK), which was 5.3% and 2.4% less than in 1991 and 1990 respectively. The energy intensity decline in 1992, however, was to a great extent due to the industrial production recession, particularly in such fuel-intensive sectors as the power industry, ferrous metallurgy, chemical and petrochemical industries.

In 1992 the electric power generation dropped 9.4% below

112

the level of 1991 and amounted to 25[illegible] kWh, of which 74 billion kWh, or 29.4%, were generated at nuclear power stations. The produced electric power, however, turned out to suffice for an uninterrupted supply of the national economy of Ukraine.

The electric power intensity of the gross domestic product was in 1992 of 990,9 kWh/thous.URK, 4,01% less than in 1991 and 4,98% more than in 1990 respectively.

Basic groups of factors determining the energetic efficiency of utilization of fuel and energy resources in Ukraine are as follows:

(1) structural;

(2) technological;

(3) economic; and

(4) legal and organizational.

We will consider the impact of every group of factors on the efficiency of utilization of fuel and power resources (FPR). Thus, structural factors represent, on the one hand, the structure of energy consumers and their contribution to the gross national product; on the other hand, the structure of energy resources being consumed.

4.2. Industry

A significant fraction in the structure of the gross national product (GNP) of Ukraine is accounted for by the industry, manufacturing energy-intensive products in such sectors as ferrous metallurgy, chemical and petrochemical industries, manufacture of building materials, etc. (See table, page 4A.)

In 1992 the industry accounted for 61% of GNP. In spite of a significant drop in the output of products in the ferrous and nonferrous metallurgy, chemical and petrochemical industries, machine-building, and building-material industry, their share in the industrial output was 47.5% in 1991 and 40% in 1992. Since

Industrial Energy Intensity

Ukraine	1990	1991	1992
Energy intensity of the gross domestic product, tce/$	0,378	0,390	0,369
Electric power intensity of the gross domestic product kWh/$	283,2	309,7	297,3

*Evaluation of energy efficiency in $ USA is done in accordance with the gross domestic product of Ukraine (prices of 1990) and mean rate of exchange. In 1992 - 1$ USA = 300 Ukrainian roubles. For the consideration: at present (1993) the rate of exchange is 1$ USA = 3075 Ukrainian roubles.

the sectors of metallurgy, chemistry and petrochemistry, and building materials consume on the order of 40% and 50% of the total fuel and power consumption, a decrease of their share in the output of industrial products results in a lower energy intensity of the industrial production and, accordingly, of the gross national product. Calculations show that the decrease in the contribution of the industry to the GNP from 61.8% in 1985 to 61.2% in 1990 brought about a reduction in the electric power intensity of products by about 1% and a relative power saving of 18,811 million kWh. At the same time the conduct of structural reconstruction of the industry is a complex enough process, based on considerable capital outlays. An overall crisis of the economy, instability of the socio-economic situation in Ukraine resulted in curtailment of the investment activity. Under such conditions, changing the structure of the economy calls for a programmed management by the state. The implementation of the program of structural reconstruction with the aim to reduce the energy intensity of the manufacture of products should be linked with other tasks of development of the national economy, in particular provision of a relative economic and currency-financial independence, solution of social problems. Unfortunately, elaboration and implementation of such a program by the state is greatly impeded by the crisis of the financial system. One of ways of its solution is attraction of foreign investments for elaboration and implementation of joint programs. At present in Ukraine there is effected a foreign crediting of projects in the metallurgy, pulp-and-paper, forestry, woodworking, medical industries and agro-industrial complex. The credits are as a rule granted to enterprises on self-repayment terms. The sum of credits being granted, however, is much less than the demand for them, which, as has been indicated, prevents carrying out significant

structural changes.

Fuel Structure

The basis of the FPR consumed in Ukraine is the boiler-furnace fuel. In 1992 its share for conversion into other energy forms (electric and thermal power, compressed air, furnace blast) amounted to 42.3%, and for production-process needs, to 49.1%. The share of natural energy resources (hydraulic and nuclear power) in the total FPR consumption was of 8.5%.

In the structure of the boiler-furnace fuel (Tables 1, 2) in 1992, natural gas, petroleum and petroleum products accounted for 61.7% of the total amount of consumed FPR, which was 1.6% less than in 1990. The decrease of the share of these types of the boiler-furnace fuel in the total amount of its consumption was due first of all to inadequate action of intergovernmental agreements (first of all with Russia) for deliveries of energy resources.

Thus, petroleum deliveries from Russia in 1992 were of 33.5 million tons as against 40 million tons under the agreement. Deliveries of commercial petroleum products dropped considerably, in particular of fuel oil by 69%. This resulted in reduction of its centralized deliveries by 44%.

The greatest shares in consumption of petroleum and its products fall at the construction and agriculture, 24.4% and 22% respectively in 1992, while the industry accounted for 14.2%.

The structure of consumption of the boiler-furnace fuel, however, varies considerably from sector to sector of the industry. Thus, in the ferrous metallurgy the share of coal in the consumption of the boiler-furnace fuel is of 52.5%, of which 38% is coke; the share of gas in the chemical and petrochemical industries is of the order of 90%, and in the building-material industry, about 84%. In the nonferrous metallurgy, petroleum and petroleum

products make up over 48% of the total amount of the boiler-furnace fuel used.

This is much higher than on the average for the industry and for the national economy of Ukraine as a whole.

The amounts and structures of consumption of the electric and the thermal power are given in Tables 3-6. The largest consumers of these energy forms are the industry and public utility sector.

Energy Efficiency of Industrial Sectors

It is to be pointed out that change of the FPR consumption structure is inseparably linked both with the structural reconstruction of the national economy and with introduction of advanced technologies and technical facilities into manufacture of products

Thus, basic fuels consumed in the ferrous metallurgy are coke as well as natural and blast-furnace gas. The increase in the fuel intensity of products for practically all production processes from 3.51 c.e.t./thous. URK in 1990 to 3.64 o.e.t./thous. URK in 1992 was due first of all to the technical and technological backwardness of the ferrous metallurgy. The proportion of steel made by the open-hearth method is too great (over 50%); there are many worn out and obsolescent rolling mills. The project of advance of the ferrous metallurgy, elaborated in 1992, fails to incorporate a structural reconstruction of the sector and contemplates retention of the blast-furnace operation at all works with a full metallurgical cycle, operating at present, though with reduced amounts of pig iron manufacture at every of them. Such an approach is due, regretfully, to the present economic situation in Ukraine as well as to a significant proportion (38%) of pig iron in exports of metallurgy products. At the same time, as indicated by calculations, along with reduction of pig iron manufacture in Ukraine on the whole and at most works, it is possible and eco-

nomically advantageous to cease pig iron manufacture at the Makeevka integrated iron-and-steel works and a number of metallurgical works. Such a version creates conditions for terminating the operation of coking and coke by-product plants situated near metallurgical works, which will in turn significantly improve the ecological situation in large industrial centers and result in a fuel saving. At the same time the electric power intensity of ferrous metallurgy products may increase because of introduction of more advanced technologies of steelmaking, rolling, manufacture of pipes, etc.

In addition, the electric power consumption for production, in particular of iron and manganese ores, will increase due to worsening of mining-geological conditions of their extraction.

As indicated by calculations, however, the greatest impact on the consumption of energy resources both in the ferrous metallurgy and in other industrial and national economy sectors has been exerted by the curtailment of production.

Thus, the output of basic types of ferrous metallurgy products declined by 3.7-12%, and of nonferrous one, by 6%. This was caused by lack of coking coal, scrap, and some material resources, restrictions on supply with natural gas and electric power.

The drop in output of the chemical and petrochemical industries in 1992 was as great as 12.5%; it took place mainly in the production facilities for processing of petroleum products and phosphorous raw materials. Due to reduction in deliveries of petroleum and apatite concentrate from Russia, the output of white petroleum products and phosphate fertilizers decreased twofold; of polystyrene, 1.6-fold; and of polyethylene, 2.1-fold.

The output of machine-building industry products declined by about 9%.

For the industry as a whole the decrease in boiler-furnace fuel consumption in 1992 as compared with 1990 was by 96.5% due to the curtailment of industrial output; specific fuel consumptions for manufacture of products accounted for as little as 3.5%.

Presented below is the analysis of energy utilization in such energy-intensive industries as the petroleum-refining, chemical and petrochemical, and building-material ones.

The petroleum-refining industry of Ukraine processes the imported stock. The own petroleum production suffices for loading as little as 7% of the capacities. Due to short deliveries of petroleum from Russia, the volume of its processing at Ukrainian plants dropped by nearly a quarter. Moreover, the industry is technically backward; the petroleum refining degree is less than 55%, which is considerably, nearly 6%, less than in other CIS countries, not to mention industrially advanced ones. Possibly, when catalytic cracking plants at the Lisichansk and Kremenchug petroleum-refining works have been put on stream, a refining degree of 68% will be reached. Aging of the equipment, unsteady operation due to absence of stock, worsening of its quality and of the refining degree lead to higher specific consumptions of fuel, electric and thermal power.

In the chemical and petrochemical industry, reducing the specific consumption of energy resources proves to be impossible because of a low technical level of many works and technologies employed. The physical wear of basic industrial production assets is as high as 51%. An adverse effect is exerted by irregularity of supply with most important types of raw stock and materials (phosphates, synthetic resins and plastics, soda products, etc.). Thus, specific consumptions for production of 1 t of ammonia over 1991-1992 were as follows: fuel, 1490 c.e.kg; electric power, 416 kWh; and thermal power, 0.433 Gcal; this was ac-

companied by an ammonia output drop by 14% in 1991 below the 1990 level and by 9.8% in 1992 below the 1991 level. For other product types the specific consumptions of energy resources either remain unchanged or tend to increase. Reducing the energy consumption per unit product in the chemical and petrochemical industry calls for introduction of advanced technologies and replacement of equipment operated more than 20 years.

The development of the building material industry will involve no significant changes in trends of specific consumptions of energy resources for manufacture of products. This is associated, on the one hand, with an inadequate introduction of measures for cutting the specific energy consumptions because of lack of the required capital investments and a proper organization of the material and technical supply and, on the other hand, with the technical backwardness of production facilities (the share of cement manufactured by the dry process is as little as 13-14% of the total cement production in Ukraine).

Summary

Thus, the conducted analysis of the energy consumption in the industry as a whole and in some its sectors demonstrated that enhancement of the efficiency of utilization of energy resources, reduction of the energy-intensity of products, saving of fuel, electric and thermal power along with stabilization and increase of the output of products can be achieved through the technical updating and introduction of advanced technologies. This, however, is an impossible task for Ukraine at present. Since basic production assets of the industry are very capital-intensive and most of them, especially in energy-intensive sectors of the heavy industry, will for a long time remain the state property, it is necessary to attract to their modernization foreign investors, granting them appropriate guarantees and tax privileges. Such

an approach would make it possible, raising the technical level of production, to affect indirectly its structure towards required changes and would assist in preventing an ecological catastrophe, which is of no small importance in view of the geographical position of Ukraine.

4.3. Housing and Public Utility Sector

Apart from the industry, a large enough consumer of the boiler-furnace fuel is also the public utility sector, which accounts for 15.5% of the total consumption of the fuel in Ukraine. The share of the sector in the electric and thermal power consumption is of 18.2% and 26.3% respectively.

In the consumption of the boiler-furnace fuel for needs of the housing facilities, public utilities, and consumer services, 51.8% is accounted for by coal and coal briquettes; 36.6%, by natural gas; 5%, by petroleum and petroleum products; 3.8%, by liquefied gas; and 2.8%, by firewood, peat, and other fuels (Table 2).

The consumption of the boiler-furnace fuel by this sector in 1992 increased by 2.7% over the 1990 level (Table 1).

The electric power consumption by the housing facilities, public utilities, and consumer services in 1992 increased over the 1990 level by 1.0%, and the thermal power consumption, by 2.8%.

The efficiency of utilization of energy resources in this national economy sector depends on the existing public buildings and dwelling houses and those under construction, possibilities for enhancing the comfort of life, development of the sphere of services. In Ukraine, public buildings and dwelling houses have mainly been constructed in towns and town-type settlements as multistorey buildings whose specific thermal characteristics fail to meet the standards adopted in industrially advanced

countries. Moreover, no space heating control is provided in public and dwelling buildings.

Heat Supply

It turned out that the concept of development of a centralized heat supply for housing facilities and public utilities has been prevailing for a long time in the former USSR. In Ukraine the share of thermal power supply from centralized sources is of 40%. The centralized heat supply, however, has a number of disadvantages. In particular, provision of reliable heat supply calls for a high-quality construction of heat-supply systems, steam and hot water supply pipelines; instrumentation for diagnostics of their technical state; shutoff valves; monitoring and recording instruments; and timely regular repairs. However, planned repairs and renewals of heat-supply systems are carried out untimely and with a low quality, which results in a rapid-rate deterioration of the systems. The wear of basic production assets of heat-supply systems is as high as 51.1%. Moreover, when the heating season has ended, the hot water supply is commonly turned off to carry out repairs of hot-water heater plants, boiler equipment, heat-supply pipelines, etc., which produces discomfort for consumers. It is indeed difficult enough to predict the number and durations of disconnections of the hot water supply. The available instruments for metering the thermal power consumption and thermal losses are of a low quality, public and dwelling buildings are not provided with instruments and valves to control the room temperature when the space heating is on, which accordingly does not assist in an effective thermal power utilization. The technological consumption or, more exactly, the loss of thermal power during its conveyance in systems amounts in Ukraine to 6.1%. The situation is aggravated by that heat-supply systems are very capital-intensive and a large part of

them belongs to local public utility agencies, which have no financial resources for their renewal. Of the total length of heat-supply systems in Ukraine, 18% belongs to public utilities and 7% to the Ministry of Power Industry of Ukraine.

Analyzing the above leads to a conclusion that the relative fuel saving obtained at a combined electric and thermal power generation at heat-and-power stations is largely offset by the cost of construction of trunk heat-supply pipelines and local heat-supply systems, their maintenance, and elimination of their failures. Therefore, in our opinion, a further development of a centralized heat supply in Ukraine is not advisable. Taking into account the experience of industrially advanced countries in meeting the demands of the housing-utilities sector for space heating, food cooking, and hot water supply, in elaboration of the energy program of Ukraine there should be contemplated the use of nontraditional sources and electric power for these purposes. The Ukraine's power industry potential allows an increase in the electric power supply to the housing-public utilities-consumer sector. This will yield a relative saving of the boiler-furnace fuel at the national economy level, enhance the comfort of life, and assist in improvement of the ecological situation in Ukraine. To upgrade the efficiency of utilization of energy resources in this sector, measures to improve specific thermal characteristics of dwelling houses and public buildings should also be carried out.

4.4. Agriculture

The share of agriculture in consumption of the boiler-furnace fuel is on the order of 2%. Its main types used there are natural gas (51.5%), coal and products of its processing (23.9%), and petroleum and petroleum products (22%) (Table 2).

The agriculture's share of consumption of thermal energy is

as well insignificant, of 3.3%; in the electric power consumption it amounts to 7.3%.

Main uses of the boiler-furnace fuel, electric and thermal power are heating of winter and spring hothouses and stock-breeding farms, drying of grain and grass meal, etc. It is to be pointed out that implementing energy-conservation measures in agriculture is very difficult because of its technical backwardness.

Increasing the level of automation and mechanization of production processes in agriculture will result in greater specific consumptions of energy resources. Thus, the level of mechanization of processes in the stock breeding is at present as follows: processing and distribution of feeds at horned cattle farms, 72%; at pig farms, 66%; and at polutry plants, 92%; manure removal, 97%, 93%, and 91% respectively.

A further development of the Ukraine's agriculture, however, contemplates no establishment of large farms and complexes. Private farms are to become predominating. Due to this, characteristics of consumption of energy resources will change qualitatively, the control over their utilization will weaken. The level of provision with gas supply in the countryside is at present of 80.8%, of which 8.3% is natural (pipeline-fed) gas and 72.5% is liquefied gas (in bottles). Along with a further provision of the countryside with gas supply, which will be restrained by absence of own gas reserves in Ukraine and dependence on its deliveries from other CIS countries, the importance of the electric power will increase: it will be more extensively used for agricultural production needs. This necessitates development of economical equipment with a low level of consumption of energy resources, oriented at the use at private farms. In addition, to upgrade the efficiency of utilization of energy resources in agriculture

it is needed to develop nontraditional energy sources, in particular to popularize biogas plants for utilization of agricultural production wastes.

4.5. Transport

The share of transport in consumption of fuel and energy resources is: boiler-furnace fuel, 2.8%; electric power, 5.4%; and thermal power, 2.1%.

Main types of the boiler-furnace fuel, used by transport, are natural gas (91%) and coal (1.5), consumed mainly by compressor gas-transfer plants, for space heating in passenger cars and station buildings, and by boiler plants.

The structure of electric power consumption by transport is as follows. The railway electric traction accounts for 84.8% and 51.1% of the total electric power consumption by the railway transport and the sector as a whole respectively. The share of gas and petroleum transportation (consumption for needs of gas and petroleum pipelines) in the total electric power consumption is of 12% and 2.6% respectively. The urban electric transport consumes 13.2% of the electric power, of which the consumption for the electric traction of trolley buses and streetcars is of 51.1% and 40.3% respectively. The specific electric power consumption by the latter is of 195 and 135 kWh/thous.ton-km gross respectively; it depends first of all on technical characteristics and state of the trolley bus and streetcar fleet in service. Unfortunately, lack of possibilities for renewing the urban electric transport fleet will result in an ineffective utilization of electric power.

5. Regional Distribution of Energy Resources

In the distribution of fuel and energy resources among economic regions (Donetsk-Dnieperside, South-Western, and Southern), the prevailing share in the industrial energy consumption falls

at the Donetsk-Dnieperside region, where the heavy industry, in particular ferrous metallurgy, chemical and petrochemical industry, machine-building and metalworking, and manufacture of building materials account for the major part in the economic structure. More than half of all large thermal power stations of Ukraine are in this region.

Levels of consumption of the boiler-furnace fuel, electric and thermal power for economic regions of Ukraine are presented in Table 7.

In the industrial production of the South-Western and Southern economic regions such sectors as the machine-building and metalworking, light and food industries, and also building material industry are prevailing. Agriculture in these regions is developed adequately.

In addition, in the Southern economic region, in particular in the Crimea, there is the health-resort/health-improvement complex of the country. Unlike other economic regions of Ukraine, the Southern economic region has no adequate power supply sources.

Except for the South-Ukrainian NPS, no other large electric and thermal power producers are in this region. In the Crimea a large number of decentralized sources of heat and hot water for the space heating, food cooking, and sanitary-hygienic needs, which are mainly coal- and fuel oil-fired, bring about a considerable environmental pollution. A large number of sunny days per year in the Crimea offers possibilities for utilization of the solar energy, in particular for production of steam and hot water for sanitary-hygienic needs.

It should be pointed out that from the technical standpoint the Crimea's energy facilities are in need of a considerable updating, no resources for which are available in the Crimea. In

view of this, establishment of joint ventures with foreign investments in the recreation industry in the Crimea and other areas of the Southern and South-Western economic regions will indirectly enhance the efficiency of both generation and consumption of energy through introduction of modern, ecologically clean technologies.

6. Economic Stimuli

The efficiency of utilization of energy resources is substantially affected by economic factors of energy conservation management, in partcicular by energy and fuel prices. In Ukraine the energy and fuel prices are entirely determined by prices for energy carriers delivered from Russia. Increase in prices for energy resources can, however, exert a favorable effect by reducing the specific energy consumption under conditions of economic stability, when an enterprise can select a more efficient equipment or technology and obtain preferential credits for its purchase and also when differential rates have been developed, making it possible to regulate the energy consumption, in particular the electric power consumption. Unfortunately, in Ukraine, which is experiencing a deep economic crisis, economic factors, in particular the rise in prices for energy carriers, fail to stimulate an effective utilization of fuel and power resources, but result in curtailment of production and a corresponding energy consumption decrease. At the same time, as shown by the above-conducted analysis, specific energy resource consumptions per unit product either tend to increase or remain unchanged. Enterprises are at the present stage uninterested in saving of energy resources, since their value is automatically included into the product cost. As enterprises are monopolists in manufacture of many product types, this results in a new surge of product prices. It is to be emphasized that without organizational measures and legislative acts the economic factors

exert no proper influence on the energy conservation efficiency. At the administrative-command economy, by the way, measures for saving of energy resources were taken, planning of energy resources was carried out, their rates per unit products were set, and bonuses for their saving were established. At present, for example, an enterprise pays at a tenfold rate for the amount of electric power consumed over the amount indicated in the contract with the power-supply organization. A tax policy encouraging the saving of energy resources and imposing penalties for their unjustified overconsumption is essential for effective energy utilization.

We think that awarding of bonuses for saving of energy resources should be resumed.

7. Organizational and Legal Factors

Organizational measures for effective utilization of the resources should include establishment of a system of the account of and control over their consumption.

A law on energy conservation, whose main provisions include regulation of utilization of energy resources, economic methods for stimulating the energy conservation, standardization of the energy-consuming equipment, etc., has been elaborated over the last two years in Ukraine.

8. Banks and Investments

At the present stage of transition to the market economy, under conditions of scarcity of energy resources, with a not adjusted mechanism of price formation and economic stimulation, the state should be more interested in an effective utilization of energy resources and introduction of the energy conservation than an end user is. At the same time in Ukraine there are no special agencies for planning, implementation, and control over the state energy conservation policy. Establishment of such agencies is contemplated by the draft law on energy conservation. Moreover,

the state energy conservation policy should involve stimulation of crediting of programs or particular measures on energy conservation. However, the National Bank of Ukraine refuses in granting credits for implementation of economic and technical energy conservation measures. Such credits can be obtained in commercial banks. A leading of them, the "Prominvestbank" can grant such a credit. To obtain a credit, it is necessary (1) to become a customer of this bank and (2) after determining exactly the list of documents and substantiations, to prepare them and submit to the bank for examination. It is to be noted that stimulation of the financial activity, crediting of programs and measures on energy conservation would render manufacturing enterprises interested i production of energy-conserving equipment as well as of instrume tation for monitoring the efficiency of utilization of energy re sources. The Ukraine's machine-building complex is capable of fulfiling the task of providing consumers of every national economy sector with metering instruments and other energy-conservin equipment. In Ukraine there are about 20 works manufacturing industrial valves; six works, electric meters; and 4, heat, gas, and water meters.

9. Co-operation

To conclude, it is to be noted that the task of the interna tional co-operation is to assist Ukraine in organization of all forms of energy conservation management, in particular in develo ment and dissemination of advanced technologies and measures, ad vance in research and production, elaboration of energy strategi es and demonstration programs, organization of training and retraining of specialists, dissemination of knowledge, etc. Concre te steps along these lines have already been made on the part o both the European Community and Ukraine. The EC's project "The global strategy of energy conservation in Ukraine" is being dis-

cussed; fulfilment of a number of projects by Danish, Dutch, and French firms has begun. The "EC-energocenter" (THEPMI program) has been functioning for a year in Kiev.

Elaboration of the concept of the energy policy under new economic conditions has been commenced in Ukraine, where much importance will be attached to issues of enhancement of energy efficiency and energy conservation. It is to the common benefit to orient the policy at problems of the world power engineering and global energy strategies.

TABLE 1. Consumption of boiler-furnace fuel in national economy of Ukraine

(in thousand coal equivalent tons)

Sectors	1990					1992				
	Total	Coal and its processing products	Natural gas	Petroleum and petroleum products	Others *	Total	Coal and its processing products	Natural gas	Petroleum and petroleum products	Others *
National economy including:	282596	95391	136151	36056	14998/11450	267977	89454	131071	34188	13264/9825
Industry	228812	71961	112902	31906	12043/11414	209851	65328	104122	29860	10541/9789
Construction	2043	599	950	480	14/2	2156	633	982	525	16/2
Transport	5207	120	4651	411	25/-	7688	112	7003	393	180/-
Agriculture	5341	1273	2664	1257	147/10	5960	1420	3064	1310	166/9
Housing facilities, public utilities, and consumer services	41193	21438	14984	2002	2769/24	42322	21961	15900	2100	2361/25

* In denominator: combustible fuel and power resources.

TABLE 2. Structure of consumption of boiler-furnace fuel in national economy of Ukraine and its sectors

Sectors	1990					1992				
	Total	Coal and its processing products	Natural gas	Petroleum and petroleum products	Others*	Total	Coal and its processing products	Natural gas	Petroleum and petroleum products	Others*
National economy	100	31.7	49.7	13.6	5.0/3.6	100	33.4	48.9	12.8	4.9/3.7
including:										
Industry	100	29.0	50.9	15.3	4.8/4.5	100	31.1	49.7	14.2	5/4.1
Construction	100	29.2	46.0	24.0	0.8/0.1	100	29.4	45.5	24.4	0.7/0.1
Transport	100	1.5	90.8	5.2	2.5/-	100	1.5	91.1	5.1	2.3/-
Agriculture	100	23.8	51.4	21.9	2.9/-	100	23.9	51.5	22.0	2.6/-
Housing facilities, public utilities, and consumer services	100	52.2	36.6	5.2	6.0/0.1	100	51.9	37.6	5.0	5.5/-

* In denominator: the share of combustible FPR in the total consumption of energy resources.

TABLE 3. Electric power consumption in national economy of Ukraine

(million kWh)

Sectors	1990	1992
National economy - total	270510.8	247878.3
including:		
Industry	148100	130879.7
Construction	3981.2	3222.4
Transport	14475	12641.8
Agriculture	19011.4	18095.1
Housing facilities, public utilities and consumer services*	44671.0	45113.9
Technological needs of the "Electric power industry" sector	40272.2	37925.4

* including needs of rural population

TABLE 4. Structure of electric power consumption in national economy of Ukraine

(percent)

Sectors	1990	1992
National economy - total	100	100
including:		
Industry	54.7	52.8
Construction	1.5	1.3
Transport	5.4	5.1
Agriculture	7.0	7.3
Housing facilities, public utilities and consumer services*	16.5	18.2
Technological needs of the "Electric power industry" sector	14.9	15.3

* including needs of rural population

TABLE 5. Thermal power consumption in national economy of Ukraine

(thous. Goal)

Sectors	1990	1992
National economy - total	411298	407000
including:		
* Industry	272648	266178
Construction	9760	9361
Transport	8590	8547
Agriculture	13804	13431
Housing facilities, public utilities and consumer services	106500	109483

*"Industry" includes other sectors of the national economy

TABLE 6. Structure of thermal power consumption in national economy of Ukraine

(percent)

Sectors	1990	1992
National economy - total	100	100
including:		
Industry	66.3	65.4
Construction	2.4	2.3
Transport	2.1	2.1
Agriculture	3.3	3.3
Housing facilities, public utilities and consumer services	25.9	26.9

TABLE 7. Consumption of fuel and power resources in 1992 in regions of Ukraine

Resources	Ukraine	Regions		
		Donetsk-Dnieper-side	South-Western	Southern
Boiler-furnace fuel, thous. coal equivalent tons	267977	176159	73399	18419
Electric power, million kWh	247878.3	159118	64109.4	24650.9
Thermal power, thous. Gcal	407000	228580	137701	40719

NOTES

1. Privatization laws are still actual. However, at the present stage of the economic crisis the Cabinet on Ministers is more and more oriented towards centralized planning. In Ukraine 90% of property still refers to the state. Suspension of the Law "About Enterprises" for some period is possible.

2. In 1992 electricity tariffs on the groups of users were twice changed against those stated on 15.04.1992 tariff. On 1.05.1993 new tariffs on electricity were introduced. (See table below.)

CHANGING OF TARIFFS IN ENERGY SYSTEMS OF UKRAINE IN 1992 AND 1993
(Table 6 of "Prospective Changes in Ukraine")

Consumer category	Donbassenergo, roub./kWh				Vinnitsaenergo, roub/kWh			
	Price-list 15.04.92	New tariffs 9.11. 1992	26.12 1992	1.05 1993	Price-list 15.04.92	New tariffs 9.11 1992	26.12 1992	1.05 1992
1. Commercial and the like consumers with the connected power capacity of 750 KVA	1,3	3,24	6,15	26	1,4	3,73	7,08	28
2. Commercial and the like consumers with the connected power capacity of up to 750 KVA	1,7	4,23	8,04	40	1,7	4,52	8,59	40
3. Electrified railway transport	1,7	4,23	8,04	40	1,7	4,52	8,59	40
4. Electric city transport	1,7	4,23	8,04	40	1,7	4,52	8,59	40
5. Non-commercial consumers	1,7	4,23	8,04	40	1,7	4,52	8,59	40
6. Commercial agricultural consumers	1,00	1,00	3,75	19,5	1,00	1,00	3,75	19,5
7. Population:								
-urban residents	0,50	0,50	2	10*	0,50	0,50	2	10*
-rural residents	0,25	0,25	1	5*	0,25	0,25	1	5*

*/ are not introduced yet