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EVALUATION OF THE IMPACT OF THE INDUSTRIAL ENERGY COMPONENT OF THE EMERGENCY ENERGY PROJECT
(180-0015)

Prepared for:

U.S. Agency for International Development
Bureau for Europe and Newly Independent States
Office of Development Resources
Energy and Infrastructure Division

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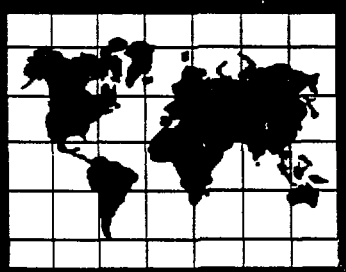

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The contents of this report include recommendations based on data supplied by the client, by Eastern European plant personnel, and on calculations and engineering judgment. The conclusions reached were based on a limited engagement of only several hours' time in each plant, and not on exhaustive engineering analyses. This report conforms to standard commercial practice and was prepared under the guidance of a registered Professional Engineer licensed to practice in the United States.

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LIST OF ACRONYMS

AG	Incorporated Company (Germany)
ARCE	Romanian Energy Efficiency Authority
ASME	American Society of Mechanical Engineers
AV Rt	Hungarian state holding company for privatization
AVU	Hungarian state property agency
Btu	British Thermal Unit
C	Degrees Centigrade (temperature)
Cal	Calorie(s)
CES	Czech Republic national electric utility
CCF	Hundreds of cubic feet
CESR	Bulgarian Commission on Energy Rate Regulation
CSFR	Federal Republic of Czechoslovakia
DSM	Demand Side Management
EBRD	European Bank for Reconstruction and Development
EC	European Community
EEP	USAID Emergency Energy Project
EGI	Hungarian Architect Engineering Company
ESCO	Energy Service Company
F	Degrees Fahrenheit (temperature)
GCal	Giga calories (one billion calories)
GOB	Government of Bulgaria
GOR	Government of Romania
GJ	Gigajoules (one billion joules)
hr	hour(s)
IEA	International Energy Agency
kVA	kilo-volt-amperes
kVAR	kilo-volt-amperes reactive
kWh	kilo watt hours
m3	cubic meters
MMBtu	Millions of Btus
MOI	Ministry of Industry (Bulgaria)
MW	Mega watt(s)
MWh	Mega watt hours
NGO	Non-Government Organization
NIS	Newly Independent States of the Former Soviet Union
NOx	Oxides of Nitrogen
PACD	USAID Project Activity Completion Date
PHARE	European Community Energy Efficiency Program
ppm	parts per million
psi	pounds per square inch (pressure)
RENEL	Romanian national electric utility
SA	Incorporated company (Romania)
SEI	State Energy Inspectorate (Czech Republic)
SEVEn	Czech organization for Energy Efficiency Promotion and Studies
SOCER	Romanian Society for Optimization of Energy Consumption
SOx	Oxides of Sulfur
USEMB	United States Embassy
yr	year(s)

1. EXECUTIVE SUMMARY

USAID authorized the Emergency Energy Project (EEP) November 16, 1990 for $10 million, and project implementation commenced almost at once. The Original Project Activity Completion Date (PACD) was September 30, 1991. USAID subsequently amended the project to a new total of $11.75 million, and the PACD was extended to June 30, 1994 to allow for use of reallocated funds for expanded Hungary activities.

Purpose and Description - The purpose of the EEP was to assist with immediate measures to improve the efficiency of energy use in Central and Eastern Europe. The project provided technical assistance, training, and energy efficiency equipment and addressed four areas:

(i) low-cost, immediate measures to improve energy efficiency in industry;

(ii) refinery "debottlenecking" and operational improvement;

(iii) purchasing oil more effectively on the spot and futures markets; and

(iv) design of new domestic, particularly petroleum, price structures.

USAID initiated the program as a focused, short-term approach to the energy crisis faced by the newly independent countries in Central and Eastern Europe in the fall of 1990. This period was marked by the mid-East oil supply uncertainty caused by Iraq's invasion of Kuwait, reduced oil deliveries from the Soviet Union (the primary source of oil and gas supplies), and the Soviet Union's announced demand for payment in hard currency for energy supplies beginning in January, 1991.

Project design and implementation were shaped by the following realities: economic and political factors in the region were changing rapidly; the political developments led to a questioning of and decline in the philosophy and use of centralized planning, and the rise of privatization; many plants had a limited exposure to western technical personnel and technology; there were large overstaffed plants with outdated technology; efficiency awareness was very low as a by-product of subsidized low energy prices and emphasis on production; energy waste and high environmental pollution levels were widespread; and energy prices were rising with the emerging growth of market economies.

The original project provided assistance to six countries; Bulgaria, Czechoslovakia (later split into the Czech Republic and Slovakia), Hungary, Poland, Romania, and Yugoslavia. The Baltic states of Estonia, Latvia, and Lithuania were subsequently added and the program in Yugoslavia terminated because of the unrest there.

The industrial energy efficiency program component of the EEP - the primary subject of the evaluation - was designed to identify and implement no-cost and low-cost quick payback measures to improve energy efficiency, to conduct energy audits and share energy audit and management techniques, including financial and economic analyses with the plant staff, and to furnish energy efficiency equipment to fulfill program objectives. The component also included preparation of industry plant profiles, and policy and institutional analyses.

USAID placed major contracts with three contractors to implement the industrial energy efficiency component: International Resources Group (IRG) for Bulgaria and Poland; Resource Management

Associates of Madison (RMA) for Czechoslovakia, Lithuania, and Romania; and RCG/Hagler, Bailly for Estonia, Hungary, Latvia, and, initially, for Yugoslavia.

Purpose of the Evaluation and Methodology Used

The purpose of the evaluation described in this report was to determine the impact of the industrial energy efficiency component of the EEP. The specific objectives were to: (1) determine the effectiveness of the technical assistance, training and equipment supplied in achieving energy savings and management changes in the industrial plants, and (2) determine the lessons learned which are relevant to the follow-on industrial energy efficiency work (e.g. the Regional Energy Efficiency Project) that has been initiated.

A three man team performed the evaluation, concentrating on industrial efficiency activities in four countries; Bulgaria, the Czech Republic, Hungary, and Romania. The team visited these countries in June and July, 1993. The team reviewed a substantial portion of the project documentation including audit reports and energy policy studies, interviewed personnel from the three prime contractors and their local subcontractors, discussed the impact of the project with local USAID official and host country officials, and visited twenty-three of the thirty-two plants which had received technical assistance in these countries (the project in total provided assistance to fifty-two plants). During the plant interviews, the team discussed the status and performance of the equipment supplied, collected data on the energy savings resulting from the project, recorded changes in energy efficiency culture and management, and looked for evidence of a spread of energy efficiency awareness to other plants or industrial sectors.

Findings and Conclusions

The USAID Emergency Energy Program has been extremely successful in producing high individual rates of return and a solid receptivity to energy efficiency measures. The project, although originally authorized and implemented with a short term focus, has also had a long term impact, as evidenced by follow-up activities now being implemented.

Current policy conditions - energy prices at or near world market levels, and government support for privatization - create the right climate for extension and deepening of energy efficiency efforts. Energy efficiency is also accepted as a significant action which the countries can undertake to control air pollution and other industrial wastes.

The more detailed findings and conclusions are grouped below in four broad categories: (A) project initiation and implementation; (B) energy efficiency awareness; (C) equipment status and performance; and (D) country and policy-related findings. The most notable were:

Project Initiation and Implementation

- The industrial energy efficiency component of the EEP succeeded in quickly identifying and implementing near-term, no-cost or low-cost measures which improved, significantly in some cases, energy efficiency in Central and Eastern European plants.

- The selection of plants was well done and was based on the potential for saving energy, the receptivity of plant management, the long-term economic viability of the plant, the potential for privatization, and the similarity to other facilities which could benefit from the experience gained at the plant.

- The EEP audits and contractor recommendations produced positive economic benefits in a wide variety of industrial facilities, and some remarkable savings were obtained

for little or no cost. Plants where process modifications were made showed particularly large savings for essentially no cost. For example, the Kremikovtsi Iron and Steel Rolling Mill in Bulgaria saved about $ 270,000 annually in electricity charges by shifting 10 MW of electric furnace load to night operation; a more dramatic example was seen at the Pannonglas Oroshazi Uveggyar glass plant in Hungary where consolidation of production into three lines from four reduced annual gas costs by $ 2,000,000.

- A number of factories showed significant savings for relatively small investments in equipment. For example, at the Buszesz Yeast and Alcohol plant in Hungary, the EEP recommendations attained savings of $ 233,000 annually with an equipment outlay of $ 29,100. Using the recommendations from the EEP audit team, the plant installed additional equipment which resulted in saving an additional $130,000 per year. At the Bucharest South power plant in Romania annual savings in the range of $410,000 to $ 508,000 were obtained with equipment purchases of $ 34,800. And in Bulgaria, at the Izida ceramics plant, initial savings of $ 28,600 resulted from installation of the USAID-supplied equipment; another $ 232,000 can be saved when EEP-recommended furnace technology is put in place. Most energy efficiency equipment installations in the four countries showed very short paybacks (on the order of a couple of months).

- Some factories, notably the district heating works in Budapest, the milk processing plant in Bulgaria, and the plants in the Czech Republic where building heating system modifications were made, obtained relatively small savings. Attempts to save energy with building heating modifications and lighting improvements yielded longer payback periods but did improve worker comfort and may eventually increase productivity.

- The project successfully introduced U.S. monitoring and measuring equipment into the region and enabled several U.S. manufacturers to initiate or increase product sales and to establish a sales presence in the region. Without the EEP the risk and expense of market penetration would have been too great. As an example, Armstrong International, manufacturers of steam traps, established a sales representative arrangement with Ecotechproducts (the local EEP subcontractor) in Bulgaria after the conclusion of the EEP. Ecotechproducts has gone on to increase awareness of the benefits of replacing leaking traps and has significantly expanded sales of Armstrong products in Bulgaria.

- The plant staff quickly absorbed the technical aspects of energy efficiency measures but will need additional technical assistance to assimilate and integrate the economic analysis associated with the selection and implementation of energy efficiency measures.

Energy Efficiency Awareness

- The EEP increased energy awareness in the host countries. The interaction among the audit team members, the plant personnel, and the local subcontractors was effective in focusing attention on energy costs and transferring knowledge on performance of energy audits and the savings from equipment supplied under the EEP (e.g. steam traps) led plants to purchase and install additional energy efficiency equipment. Improved knowledge of energy costs also enabled some plants to save money by renegotiating the terms of their gas and electricity contracts or to shift demand to lower rate periods.

- The EEP focused the attention of plant managers on the benefits of energy efficiency. The presence of USAID and the western contractors also enabled lower-level energy managers to obtain upper management attention for energy efficiency projects that would otherwise have been neglected.

- Energy efficiency awareness is increasing but is not yet a top priority in most industrial plants; many plant managers are preoccupied with survival and believe that the path to survival lies through increased production. This is undoubtedly a holdover from the days of central planning with its emphasis on production without consideration of costs.

- Information on energy efficiency is becoming available but is still not widely available. The EEP did organize a final seminar in each of the countries to review the results at the conclusion of the program but there were no provisions for further action. Some private initiatives have started to fill this need; Armstrong, for example, has set up an Energy Efficiency Council in each country where they give a two day seminar on energy efficiency. These seminars are helping to spread awareness of energy efficiency.

- Energy efficiency service capability is currently limited, although there is a strong technical base on which to build. However, as demand for services develops, additional assistance will be required to strengthen the capabilities of firms and individuals in economic analysis, marketing, and management.

- The governments appear open to privatization of energy efficiency services, although growth will vary from country to country, and is likely to be slow.

Equipment Status and Performance

- The team verified the installation and operation of almost all USAID-supplied equipment in the plants visited. The vast majority of the equipment was well accepted, correctly utilized, and yielded measurable savings.

- In a few cases there were problems in commissioning of equipment as well as problems in obtaining service and spare parts. The tight budget prevented direct U.S. contractor involvement in equipment installation in every plant and it was, therefore, necessary to use local consultants to handle much of this work. These equipment problems are being addressed in the follow-on Regional Energy Efficiency Project.

- The portable energy efficiency equipment not provided to industry plants but left in the country at the completion of the project for diagnostic use by local entities has not been used as intensively as planned. This part of the program was carefully planned to provide equipment to emerging private firms who would extend the energy efficiency work begun under the EEP. Success was seen in Hungary where the equipment was left with a private firm. In Czechoslovakia, personnel changes due to the breakup of the country retarded the efforts of the quasi-government group there to promote use of the equipment. The lack of suitable private firms in Romania and Bulgaria forced the project to leave the equipment with government agencies who did not aggressively pursue use of the equipment.

- Plant personnel were very appreciative of both the technical assistance provided by the contractors and the energy efficiency equipment provided for the plants. They were very happy that the EEP was not just another paper study and felt that the equipment multiplied the impact of the project.

time period. Increased emphasis on record keeping should be part of future programs to USAID in this effort.

- USAID efforts to introduce private sector energy efficiency capacity is a welcome complement to government-oriented programs, and will help to support the movement to privatization in the region. However, full acceptance and implementation will take time.

Principal Recommendations

In the area of industrial energy efficiency, the challenge for the Eastern European countries is to create both a sustainable market for energy efficiency services and high quality private sector capability to deliver these services. The market for these services depends upon information and awareness, continued high rates of return made possible by energy prices approaching world market levels, and, over the longer term, availability of capital to finance viable projects.

USAID's program should build upon the successful start and lessons from the projects already implemented. There is a continuing need for: technical assistance to strengthen in-country private energy efficiency services; addition of monitoring equipment and measuring equipment to complement technical assistance; a consistent effort on information dissemination; and building a much stronger connection between audits and recommendations (which identify needs and activities) and capital to implement changes.

The following specific recommendations will help USAID build upon the success of activities financed under the EEP:

- **Continue Programs to Encourage Energy Efficiency**

  The EEP clearly demonstrated that significant energy savings can be obtained in Eastern European industrial facilities with very modest investments. The rise in energy prices and progress in privatization create a receptive climate for industrial energy efficiency. USAID should direct its efforts toward (i) increased information dissemination to expand awareness of energy efficiency technology, and (ii) financing low-cost equipment in conjunction with technical assistance.

- **Continue to Strengthen Private Sector Capability to Perform Energy Efficiency Projects**

  Private sector capability to provide energy efficiency services is still in its infancy in Central and Eastern Europe; its development will depend on market forces, keyed in large part to the movement of energy prices. People with excellent technical ability are already available in these countries. USAID efforts to enhance private sector capability in energy efficiency, particularly in the areas of economics, marketing, and management, fit well with the policies of broader program objectives to stimulate economic growth and encourage privatization.

- **Assure Expanded Use of Equipment Supplied to Local Government Agencies**

  Except in Hungary (where EGI has leased out equipment for private use), the monitoring equipment left in the host countries has not been used intensively. USAID should work with host country officials and emerging privatized firms to correct this situation by identifying one or more groups that have the competence and interest to effectively utilize and properly maintain this equipment.

- Some plants also made use of USAID-supplied equipment to improve quality as well as save fuel. At the large Griro pressure vessel plant in Romania, for example, the infrared thermometers were used to determine the temperature of metal pieces about to be welded or rolled and to reduce overheating in electric furnaces at the foundry. This use of the equipment saved gas but, perhaps more importantly, reduced rework and material waste.

- The results of the EEP and follow-on orders for additional equipment led several US companies to set up sales representatives or distributorships, which have led to continued sales of their products, e.g. Armstrong, Bacharach, and Johnson Controls. In addition, in the Czech Republic, energy awareness fostered by the EEP was responsible, in part, for enabling an American energy service company to conclude agreements with several plants outside of the project context.

Country and Policy-Related Findings

- The energy price increases now approaching world levels in Central and Eastern Europe are starting to focus attention on energy efficiency as a way to increase profits and assure plant sustainability.

- An understanding of the relationship between investment today and future savings did not appear to be widespread in the business community.

- The prospect of privatization has created barriers to the exchange of information among plant owners and operators; some technical data formerly exchanged now is treated as proprietary information.

Lessons Learned

Although the lessons learned from the EEP vary from country to country, the following are the broad lessons that derive from evaluations in the four countries:

- Low-cost/no-cost energy efficiency measures can be put in place quickly and can yield significant energy savings well when introduced in a well planned program directed by energy professionals.

- The success in extending energy efficiency measures is a function of the receptivity and strength of plant management, the savings obtained from the initial measures, the economic situation of the firm, and the degree of competition the firm faces in the marketplace.

- Provision of equipment, in addition to expert assistance, stimulates the interest of the program participants and multiplies the impact of the project. Portable monitoring and measuring equipment is particularly effective in this regard since it can be used in many plants.

- Programs which provide equipment must also establish in-country equipment servicing capability to assure host country satisfaction and protect the reputation of U.S. equipment.

- Effective dissemination and diffusion of project results requires a well directed effort including sufficient funding and manpower to continue the effort over a significant

- **Correct Installation and Commissioning Deficiencies**

  Some equipment supplied under the project has not been installed or has not functioned properly, and some spare parts are unavailable. This situation casts a bad light on the EEP and US manufacturer market penetration, even though overall the program has been quite successful. It may be noted that USAID has addressed this by directing that part of the funds for the Regional Energy Efficiency Project be used to follow up on equipment performance.

2. PROJECT BACKGROUND INFORMATION

2.1 PURPOSE AND DESCRIPTION

The Eastern Europe Emergency Energy Project (EEP) was initiated in November 1990 in response to the serious energy and economic crises in Eastern Europe caused by reduced oil deliveries from the Soviet Union, the uncertainty of Mid East oil supplies, and the shift to hard currency payments for oil and natural gas. The purpose of the EEP was to assist with immediate measures to increase the efficiency of industrial energy utilization and to improve Eastern Europe's ability to procure energy supplies from international markets. The project provided technical assistance and training in four areas: (1) low-cost, immediate measures to improve energy efficiency in industry; (2) refinery "debottlenecking" and operational improvement; (3) more effective purchasing of oil on the spot and futures markets; and (4) design of new domestic, particularly petroleum, price structures.

After government acceptance in January 1991, the program was soon operational in six countries; Poland, Hungary, Czechoslovakia, Bulgaria, Yugoslavia, and Romania. USAID placed major contracts with three US contractors (RCG/Hagler Bailly, Resource Management Associates, and International Resources Group) to examine industrial energy efficiency, and with Davy-McKee Corp. to examine oil refinery energy efficiency. During the course of the project these firms and a number of smaller firms, including local Eastern European engineering companies, performed energy audits and country analyses, specified and purchased energy efficiency equipment, conducted workshops and seminars, and set up an oil purchasing intern program. USAID provided over $1.5 million in equipment from more than 40 US manufacturers to 52 industrial plants in Eastern Europe. In all cases, the emphasis was on finding low-cost measures which could be implemented quickly and would yield rapid payback.

The project provided a focused, short-term approach to the Eastern Europe Energy crisis in late 1990 to stimulate immediate energy savings, to dovetail with longer term technical assistance and investment promotion involving cooperation with the World Bank, IEA, EC, and U.S. private industry, and to define issues and opportunities for longer term effort to restructure Eastern Europe's economies and move toward modern, efficient energy systems.

The original project provided assistance to six countries; Bulgaria, Czechoslovakia (later split into the Czech Republic and Slovakia), Hungary, Poland, Romania, and Yugoslavia. The Baltic states of Estonia, Latvia, and Lithuania were subsequently added and the program in Yugoslavia terminated because of the unrest there.

The industrial energy efficiency program component of the EEP -- the primary subject of the evaluation -- was designed to identify and implement no-cost and low-cost quick payback measures to improve energy efficiency, to conduct energy audits and share energy audit and management techniques, including financial and economic analyses, with the plant staff, and to furnish energy-efficiency equipment to fulfill the program objectives.

2.2 FUNDING AUTHORIZATION, OBLIGATION, AND EXPENDITURE

The project funding was authorized November 16, 1990 for $10 million and was subsequently increased to $11.75 million. The Project was designed with a one-year completion date of September 30, 1991. Although the majority of project work was completed by the original PACD, it was extended to June 1992 and more recently to June, 1994 to allow for expanded work in Hungary with the reallocated Yugoslavia funds.

3. EVALUATION APPROACH

3.1. METHODS AND PROCEDURES

The evaluation team used a combination of document reviews and direct interviews to obtain data for the evaluation. The documents reviewed included the energy audits for each plant in the countries evaluated, the country reports prepared for each country, and correspondence. The interviews included meetings or phone conversations with contractor and subcontractor personnel, equipment suppliers, host country officials, local USAID representatives, and responsible personnel at the plants where the equipment was installed.

To USAID in discussions with the contractors and subcontractors the form shown in Appendix C was used. The use of this form provided a measure of uniformity of interviews among the contractors and also assured that no relevant information was overlooked. The contractors and local subcontractors were very cooperative during the interviews. In some cases the interviews had to be conducted by telephone since specific contractor personnel were not available for face-to-face discussions. Interviews were conducted with personnel from RCG Hagler-Bailly, International Resources Group, and Resource Management Associates of Madison, the three prime contractors in the countries evaluated. The names of the persons interviewed are given in Appendix D.

All of the interviews with the equipment suppliers were conducted by telephone since the suppliers are located throughout the country and, because of the relatively short time required for an interview (averaging one hour), direct contact did not appear to be warranted. The form shown in Appendix C was used during these interviews. The names of the persons contacted during this portion of the evaluation are given in Appendix F.

All in-country interviews were conducted directly with relevant personnel. The team interviews included the local USAID representative and other USAID personnel (e.g. project officer), local host government officials who had been involved in the EEP, and the local subcontractors. During a typical week the team met early on Monday morning with the USAID Representative and then again at the end of the week to give the local mission a preliminary report on the team's findings. The names and addresses of the people contacted in Eastern Europe are given in Appendix E.

Direct interviews were held with the local firms who acted as subcontractors to the USAID prime contractors. The names and addresses of the local subcontractors are also given in Appendix E.

During the plant visits the team first explained the purpose of the evaluation stressing the benefits to both USAID and future programs in the host country. The team experienced very good cooperation from the plant personnel; nearly everyone thought it was a good idea and some took the opportunity to provide solid feedback (including a few complaints!) on the project. The team encouraged the plant personnel to be forthcoming.

The overview of the team's mission was generally followed by a discussion of the contractor interaction with the plant personnel and identification of the equipment furnished by USAID under the EEP. Next we discussed the performance of the equipment and tried to obtain quantitative data that would show the changes in plant performance before and after the EEP. Through the local USAID office a copy of the form shown in Appendix C had been sent to each of the plants with the request that they complete it prior to the team's arrival. Most plants complied with this request. This saved a lot of time and probably yielded more reliable data.

In nearly all plants visited the team examined the equipment furnished by USAID and discussed its operation and usage with the plant personnel. The team's findings for each plant in this area are

summarized in Chapter 4; the details of the plant visits are given in Appendix G. In general, the equipment appeared to be well used and well maintained.

After discussing equipment status and performance the team attempted to determine what follow-on actions had been undertaken at the plant. The team reviewed the lists given in the audit reports and also inquired about other recent plant modifications impacting energy utilization and/or pollution (e.g. changeover from oil to natural gas). In many cases plant managers reported that subsequent modifications were limited by availability of financing rather than by deliberate decisions to delay the implementation of audit report recommendations.

The plant interview typically wrapped up with a discussion of the plant's business situation and organization. The team attempted to identify the person responsible for energy matters in general, and conservation in particular, and to determine what changes in the organization had occurred as a result of the EEP audits and technical assistance.

3.2. ISSUES CONSIDERED

The objective of the evaluation was to determine the impact of the industrial energy efficiency component of the EEP. Specifically, the evaluation attempted to (1) determine the effectiveness of the technical assistance, training, and supplied equipment in increasing energy awareness, in saving energy, and in changing energy management practices in the Eastern European plants, and (2) determine the lessons learned from the planning and conduct of the EEP that may be relevant to subsequent energy efficiency programs. To reach these objectives a list of issues was developed. This list is given in Table 3-1.

3.3. TEAM COMPOSITION

The evaluation team consisted of three members. Their names and areas of expertise are given below:

Dr. John Ganley, Industrial Management, Team Leader
Mr. Stephen Klein, Energy Policy, USAID Evaluations
Mr. Pepper White, Energy Efficiency

In all cases at least two members of the team visited each plant.
Mr. Klein, in particular, made side visits to discuss various aspects of energy policy with local government officials, US Embassy personnel, and local banking officials.

TABLE 3-1

LIST OF ISSUES
EMERGENCY ENERGY PROJECT
ENERGY EFFICIENCY COMPONENT IMPACT EVALUATION

1. Project Initiation

Identification of energy efficiency opportunities
Plant selection criteria and process

2. Equipment Procurement

Contractor procurement process - conduct and problems
Arrangements for installation and servicing
Experience of U.S. suppliers

3. Project Achievements

Plant personnel understanding of EEP goals
Energy savings (projected vs. actual)
Follow-on energy efficiency actions taken at plants
Plant equipment and management changes
Potential role for private sector consultants
Spread of energy efficiency awareness
Increased presence of U.S. equipment suppliers

4. Subcontractor Experience

Benefits accrued during project and subsequent benefits
Role in equipment shipment, installation, and servicing
Opinion on effectiveness/cost-competitiveness of equipment
Recommendations for follow-up actions
Further contacts with U.S. firms

5. Audit Reports

Critique of report methodology and recommendations
Actual energy savings and equipment performance at plants

TABLE 3-1 (cont'd)

6. Equipment Supplied to Local Energy Agencies

Equipment status
- Equipment reliability and utilization
- Leasing arrangements
- Equipment maintenance

7. Policy and Institutional Changes

- Governmental actions concerning energy efficiency (pricing, establishment of incentives, public information)
- Establishment of private energy consultants or ESCOs
- Availability and transfer of information

4. EVIDENCE, FINDINGS, AND CONCLUSIONS

4.1 MAJOR FINDINGS

This section summarizes the major findings of the team's evaluation of the impact of the industrial energy component of the EEP. The findings have been grouped into four broad categories; (A) project initiation and implementation, (B) energy efficiency awareness, (C) equipment status and performance, and (D) country and policy-related findings. The findings are:

A. Project Initiation and Implementation

1. The Industrial Energy Component of the Emergency Energy Project succeeded in its primary goal of quickly identifying and implementing near-term, no-cost or low-cost measures to improve the efficiency of Eastern European industrial energy use. Under difficult political and economic conditions a project structure was established, contractors were brought on board and started work, and plants and subcontractors were identified in the host countries - all in the space of a few months. The project yielded positive economic benefits in a wide variety of industrial facilities and some remarkable successes were seen in the countries the evaluation team visited.

2. Plants where process modifications were made showed particularly large savings for essentially no cost. For example, the Kremikovtsi Iron and Steel Rolling Mill in Bulgaria saved about $ 270,000 annually in electricity charges by shifting 10 MW of electric furnace load to night operation; a more dramatic example was seen at the Pannonglas Oroshazi Uveggyar glass plant in Hungary where consolidation of production into three lines from four reduced annual gas costs by $ 2,000,000.

3. A number of factories showed significant savings for relatively small investments in equipment. For example, at the Buszesz Yeast and Alcohol plant in Hungary, the EEP recommendations attained savings of $ 233,000 annually with an equipment outlay of $ 29,100. Using the recommendations from the EEP audit team, the plant installed additional equipment which resulted in saving an additional $130,000 per year. At the Bucharest South power plant in Romania annual savings in the range of $410,000 to $ 508,000 were obtained with equipment purchases of $ 34,800. And in Bulgaria, at the Izida ceramics plant, initial savings of $ 28,600 resulted from installation of the USAID-supplied equipment; another $ 232,000 can be saved when EEP-recommended furnace technology is put in place. Most energy efficiency equipment installations in the four countries showed very short paybacks (on the order of a couple of months). Details of the annual savings obtained in the plants are given in Appendix G. Appendix H provides a detailed description of the results seen in Romania at the Bucharest Sud power plant.

4. Some factories, notably the district heating works in Budapest, the milk processing plant in Bulgaria, and the plants in the Czech Republic where building heating system modifications were made, obtained relatively small savings. Attempts to save energy with building heating modifications and lighting improvements yielded longer payback periods but did improve worker comfort and may eventually increase productivity.

5. The selection of plants for participation in the EEP was generally well done, especially in light of the conditions which existed in late 1990 and early 1991. Plants were selected based on their potential for saving energy, the receptivity of the plant management, the long-term economic viability of the plant, the potential for privatization, and the similarity to other facilities which could benefit from the experience gained at the plant. In only a few

cases were the plants were so large or in such poor condition that they could not significantly benefit from the project.

6. The amount of money available per plant for equipment purchases was considered low by many plant managers since it was typically a small fraction of the plant's operating budget; these comments may indicate that the plant managers did not fully understand the objective of the EEP to show significant energy savings without large capital expenditures.

7. The EEP introduced U.S. monitoring and measuring equipment into the region. The equipment was generally well accepted and utilized and has led to decisions by several U.S. manufactures (e.g. Armstrong, Bacharach, and Johnson Controls) to increase their presence in Eastern Europe. The representatives of these companies were very enthusiastic regarding their participation in the EEP. The team did note a few problems with proper installation, commissioning and post-installation servicing of equipment. In a few cases spare parts and servicing have been problematic. Post-installation servicing of equipment is being addressed in the follow-on Regional Energy Efficiency Project.

8. Diffusion of project results and increased energy efficiency awareness into other plants has occurred through the seminars held at the end of the project, efforts by local firms (often acting as sales representatives of foreign firms) to sell energy efficiency equipment, by seminars set up by foreign vendors (e.g. the Armstrong Energy Seminars), and word of mouth. Subcontractors in the countries claimed they acquired improved skills , and individual managers and plant operators improved their understanding of energy management.

9. The plant technical staffs clearly had the ability to quickly absorb the technical aspects of the energy saving recommendations. However, additional assistance may be needed to assimilate and integrate the associated economic analysis.

B. Energy Efficiency Awareness

1. Although it is an important question in Eastern Europe, energy efficiency is not yet generally regarded as a high priority item. The focus of most plant managers continues to be on survival and on production and not on energy savings. This is probably a residual from the era when meeting production goals at any cost was paramount and cheap energy was readily available.

2. Energy efficiency will be an increasing priority for governments, industry and individual consumers in Eastern Europe, driven by the dramatic rises in energy prices which have occurred in virtually every country. These countries -- previously dependent on Russian oil and gas through barter arrangements -- at the policy level now recognize the importance and viability of energy efficiency measures to their economic restructuring programs. The concern with energy efficiency that does exist has been fueled primarily by the raising of energy prices to world levels and not by government campaigns against wastage or by monitoring of energy utilization.

3. Information on energy efficiency is becoming available but is still not widely available. The EEP did organize a final seminar in each of the countries to review the results at the conclusion of the program but there were no provisions for further action. Some private initiatives have started to fill this need; Armstrong, for example, has set up an Energy Efficiency Council in certain countries where they give a two day seminar on energy efficiency. These seminars are helping to spread awareness of energy efficiency.

4. Although the ability of the private sector to provide energy efficiency services is limited there is a very strong technical base upon which to build service companies. It appears that with proper strengthening in the economics, management, and marketing areas this base could respond to demand from plants when it develops.

5. All governments appear open to the concept of privatization of energy efficiency services. However, the acceptance and support of this concept varies among the countries. Bulgaria and Romania appear less supportive than Hungary and the Czech Republic. As a consequence, the growth of these services in Bulgaria and Romania may be slow for the following reasons:

   Inertia from past and existing government-centered approaches to energy efficiency may prove difficult to overcome.

   Macro-economic production declines have reduced demand for energy, and correspondingly eased the pressure on supply, a situation which may generally continue over the next few years; and

   Uncertainties in future macro-economic development create barriers for Energy Service Companies (ESCO) agreements to pay for services from future energy savings; the team did, however, observe interest in ESCOs in Hungary and the Czech Republic.

6. The spotlight that the EEP focused on energy efficiency enabled several plant managers to get upper management attention on energy efficiency. These managers had been concerned with energy efficiency but had been frustrated in their attempts to get management to pay attention to this topic.

C. Equipment Status and Performance

1. The team was able, in almost all cases, to directly verify the installation of the equipment supplied to the plants. The equipment was generally well accepted and utilized in the plants. In a few cases, the equipment was installed but has never properly worked and there have been some problems obtaining service and spare parts.

2. Despite significant advance planning, the monitoring and measuring equipment left in the host countries at the conclusion of the EEP has been underutilized. The intent was to establish arrangements which would allow private emerging firms to rent the equipment for work in other facilities. In Romania and Bulgaria the equipment had to be left with local government agencies since no private alternatives were available. These groups did not aggressively promote use of the equipment and thus prevented attainment of the goals for this part of the program. In Czechoslovakia and Hungary the equipment was passed to the INSTAR and EGI, respectively, for management and maintenance. With the exception of EGI in Hungary, no aggressive programs for using the equipment were observed.

3. The plant personnel were very appreciative of the assistance provided by USAID, especially the fact that the project provided equipment. Many people remarked that other similar programs had provided only paper studies by consultants but no equipment.

4. The results of the EEP together with follow-on orders for additional equipment led several US companies to set up sales representatives or distributorships in Eastern Europe. Armstrong (steam traps), Bacharach (combustion monitoring equipment) and Johnson Controls have increased sales of their products in this region. In addition, in the Czech Republic, energy awareness fostered by the EEP was responsible, in part, for enabling an

American energy service company to conclude agreements with several plants outside of the project context.

D. Country and Policy-Related Findings

1. We observed significant differences among the four countries in terms of standard of living, economic development, spread of privatization, willingness to accept new ideas, and availability of support (both governmental and financial) to implement further energy efficiency ideas.

2. In addition to the differences in success (as measured by realized savings) among the countries, there were differences in success among the plants within a given country. Important factors in this regard included the plant management, plant condition, the companies' position in the newly emerging markets, the presence or lack of competition, and the influence of energy prices on production costs. Receptivity to recommendations, pride in accomplishment, and willingness to exert the effort to implement recommendations were crucial to obtaining the energy savings.

3. Some basic concepts concerning the relationship between investment today and savings tomorrow have not been fully absorbed throughout Eastern Europe although, again, there are great differences among the countries.

4. Privatization has created barriers to exchange of information among plant owners and operators; technical data that was formerly freely exchanged (since everyone worked for the government) is now treated as proprietary information.

5. Changes in organization and attention to energy matters as a result of the EEP varied widely. Some plant managers reported they had made no changes while some exhibited greatly increased attention on energy saving projects.

4.2 AUDIT REPORT REVIEW

This section provides a review of the audit reports which were used during the course of the evaluation. General comments are provided first, followed by sections containing comments specific to the reports for each country. The last section presents recommendations for future audit programs.

4.2.1 General Remarks

In general, the quality of the audits was good, considering the scope of the project and the time available--one week of audit time in the field to identify low-cost, no-cost energy efficiency measures. Most of the plant personnel were enthusiastic about the quality of the audit recommendations and the reports, together with the equipment that was supplied as a result of the audits. The quality of the recommendations is also commendable given the difficulties of working in a different language through an interpreter, and given the difficulty of obtaining follow-up information while writing the reports.

A general note is that the audit teams from the three firms focused on areas in which they had particular background or expertise. For example, the RMA team in Romania focused on boiler equipment and electrical efficiency equipment while the RMA team in the Czech Republic emphasized building heating systems, valves, and piping insulation. By contrast, the IRG team in Bulgaria included lighting systems, an energy saving option the others appeared to neglect. Hagler, Bailly included more consideration of energy management and organization than the other

contractors. None of the firms did much with compressed air systems in the plants. These systems are often leaky, and repairing these systems can be one of the quickest payback energy measures available in an industrial setting. Although all the energy saving options considered by the three contractors were valid, the variations in emphasis yielded a somewhat uneven treatment of energy saving possibilities across the four countries.

In several cases plant personnel claimed the ideas for energy saving measures contained in the reports came from within the plant and that it was principally lack of capital which prevented implementation of the energy saving options. While it appears correct that the plant engineers understood the operation of their plants quite well and were able to furnish the audit teams with considerable amounts of data, they had not, in most cases, performed economic evaluations that would allow them to substantiate their choices of specific equipment or changes in plant operation. As a consequence, the evaluation team considered it appropriate to attribute energy saving measures implemented after the audit to the audit team visit.

Specific comments regarding the reports are included in the following sections.

4.2.2 HUNGARY

1. The reports the team reviewed had several places where information was incomplete. For example, the Budapest Chemical Works report had blank spaces on the following pages:

P. 5-6:	Heat Use Breakdown
P. 21:	Specification of Orifice Plant Meters
P. 26:	Boiler Efficiency Benefits table
P. 29:	Back-up Data and Calculations
P. 35:	Schedule, Technical Risk and Reference, Back-up data and calculations.
P. 37:	Back-up Data and Calculations
P. 38ff:	Other measures in the rest of the report have missing information in numerous places.

2. Many of the expected energy savings appear to be based on "rule of thumb" engineering estimates rather than calculations.

3. Although there was a summary table in some of the reports, not all the reports had a summary table of the measures with costs and energy savings included.

4. Formatting of the margins of tabular information was often not consistent.

5. The recommendation to install orifice plate steam meters was a good idea, since these meters are very reliable.

4.2.3 ROMANIA

1. The vortex flow meter recommendations for steam and natural gas measurement were too complicated and expensive for this project. Volumetric gas flow meters and orifice plate flow meters are available that would produce more reliable results, typically at a lower cost.

2. As was the case with the reports for Hungary, there was no summary table of recommendations at the front of the report. This would have helped to quickly see the recommendations and the relative merit of the different recommendations.

3. The metric conversion charts in the back of each report were useful.

4. Calculations in the back of the reports were well laid out and easy to follow. Calculations listed specific physical parameters such as steam flow rates, enthalpies, etc..

4.2.4 BULGARIA

1. These reports did have summary tables, and the team found these to be very useful.

2. The lighting improvements that were recommended were too expensive and did not produce savings with an acceptable payback. For example, the fixtures in the Dairy Plant and the Cotton Plant in Varna cost about $290 each and had a payback over 200 years.

3. The inclusion of Appendix III: Training Seminar and Appendix IV: Energy Management Practices may not have been necessary; in any event, they should have been put at the very end so the reader did not have to thumb through them to reach Appendix V: Audit Measurements.

4. Information is repeated in many cases, but with slight differences in the lists of information. For example, much of the information in section 5, Energy Efficiency Improvement Options is repeated in section 6, Recommendations and Conclusions. It would be more helpful to list the projects up front in the report and then describe them once and only once in the back of the report.

5. No backup calculations for the estimated savings were provided, so it is difficult to verify whether the savings have a sound basis. This also makes subsequent comparisons with observed savings more difficult.

6. Some power measurements of the electric motors should have been made to corroborate the statements about load factors and efficiencies.

4.2.5 THE CZECH REPUBLIC

1. These reports were done by the same contractor as in Romania. Thus the comments that apply to the Romanian reports also apply to the Czech reports.

2. In the Czech Republic, many of the reports focused on building heating systems. While this is an important area, more attention could have been paid towards the process areas of the plant.

4.2.6 Recommendations for Future Audit Programs

1. A set of guidelines for the format and content of the audits should be provided to contractors. The US Department of Energy Institutional Conservation Program has detailed guidelines for energy audits of institutional buildings, including requirements for tables of contents, operation and maintenance summaries, capital-intensive energy conservation measures, facility descriptions, etc..

2. Similarly, recent industrial audit programs provided as part of electric utility demand-side management programs have detailed requirements. The utilities typically have third-party engineering consultants review the audits for technical content, clarity, and whether they met the audit requirements. While this does add overhead costs to the utility programs, it helps maintain a level of quality in the audit reports. Contractors under the utility programs are not paid in full until the reviewers approve the revised reports.

3. Finally, we observed that each country's audit team tended to focus on a particular set of measures. A master list of these measures could be compiled, and auditors would be required to address all measures on such a master list.

4.3 EQUIPMENT

This section describes the procurement process used by the contractors during the EEP, the methods used to assure installation of the purchased equipment, the status and leasing arrangements for equipment provided to the local governments, and the results of a survey of manufacturers who supplied equipment to the EEP.

4.3.1 Procurement Process

Nearly all of the equipment provided to the Eastern European plants during the EEP was purchased by the prime contractors and shipped to Europe. Hagler, Bailly and RMA utilized in-house staff to coordinate and perform the purchasing function while IRG used an outside consultant who was familiar with US government purchasing policies. In all three cases the purchasing agents used the recommendations from the energy audits to request quotations for the equipment needed. After satisfactory quotes were obtained, a purchase order was written and the equipment was directed to be shipped to a particular agent in the United States for preparation for shipping overseas. The equipment was shipped to Europe on an American flag carrier. Typically, the equipment was imported into the host country duty-free under the terms of country-to- country agreements.

There were special requirements such as labeling (placement of USAID stickers) and the Buy-American policy. The team found that the purchase orders contained instructions to the effect that USAID stickers be affixed to the equipment. However, much of the equipment we saw in the plants did not have stickers. A few pieces had the stickers on the packing cartons. Although some stickers may have been removed by plant personnel, it is likely that stickers were placed in areas where they fell off or were on disposable material. There was no written evidence that the contractors made special efforts to assure that stickers were in place before the equipment was shipped from the United States.

The Buy-American policy appears to have been well respected by the contractors in spite of the fact that this policy caused some difficulties in specification and installation (with metric sizing, for example). In a few isolated cases it was necessary for the contractors to obtain waivers to permit purchase of equipment made outside the U.S. The contractor purchasing personnel appear to have been aware of the regulations affecting these items and only a small fraction of the equipment required waivers.

4.3.2 Installation and Current Status

Installation was, in all cases, performed by host country personnel. In some cases the local subcontractor supervised the installation while in other cases the local subcontractor merely checked in on the installation after it was complete. The prime contractors made visits to the plants towards the end of the program (near the end of the USG fiscal year) but in several cases installation was not complete and no subsequent visits were made due to project funding limitations.

None of the equipment the team reviewed required the use of special tools or installation by factory technicians. In the majority of cases the installation was successfully completed. However, there were cases where equipment was installed but was not operational at the time the installation crews left. This happened in several instances with the vortex flow meters. We were not able to determine whether this was due to defective equipment or poor installation instructions and

training. This created a bad impression with the plant personnel. The contractors and USAID should assure in future programs that this does not occur again.

4.3.3 Leasing Arrangements

In the four countries the team visited certain energy efficiency equipment (typically monitoring instrumentation) was left in the country to continue and expand the energy efficiency work begun under the EEP. The intent of this portion of the program was to provide the equipment to a responsible private organization that could hold, maintain, and lease the equipment to private consultants at minimal cost thereby helping to promote and improve energy efficiency. Meetings were held with government and private groups to make suitable arrangements for this equipment. However, the business and economic conditions existing in late 1991 prevented formation of suitable private organizations in all host countries which could be responsible for the equipment. It was therefore not possible to fully satisfy the goal of leaving the equipment with private firms.

In Hungary an arrangement was made with The Ministry of Industry and Trade to pass the equipment to EGI, a well-respected private engineering firm, for management and maintenance. In Romania and Bulgaria no private firms were available so the equipment was left with government agencies. In Romania this was the Energy Efficiency Authority (ARCE) and in Bulgaria the Ministry of Industry. In Czechoslovakia an agreement was made with the Federal Energy Agency to pass the equipment to INSTAR ITS (formerly INORGA), a quasi-private group at Ostrava, for management under the guidance of a board including SEVEn.

The equipment left in the host countries has not been used as intensively as planned. In Hungary, EGI has made some use of the equipment by leasing it out to interested parties at reasonable prices (see Table 4-1). EGI claims that these prices cover only the costs of routine maintenance on the equipment. Judging from the dollar- equivalent prices this seems to be a valid claim. Table 4-1 also lists the customers that have used the equipment.

In Romania the equipment given to ARCE (see Table 4-2) appears to have had only modest use, in part due to reliability problems with the ENERAC combustion analyzers. Mr. Breazu, the head of ARCE, indicated they made over 2000 measurements of all types in 1992 but had no breakdown as to which were done with USAID-furnished equipment. It did not appear to the team that ARCE has made a very vigorous effort to make plant personnel aware of the availability of this equipment. They may also not possess the competence and the funding to fully utilize the equipment. Perhaps additional training could remedy this situation.

In Bulgaria, the equipment (see Table 4-3) was left with the Ministry of Industry after a series of discussions among the US contractor, USAID, and local government officials. Unfortunately, the group within the MOI charged with maintaining and utilizing the equipment has only stored it.

In the Czech Republic, disposition of the equipment and selection of the group at Ostrava occurred just prior to the breakup of Czechoslovakia. The equipment is listed in Table 4-4. The group in Ostrava has not made effective use of the equipment, in part because of lack of specific expertise due to personnel changes (resulting from the breakup of the country) and in part because Ostrava is removed from the industrial area in the Czech Republic. The USAID Representative Office in Prague is now aware of the problem and is looking into ways to get the equipment moved to a more accessible location and under the care of a group that will utilize it more effectively.

It is rather easy in hindsight to spotlight problems in this area. However, one must remember that in late 1991 and early 1992 when these arrangements were made, these countries were still trying to establish their government structures. It is not surprising, therefore, that these programs suffered from some degree of confusion.

TABLE 4-1

LIST OF USAID-FURNISHED EQUIPMENT AT EGI

NO.	DESCRIPTION	RENTAL FEE Ft/day incl VAT
1	Model 2000	2660
2	Multimeter with 3-phase probe	836
3	Stopwatch	76
4	Economy Light Meter	76
5	Omega Infrared Thermometer	760
6	Ultrasonic Stethoscope	988
7	Dranetz Model 800	6460
8	FLUKE Thermometer	380
9	Alnor Velometer	912
10	Total Dissolved Solids Meter	152
11	Halliburton cases	380

TABLE 4-1 (Cont'd)

EGI-Contracting/Engineering Co. Ltd.

List of the companies which rented equipment donated by USAID

Name of the company:	VULCANUS Tüzeléstechnikai Szolgáltató és Kereskedelmi BT. (Combustion Engineering)
Address:	1111 Budapest Bartók Béla út 52.
Contact person:	**Mr. Miklós Takács**
Name of the company:	CONTROLL Minõségfejlesztési Tanácsadó Iroda (Quality Development Advice Office)
Address:	1118 Budapest Radvány utca 34/b.
Contact person:	**Mr. Tibor Nagy, Adviser**
Name of the company:	Teskánd Téglagyár (Brick Factory, Teskánd)
Address:	8991 Teskánd, Petõfi u. 127.
Contact person:	**Mr. László Tóth, Production Manager**
Name of the company:	MOTIM Magyaróvári Timföld- és Mûkorundgyár (Alumina Factory)
Address:	9201 Mosonmagyaróvá Pf. 75.
Contact person:	**Mr. István Belecz, Plant Manager**
Name of company:	Békéscsabai Baromfifeldolgozó Vállalat
Address:	5600 Békéscsaba Orosházi út 2.
Contact person:	**Mr. István Máté, Energy Manager**
Name of the company:	PYROSWISS (Combustion Consultants)
Address:	1193 Budapest Frangepán utca 12-14.
Contact person:	**Mr. Ottó Cseh, Manager**

TABLE 4-1 (Cont'd)

EGI-Contracting/Engineering Co. Ltd.

Name of the company:	Budai Téglaipari Vállalat (Brick Factory)
Address:	1034 Budapest Bécsi út 120
Contact person:	**Mr. László Bellovics, Technical Director**
Name of the company:	Tiszai Vegyi Kombinát, Energia és Környezetvédelmi Fõosztály (Tisza Chemical Combine, Energy and Environment Dept.)
Address:	3581 Tiszaújváros Pf. 20
Contract person:	**Mr. József Szekeres, Power Plant Manager**
Name of the company:	Private Consultant
Address:	1215 Budapest Ady Endre út. 47.
Contact person:	**Mr. János Altnéder**
Name of the company:	Magyar Nemzeti Galéria (Hungarian National Gallery, Dept. of Energy)
Address:	1250 Budapest Pf. 31.
Contact person:	**Mr. Tibor Gebhardt**
Name of the company:	Budafoki Muvelõdési Központ (Cultural Center of Budafok)
Address:	1222 Budapest Nagytétényi út. 35.
Contact person:	**Mr. József Gulyás**
Name of the company:	Local Government of 11th District of Budapest
Address:	1114 Budapest Bartók Béla út 15/c
Contract person:	**Mrs. Wagner, Energy Manager**
Name of the company:	Private Consultant
Address:	1013 Budapest Pauler utca 5.
Contact person:	**dr. György Sz. Tóth**

TABLE 4-1 (Cont'd)

EGI-Contracting/Engineering Co. Ltd.

Name of the company:	Private Consultant
Address:	1056 Budapest Belgrád rakpart 26.
Contact person:	**Mr. Levente Nagy**

Name of the company:	Konkoly és Kiss Mérnöki Iroda kft. (Electric Consultants)
Address:	1111 Budapest Karinthy Frigyes út 14.
Contact person:	**Mr. László Konkoly**

Note

Some of the above listed companies used the instruments several times.

Typically no fee is charged on small private consultants.

EGI provides training each time. When the borrower seems unable to use the instruments correctly, EGI provides personnel, too. (That was the case with the National Gallery and the Budafok Cultural Center.)

Electric analyzers are lent only for qualified companies/persons.

TABLE 4-2

LIST OF USAID-FURNISHED EQUIPMENT AT ARCE

QUANTITY	DESCRIPTION
2	2000 Combustion Analyzer
1	Controllotron Flow Meter
1	386 SX Personal Computer

TABLE 4-3

DISPOSITION OF USAID-FURNISHED EQUIPMENT
AT BULGARIAN MINISTRY OF INDUSTRY

DESCRIPTION	QTY SHIPPED	QTY OBSERVED @MOI
Videotapes - Armstrong	7	*
Buhl Overhead Projector	1	**
Transparency Film - Set	1	**
Projection Screen	3	**
Davis Differential Pressure Gauge	2	1
Wahl Thermometer and Probe Kit	2	1
Fluke Multimeter	2	1
Packard-Bell PC and Accessories	2	1
2000 Combustion Analyzer	6	3
Davis Infrared Thermometer	3	1
Davis Oxygen Analyzer	2	1
Invest Software	2	**
Replacement Pump	1	0
Books - Set	1	**

*	Equipment at Bulgarian Committee on Energy
**	Equipment held by Ecotechproduct

TABLE 4-4

LISTING OF USAID EQUIPMENT AT INSTAR/OSTRAVA

FEFERÁLNÍ ENERGETICKÁ AGENTURA, CSFR
INORGA ITS, spol. s r.o., Ostrava

SEZNAM PŘEDÁVANYCH PŘÍSTROJÚ

Číslo	Druh přístroje	Počet	Předano
1.	Ultrasonic Thickness Gauge	2	
2.	Fluke Multimeter	2	
3.	CLAMP-ON AC/DC Current Probe	2	
4.	AC Power Meter/Printer	2	
5.	Three Phase Kit	2	
6.	Fuels Changing Software for ENERAC 2000	2	
7.	TIF 2300 Power Factor Meter w/Case	2	
8.	WATTPROBE Clamp-on Wattmeter	2	
9.	Platinum Thermometer	2	
10.	Immersion Probe	2	
11.	Surface Probe	1	
12.	Needle Probe	2	
13.	Portable Ultrasonic Flowmeter	2	
14.	Portable Thermal Printer	2	
15.	Portable Combustion/Emissions Monitor	2	
16.	NO_X Measurement 0-2000 ppm range	2	
17.	SO_X Measurement 0-2000 ppm range	2	
18.	Emission Package	2	
19.	Internal Modem	2	
20.	Printer	2	
21.	Enercomp 2000	2	
22.	Laptop Epson 286	2	
23.	Basic Calibration Kit	2	
24.	NO_X Calibration Gas	2	
25.	SO_2 Calibration Gas	2	
26.	Condensation Trap	2	

TABLE 4-4 (Cont'd)

27.	Compact Tool Kit	2	
28.	Stainless Steel Pressure Gauge (100 psi)	2	
27.	Stainless Steel Pressure Gauge (400 psi)	2	
28.	Stainless Steel Pressure Gauge (1000psi)	2	
29.	Digital Heat Spy	1	
30.	Air Velocity & Temp Meter	1	
31.	Psychrometer, Sling	2	
32.	Thermometer (-10 - 100 ^{o}C)	2	
33.	Pocket Thermometer (-45 - 50 ^{o}C)	2	
34.	Pocket Thermometer (-15 -105 ^{o}C)	1	
35.	Portable Printer CANON BJ-10 e	1	
36.	CANON BJ Ink Cartridge	2	
37.	SHARP 1600 Computer	2	
38.	CE 161 Memory Module	2	
39.	14 pin RS232 Sharp Cable	2	
40.	Tape Measure	1	

Me ˇ r ˇ ící pr ˇ ístroje uvedené v tabulce pr ˇ evezme INORGA ITS s.r.o. od Federální energetické agentury.

INORGA ITS spol. s r.o.
zastoupená:

Jméno:_____

Funkce:_____

Podpis:_____

Federální energetická agentura
zastoupená:

Jméno: _____

Funkce: _____

Podpis: _____

**Signatures on hard copy

TABLE 4-4 (Cont'd)

RENTAL FEES

I. WITHOUT OPERATOR

LIST OF EQUIPMENT

A1 Ultrasonic Thickness Gauge
A2 Multimeter
A3 Power Master IIIB/Printer
A4 TIF 2300 Power Factor Meter w/Case
A5 Wattprobe Clamp-on Wattmeter
A6 Portable Ultrasonic Flowmeter
A7 ENERAC 2000
A8 Platinum Thermometer
A9 Digital Temperature Meter
A10 100-VT Velocity Meter
P1 Portable Thermal Printer
P2 SHARP 1600 Pocket Computer

ESSENTIAL COMBINATION OF APPARATUS FOR MEASUREMENT

Comb.	Apparatus			Rent	Measurement
C1	A2	A1.A6	P1	3,000	flow of liquid
C2	A2	A3.A4.A5	P1	1,800	electric measurement
C3	A2	A7	P2	2,100	emissions
C4	A2	A8		300	temperature
C5	A2	A9		1,000	temperature
C6	A2	A10		300	air velocity

OPTIMUM COMBINATION OF APPARATUS FOR MEASUREMENT

Comb	Apparatus	Rent	Measurement
C1.C4	A1.A2.A6.A8.P1	3,250	A. flow of liquid
C2	A2.A3.A4.A5.P1	1,850	B. electric measurement
C3.C6	A2.A7.A10.P2	2,300	C. gas
C4.C5	A2.A8.A10	500	D. temperature

II. WITH OPERATOR

Rental fees are raised on 500 Kc's.

4.3.4 Manufacturer's Response and Support

As part of the evaluation, six manufacturers who had supplied equipment to the EEP were interviewed. The manufacturers are listed in Appendix F including the name of the person interviewed. The interviews were conducted following the form shown in Appendix C. This form forced some degree of uniformity among the interviews.

All the manufacturers appeared to have understood the goals of the EEP. Three of the manufacturers, UE Systems, Armstrong, and Bacharach, were very enthusiastic about their participation in the project. For example, Mr. Hickox of Bacharach said that their sales volume in Eastern Europe had increased from 1% of total sales in 1992 to 4% in the first quarter of 1993. As a result, he has reorganized his European sales force to put more emphasis on Eastern Europe. Mr. Bloss of Armstrong reported that the EEP had accelerated their presence into the Eastern European marketplace. Both Bacharach and Armstrong have set up sales representatives in Hungary and Romania and Armstrong has also established representation in Bulgaria. Armstrong has, in addition, established an Energy Efficiency Council in each of these countries where they give annual two day seminars on energy efficiency.

Two of the manufacturers (Honeywell and Dranetz) had very little awareness of the role of their equipment in the EEP and had seen no significant impact on sales as a result of their equipment being used in the project. Mr. Cesard of Dranetz said that their equipment was not a big ticket item and that they could not afford, at the present time, to mount a serious marketing effort in Eastern Europe without a greater potential market.

Since the manufacturers sold directly to the contractors they had no interface with the end users in Eastern Europe. Mr. Hickox and Mr. Bloss were the only persons interviewed who had direct marketing experience in Eastern Europe. Only in the few cases where there were servicing problems did some minimal level of contact open up at the plant level. The relations with the contractors was straightforward and no problems were noted. Several people commented on the high degree of technical competence in Eastern Europe (something the team also observed).

Several manufacturers noted that the ability to support the equipment is key to success in markets like Eastern Europe. There is essentially no selling infrastructure in these countries although it is starting to develop in Hungary and The Czech Republic and, to a much more limited extent, in Romania. Several plant managers reported that they had not been able to obtain replacement parts or service for their combustion analyzers in spite of repeated attempts to contact ENERAC's representative in Italy.

Most of the manufacturers felt the Eastern European market will grow, albeit slowly, over the next few years. There will be intense competition from the West Europeans, especially the Germans, and anything the US Government can do to help would be appreciated.

4.4 ON-SITE PLANT EVALUATIONS

This section provides summaries of the team's visits to twenty-three plants in Hungary, Romania, Bulgaria, and the Czech Republic. Details of each of the plant visits are given in Appendix G. To the extent possible, four broad areas were covered during each plant visit; (i) the status of the USAID-supplied equipment, (ii) energy saving measures that were implemented at the plant, (iii) actual energy savings and specific energy consumption, and (iv) plant management, energy organization, and the overall business climate.

4.4.1 HUNGARY

In Hungary the team visited six plants (Buszesz Yeast and Alcohol, Budafok Paperboard, FSV Sutiopar Bakery, Budapest District Heating Works, Budapest Chemical Works, and Csepel Metal Works). The team was not able to visit the Pannonglas plant because the company was reported to be in bankruptcy nor the Hungalu Motim Alumina which is located far outside Budapest. Travel to the latter plant would have consumed considerable time. This is unfortunate because the audit team estimated large energy savings for these two plants (3.4 M$ for Pannonglas and $430,000 for Motim).

Hungarian industry had been evolving towards a market economy and privatization of state industries for several years prior to 1989. There were concerted efforts to produce market-oriented products, to introduce modern fabrication and processing technology, and to reduce specific energy consumption although the latter were still in the initial stages of implementation. Increased industrial energy prices, which are now comparable with those in Western Europe, emphasize the need for and benefit from implementation of energy efficiency improvements.

Two of the plants visited (Buszesz Yeast & Alcohol and Budafok Paperboard) have been substantially privatized through purchase by firms outside Hungary. A third firm, Budapest Chemical Works, was being examined for purchase by a Western European firm at the time of the team visit. Overall, the team was impressed by both the management and technical people in the plants in Hungary. The USAID-supplied equipment appeared to be correctly installed and properly used and several plants, notably the Yeast & Alcohol plant and the Chemical plant, used the EEP assistance as a base to expand their energy efficiency programs.

The actual savings recorded by the plants are shown on Table 4-5. It can be seen that the low-cost measures recommended by the USAID contractors resulted in paybacks of only a few months - a remarkable accomplishment. For example, the Yeast & Alcohol plant payback period was only 1.5 months and that for the Metal Works was only 1.7 months. The only facility not able to provide the team with actual energy savings was the building in the district heating system. This was because they had not yet accumulated data from a full one year period including the winter when they expected to see most of the savings.

4.4.2 ROMANIA

The evaluation team visited six plants in Romania (Bucharest milk plant, Bucharest South heat and power station, Urziceni soybean oil processing plant, Cimpulung cement plant, Craiova fertilizer plant, and the Griro pressure vessel plant). Time did not permit visits to the other two plants audited (Galati iron and steel plant and Celhart pulp and paper plant). The audits were also successful at identifying significant potential savings for these plants ($660,730 for Galati and $400,000 for Celhart).

Romania is well behind Hungary and the Czech Republic in development of a market economy, elimination of subsidies for energy, and implementation of energy efficiency measures. There is very little privatization, many of its plants are in relatively poor condition, and industry is still

adapting in efforts to produce goods that are competitive on the open market. Most of the plants are operating at levels well below those of several years earlier. Still, the team saw some remarkable examples of energy efficiency programs including the Griro Plant which can fabricate large tanks and vessels in conformance with the ASME Pressure Vessel Code and the Bucharest Sud Power Station which has instituted a number of improvements in spite of a lack of incentives. The Griro Plant exports about 80 percent of its products.

The USAID-supplied equipment was greatly appreciated by the plant personnel in Romania. It appeared to be correctly installed and used in the plants the team visited. The workers at the Griro plant have carried this further by using the thermometers to determine the temperature of metal to be welded. Several plants noted they had had problems with the analyzers and could not obtain spare parts. There were also problems with gas flow meters.

As in Hungary, the savings actually seen in the plants were significant and, again paybacks on the order of several months were recorded. In the case of the Bucharest Sud Power Plant there was a large difference between the projected savings and the actual value; this appears to be due to overestimation of the possible changes in combustion efficiency.

4.4.3 BULGARIA

The evaluation team visited six plants in Bulgaria (the Sodi soda ash plant and the Parvi Mai cotton processing plant in Varna, the Kremikovtsi iron and steel mill and the Serdika milk plant in Sofia, the Chimco chemical works in Vratza, and the Izida Ceramics plant in Elin Pelin). Time did not permit visits Pharmacia chemical and pharmaceutical works or to the poultry slaughterhouse in Tolbuhin.

Like Romania, Bulgaria suffered from a tightly controlled, centrally planned economy for a number of years prior to 1990. A market economy and private firms are only now starting to appear. Bulgaria patterned its industry after the former Soviet Union with large, often energy inefficient factories.

The EEP program for equipment installation and utilization was less successful in Bulgaria than in the other countries visited. Although all the equipment was accounted for (i.e. present in the plants), some of it had not been installed at the time of the team visit. The emphasis is still on production in most of the Bulgarian plants and there is a very low level of energy efficiency awareness. However, the team again observed awareness in the plant management at the Izida Ceramics plant and at the Devni Soda Ash plant. In both plants, however, the actual energy savings were rather low (see Table 4-5) and for three of the six plants actual results were not available.

4.4.4 THE CZECH REPUBLIC

Eight plants were audited in Czechoslovakia during the course of the EEP. However, on January 1, 1993 the country was peacefully split into two new countries; the Czech Republic and Slovakia. The evaluation team visited the five plants which reside in the current Czech Republic. These are the Pragolaktos dairy plant, Branik brewery, Tofa wood products plant, the Cerny Dul fabric plant and the Autobrzdy auto parts plant. The other three plants which were audited are found in Slovakia. All eight plants showed significant potential savings as a result of the audits.

The Czech Republic has a long history of industrial excellence, particularly in heavy industries. There was a solid appreciation of energy efficiency present in the plants that the team visited. However, the actual energy savings were not very large in these plants. This is due in large part to the fact that the USAID contractor focused on building heating improvements rather that process improvements. These generally have long payback periods.

TABLE 4-5

SUMMARY OF ENERGY SAVINGS AT PLANTS AUDITED IN EEP

HUNGARY

PLANT	EEP EQUIPMENT COST (K$)	SAVINGS (K$)	PAYBACK PERIOD (Mo.)
Yeast & Alcohol	29.1	233. -364.4	1
Paperboard	16.7	451.6	< 1
Bakery	11.1	15.8 - 79.0	2
District Heating	30.3	12.8	28
Chemical Works	33.0	380.4	1
Metal Works	18.7	237.0	1
Alumina	29.4	171.4	2
Glass	44.8	3,005.0	< 1

ROMANIA

PLANT	EEP EQUIPMENT COST (K$)	SAVINGS (K$)	PAYBACK PERIOD (Mo.)
Power Plant	34.8	410.6 - 508.6	1
Cement	24.3	150.0 - 375.0	< 1
Pressure Vessel Fab.	35.8	279.0	2
Fertilizer	30.2	445.8	1
Milk Processing	10.2	22.8	6
Soybean Processing	14.4	35.5	5
Iron and Steel	31.3	660.7	< 1
Pulp and Paper	30.6	399.5	1

BULGARIA

PLANT	EEP EQUIPMENT COST (K$)	SAVINGS (K$/YR)	PAYBACK PERIOD (Mo.)
Ceramics	21.0	28.6	9
Iron and Steel	15.4	328.3	< 1
Soda Ash	49.3	103.2	6
Ammonia/Urea	8.3	7.9	12
Milk Processing	30.3	8.7	40
Cotton Processing	31.7	13.2	28
Pharmaceut/ Chem	26.0	158,3	2
Poultry	32.2	110.7	3

CZECH REPUBLIC

PLANT	EEP EQUIPMENT COST (K$)	SAVINGS (K$)	PAYBACK PERIOD (Mo.)
Auto Parts	9.6	105.0	< 1
Textile Processing	12.4	40.6	4
Wood Products	11.1	13.1	10
Brewery	9.8	10.0	12
Milk Processing	35.5	2.7	157

4.5 SUBCONTRACTOR EVALUATION

This section provides the results of the team's review of the local subcontractors used by the USAID prime contractors in the four countries.

4.5.1 HUNGARY

The Hungarian engineering firm EGI acted as a subcontractor to Hagler, Bailly during the course of the energy efficiency project in Hungary. EGI is a major engineering firm that had approximately 500 personnel during the period of the audit. EGI also assisted the Ministry of Industry and Trade in selection of the plants for energy efficiency demonstrations. Subsequent to completion of their role in the energy efficiency project EGI was privatized and 85% of the shares of the company are owned by the German firm GEA; the remaining 15% of the shares are owned by the employees.

EGI assisted in all phases of the work in Hungary including energy audits, specification and installation of equipment, and translation of documents. EGI credits the collaboration with Hagler, Bailly during the EEP for teaching them how to properly do energy audits. The focus on financial data and the economic impacts of wasting energy, the use of standard forms, the use of instrumentation, and follow-up actions were listed by EGI as positive outputs from the project.

EGI currently has control of the portable instrumentation provided by USAID to the Hungarian Ministry of Industry and Trade. Although the Ministry holds title to the equipment, EGI stores and maintains the equipment since the Ministry has no in-house capability to maintain and monitor use of the equipment. EGI leases the equipment to various Hungarian firms for modest charges that cover the costs of handling and maintenance. During the last year 15 clients have leased various pieces of equipment. A list of the equipment and the leasing fees is given in Table 4-1; a list of the clients to whom equipment was leased is also given in Table 4-1.

Based on the knowledge gained within the framework of the USAID program, EGI has been trying to expand their energy audit business. There are now about 10 people in EGI concerned with energy efficiency. Their energy audit work has not grown as quickly as hoped. EGI attributes this to lack of appreciation of the value of energy audits on the part of Hungarian management and to the relatively tight economic situation in many plants.

The plant personnel we talked to were very familiar with EGI and appeared to value EGI's work during the project. It appeared that EGI played a larger role in the industrial energy component in Hungary than did subcontractors in the other countries we visited.

EGI gave good marks to the seminar held at the end of the project but noted that there was no follow-up activity. They also noted there is an energy seminar held several times a year by the Ministry of Industry and Trade. Energy efficiency is sometimes included on the agenda but we were unable to determine whether the USAID program has influenced the activities of this group.

EGI felt that the installation of the computers in the plants made a big difference in the Hungarian energy accounting practices. They also noted that there are still several barriers to greater inclusion of energy efficiency measures in Hungarian industry. They included in this list (1) the lack of sufficient laws and regulations, (2) resistance to change on the part of the large energy monopolies, (3) the lack of demand-side management programs, and (4) a general lack of awareness and know-how. Hungary has enough internal generating capacity and does not currently put any emphasis on DSM.

4.5.2 ROMANIA

In Romania RMA contracted with Instapart to provide local support. The principal contact at Instapart was Mr. Mihai Maracineanu. Instapart did not participate in the audits and only came on the scene later in the program, after the first round of trips. Instapart had a contract with RMA to receive the fixed (as opposed to mobile) equipment, help with customs clearance and transport to the plants, conduct pre-installation training, perform equipment installation supervision (installation was done by the plants), startup and commission the instrumentation, and follow-up and monitor the equipment performance. They also provided some translation services for drawings and manuals. Their contract with RMA ended in June 1992.

Mr. Maracineanu said he had to do quite a bit of post-installation service work, particularly with the combustion analyzers. Neither the people in the US nor their representative in Italy responded to his inquiries. He also noted they'd had a number of problems with the vortex flow meters some of which never worked after installation. The firm's European representatives in Germany responded to questions but requested payment to repair the units. The RMA project manager now works for another firm and is doing some work in Romania. He has been very helpful in trying to get to respond to cries for help. Mihai also felt the rather late installation (it occurred near the end of the project) was a negative aspect of the project since it prevented USAID payments for service.

It appeared to the team that Mr. Maracineanu was well known and well liked by the plant personnel who participated in the EEP. They felt that they could call on him when they had problems and he seemed sincerely interested in helping even though he wasn't getting paid.

4.5.3 BULGARIA

In Bulgaria, International Resources Group employed the firm Ecotechproduct, a firm that had been recently formed in Sofia by Mr. Christian Spassov. Mr. Spassov accompanied IRG team members to the various plants, helped with translations and technical discussions, and followed up on equipment installation and servicing. The IRG project manager had nothing but praise for Mr. Spassov and his associates. As a result of its participation in the EEP, Ecotechproduct has established a sales representative arrangement with Armstrong focusing particularly on steam traps. This has opened up the Bulgarian market for Armstrong, resulted in additional sales of their products, and brought American technology into Eastern Europe.

4.5.4. THE CZECH REPUBLIC

In the Czech Republic the prime contractor (RMA) used two local subcontractors; SEVEn (Stredisko pro Efektivni Vyuzivani Energie) and Energoprojekt. SEVEn is an independent, non-profit organization founded in 1990 to promote efficient use of energy as a means to protect the environment and support economic development. Energoprojekt is an engineering consulting firm with extensive experience in the power industry.

4.5.4.1 SEVEn

SEVEn provided assistance to RMA, particularly during the first part of the project, and completed two RMA subcontracts during the EEP, "Effective Use of Energy in Industry", and "Energy Pricing". SEVEn worked with the Ministry of Industry, USAID and RMA to identify the eight plants (in what was Czechoslovakia) which would be audited by the American contractors and would be the recipients of US equipment. SEVEn provided some help during the conduct of the audits although the bulk of this work and the follow-on work associated with installation was handled by personnel from Energoprojekt.

SEVEn also organized two seminars (one in Prague and one in Bratislava) in August 1991 to present the results of the EEP to about 100 people. The turnout for these meetings was considered respectable since they were held during the height of the vacation season due to USG deadlines. SEVEn also felt that follow-up was a problem with the USAID program.

SEVEn also started an energy data base during the EEP and continues to maintain it (about 50% of SEVEn's funding is provided by the US). SEVEn also played an important role in introducing an American ESCO into the Czech Republic which has resulted in the ESCO signing several contracts with Czech and Slovak firms. SEVEn noted that energy conservation measures could sometimes push a company being considered for privatization into the black. Also environmental considerations are starting to drive energy modifications.

4.5.4.2 Energoprojekt

Energoprojekt was selected by RMA after discussions concerning capabilities and labor rates. SEVEn had recommended several Czech firms for RMA's consideration. Energoprojekt did not have a lot of experience in energy efficiency work but no one in Czechoslovakia did. Energy efficiency was not an important consideration when the price of energy was low.

Mr. Malek, who was the principal contact with RMA, felt that, although the seminars were good, the real benefit from the EEP was in showing what can be done in a relatively short period of time. He also noted that the environment was very different then; people were not aware of the market system. No technical help is needed - what they need is help in getting financing.

Mr. Malek felt that RMA hadn't had much experience dealing with foreign firms or with small businesses. Energoprojekt had no problems dealing with RMA.

Energoprojekt's role consisted of collecting information on the plants during the course of the project. They were not present at the beginning of the project and were not involved in selection of the plants. They did accompany RMA during the plant visits and provided miscellaneous services such as settling technical questions, negotiating, translation, and faxing various pieces of information to RMA. He mentioned that RMA's initial list for equipment was too expensive and Energoprojekt helped RMA pare it down to something reasonable.

Energoprojekt was not involved in the installation of the equipment; the plants found contractors to do this. He thought the plants paid the contractors and were then reimbursed by RMA. Energoprojekt was not, to the best of his knowledge, called upon for any kind of servicing after the installation.

He felt the technical assistance was welcomed although the reception varied from plant to plant. At some plants the local competence was not high (e.g. Cerny Dul) or the USAID project had a low priority (e.g. Branik brewery) while at others (e.g. Tofa Albrechtice) the plant people knew exactly what they wanted to do. He thought the equipment furnished was of very good quality; unfortunately, the amount of money available for equipment was not large.

Incidentally, Mr. Malek now works for a firm called Energoconsult (a 30-40 person spin-off of Energoprojekt) which does consulting in the power sector. Their main client is CES, the national utility. He said this is a new thing for them since they now have to competitively bid on proposals. He wasn't sure that a firm could survive doing energy efficiency consulting. Although most plants don't have people experienced in energy efficiency, they don't have much money either and have a tough time obtaining financing.

4.6 POLICY CONTEXT

This section provides a description of some of the considerations which surround the energy efficiency component of the Emergency Energy Project. Energy pricing, the roles of government and private sector entities, institution building, and information transfer are examined. A separate section was prepared for each country and the above four items are reviewed for each country.

4.6.1 HUNGARY

4.6.1.1 Energy Pricing

Hungary's pricing policies now provide a positive environment for promotion of increased energy efficiency, with prices increasing dramatically over the past three years. Hungary's imports of oil and gas via pipelines from Russia are paid in foreign exchange at the border price. By 1995, Hungary plans to establish all prices at world market levels, positive current pricing changes continue to that goal.

Rising energy prices have been a key factor in the greater interest in energy efficiency. DMS, an American firm that has made a recent decision to establish itself in Hungary to represent manufacturers of equipment (monitoring and measuring as well as Armstrong Steam Traps), referred to the perception that energy efficiency now plays as one factor in its business decision. Honeywell officials -- selling to the large electricity and industrial market -- also remarked on the pressures on Hungary's exports which increasingly faced international competition and the large internal rise in energy prices from a few years ago as boosting interest in their energy control systems.

Further evidence of the impact of energy efficiency interest is found in reduced floors for take or pay contracts. At least three of the eight firms where audits were carried out reduced the fixed fee for energy use when they realized through energy efficiency measures that they could live with a lower level of assured energy.

4.6.1.2 Government and Private Sector Roles

a. Government - The Government ministries are undergoing a transition in responsibility for energy, reflecting the push for privatization within the economy. With this movement, the principal advocate for the EEP within the Hungarian Government has now moved to AV Rt., the Hungarian State Holding Company responsible for identifying and promoting the

privatization of state-owned firms. The Hungarian Ministry role to promote state programs is being reduced.

The State Holding Company portfolio contains two kinds of companies; (i) Companies likely to be privatized; and (ii) companies where for strategic or political reasons control will remain in state hands. The latter group presents a difficult challenge for the government to consider the trade-offs between production and efficiency, and possible greater unemployment if large and inefficient state enterprises are scaled down or closed. Just within the small sample of firms which the evaluation team visited, the evaluation team received constant comments from officials wondering what their industrial future would be.

The government approach to the EEP took maximum advantage of the momentum for privatization. Thus, audits were set up for companies on the possible list as candidates for sale. This linking of candidate firms with an energy audit has helped with the private sale process discussed below. "The floor is endless to carry out energy efficiency work in Hungary" was one of the memorable statements made to the team.

The principal government spokesman for the EEP described a threefold impact of the EEP: (i) Companies involved in the program made direct energy savings; (ii) the audience for energy efficiency was significantly enlarged through seminars and word of mouth; and (iii) consultants were able to learn from the USAID contractor (This official summarized the impact with the words, "the consultants produced a dramatic change in our lives").

The Government of Hungary is still struggling with new energy laws which will increase the incentives for greater efficiency, including setting standards. The new law is beset by much of the political controversy over the pace of privatization and its impact on jobs and equity.

b. Private Sector - Private sector capacity in energy efficiency exists, though in a very early stage. Hungary is blessed with world class technical talent, which can be brought to bear in the efficiency field when the market exists. Many firms or individuals set themselves up as energy efficiency experts, often with companies of one or only a few people. The depth of their individual expertise in energy efficiency is still to be tested, once a strong market develops.

The most experienced firm in the field is EGI, a large Hungarian contracting and engineering company with a separate division dedicated to energy conservation. EGI was the sub-contractor to Hagler, Bailly for conduct of the audits and subsequent implementation of the EEP. EGI will continue to be a leader in delivering energy efficiency services in Hungary, though its activities under any USAID financing will be reduced because it has been purchased and is now a subsidiary of GEA, a German company.

The EEP apparently has had a direct result on foreign investment, though the team had difficulty making a tight connection. Both the paper factory and the yeast factory had moved to private hands subsequent to the audits. The yeast company manager in particular cited the EEP's role in promoting energy efficiency with these words: " The spark existed in each of the colleagues at the plant to become
much more efficient. The USAID-financed team managed with its intervention to ignite the work". In addition, DMS, mentioned above, also established itself because of the encouragement of the EEP.

4.6.1.3 Institution Building, Sub-contractors, and Training

The EGI personnel were quite forthright in their praise for the USAID contractors help to build their capacity. Although EGI had been conducting energy work for several years, they stated that the USAID-financed team showed them how a good audit is done. What EGI learned is now applied in all of their work, as they combine a structure, instruments, forms, and a careful selection of clients likely to understand and implement the recommendations. Their whole approach changed in that they now look at money figures as well as quantitative energy figures.

On the institution building side, the EEP was also cited as having an impact on the orientation of the EC PHARE program, which works mainly through government programs. Initially, the PHARE program concentrated on European consultants, either resident in Hungary or as short-term consultants, to implement its programs. The approach introduced by the USAID-financed team led to Hungarian pressure to restructure the programs to include sub-contracts for Hungarian firms. Sub-contracting has now increased. (A curious Catch-22 exists for EGI because it is considered a Hungarian firm by the EC programs and therefore ineligible as a prime contractor, but is also ineligible for any USAID-financed work because it is considered a German firm).

The USAID-financed training program for energy efficiency builds upon the successes of the EEP, and assumes that the market will continue to expand for these services. There appear to be a set of actions that USAID might take to help expand the private market for energy efficiency services that would also reinforce USAID's broader program goals for macro-economic restructuring, supporting economic growth and privatization. Specific actions include:

- Financing for audits focused on public sector schools and hospitals where the private firms would establish a market expertise; capital for implementation could be linked to funds already available to assist municipalities;

- USAID-financed audits for firms held by the State Holding Company which are under consideration for privatization; here energy audits could identify significant improvements in the operating results of the company and thus enhance their attractiveness;

- Identification of already privatized firms that could institute a set of cost controls and energy improvements, in which the costs of the Hungarian consulting firm work was cost-shared with USAID financing; and

- USAID-financed studies with the graduates of the training program to provide a more in-depth knowledge of the market, and projections of future demand.

4.6.1.4 Information Transfer

The USAID-financed workshop held in January, 1992 produced enthusiasm and results among the large number of attendees. The largest immediate impact of the EEP was the perception that programs could be mounted and monitoring and measuring equipment supplied quickly that led to concrete energy savings. This urgency was compared with programs of other donors that had already been operating programs for some time when the USAID EEP started. Some of this momentum was lost with the break in follow-up activity to the EEP, an unfortunate consequence. But even with the advantage of hindsight, the extent of success of the EEP would have been hard to predict, and USAID would be pressed in any event to produce the same quickness of implementation with longer term program objectives.

The evaluation team noted the hesitancy of some firms to share information with other firms in the industry, because the advantage of cost controls, though energy efficiency provided a competitive advantage.

USAID efforts to encourage information sharing should be pursued through the NGOs now being formed as well as through the more traditional Government-led structures. The Hungarian Energy Association can play a particularly effective role with modest USAID financing. This organization -- centered in the university -- has strong ties through the student and former student body with the engineering talent that staffs both Hungarian firms and government. Information sharing efforts must address the traditions of state control over information, and possible competition among different NGO and government-sponsored organizations over the data bases.

4.6.2 ROMANIA

4.6.2.1 Energy Pricing

The RMA work underscored the importance of price incentives as a necessary condition for encouraging energy efficiency. This emphasis -- contained in its general reports and plant specific audits -- was evident from the evaluation team's conversations with Romanians with whom the RMA team had worked. They all made reference to the changed conditions caused by the Russian decision to accept only hard currency in payment for Romanian imports of oil and gas.

Romanian pricing reform continues to be implemented, and the proposed policy is that prices will reach world market levels by 1995. Romania government policy and citizen response to higher prices was sharply brought home during a field visit to the Cimpulung Cement plant and Craiova Fertilizer Plant. During that trip, the team had difficulty buying gasoline because there were long lines of cars in anticipation of another price rise to be put into effect the following day (July 1). The lines disappeared the next day.

Several plant managers reported closing down production lines for a limited time for lack of fuel. This may reflect supply constraints, especially in winter when natural gas supplies are stretched to meet heating needs. But supply constraints may also be a proxy used by plant managers sensitive to production costs which exceed sales revenues who need an excuse acceptable to workers to shut down the plant.

A solid rationale for the EEP was borne out by the macro-economic conditions prevailing during the team's visit:

- The industrial base is both energy intensive and energy inefficient. Energy intensity often runs 3 to 4 times comparable industrialized country standards.

- Romania uses 1/3 of its export earnings for energy imports.

- Romanian dependence on Russian oil and gas makes the country's economic reform effort unduly dependent on outside forces it cannot control.

- The privatization process continues to move ahead, especially for small and medium sized business. The U.S. Economic Counselor cites figures for May, 1990 for creation of 260,000 new businesses, of which 30,000 had foreign participation and 75% of which had fewer than 10 people.

- Energy efficiency improvements -- especially low cost/no cost measures -- mesh well with Romania's highly skilled labor force which can produce high economic returns without requiring significant capital.

4.6.2.2 Government and Private Sector Roles

a. Government - The RMA report, Industrial Energy Efficiency and Institutional Analysis in Romania, provided a useful overview of industrial energy use. The evaluation team found it a valuable reference for discussions with GOR officials and plant managers. The report's identification of major energy users in a few sector's provided an excellent lead-in to the nature of Romania's industrial energy policy. This identification -- which indicates chemicals and ferrous metals account for about 60% of total industrial energy use -- supplies a context for structuring energy efficiency proposals.

The Romanian Agency for Energy Conservation (ARCE) is the principal GOR entity promoting energy efficiency measures. As a government entity, it appears to be concentrating its attention on a few projects which will have large payoffs. In 1993, ARCE proposes to implement 18 projects at a total cost of $2.4 million, of which ARCE will finance directly $470,00 or about 18% of the total. USAID assistance through ARCE from the EEP has encouraged and strengthened its role, a decision that appears well justified by subsequent project and sector developments.

ARCE has supported USAID programs to promote a private sector role in future energy efficiency programs. While government agencies in some countries have a tendency to resist strengthening the private sector, ARCE seems quite responsive to creation of capacity in the private sector as a complement to its own programs. Given its positive approach, USAID programs should consider allocating funds to help ARCE in areas appropriate to its public sector role as part of a follow on project. Such support could include working to increase information awareness about successful practices as well as participation in possible training programs.

The evaluation team learned about a planned activity that would fit a public support role for ARCE. The new Society for Optimizing Energy Consumption in Romania (SOCER) is organizing a seminar in October, 1993 entitled "Methods and Equipment for the Energy Measurement, Management and Preservation", and an associated equipment exhibition. USAID should consider attending, and encouraging representatives from U.S. equipment manufacturers also to attend. Mr. Alex Marinescu, head of the ARCE division in Craiova, is a prime mover in the new association, and the USAID might consider working with him as well as other Romanian organizations to increase the public exposure to successful energy efficiency practices.

RENEL, the electricity utility, also plays an import government role in the sector, and would appear to merit USAID support. At the technical level, the evaluation team was impressed by the remarkable performance of the plant manager of the Bucharest Sud power plant (550 MW installed capacity) in utilizing the USAID-financed equipment, and his willingness to discuss problems and potential solutions.

The team initiated a meeting with the Bucharest West Plant (250 MW) plant manager to test the spread effects of the demonstration program. The team found that -- not only had the USAID-financed equipment been used at the Bucharest West plant, but the two plants had even run a comparison test of effectiveness of the measuring equipment. This test compared results on two similar boilers and steam turbines (125 MW each) purchased from Czechoslovakia and installed in the mid 70's in each of the plants. Both plant managers were convinced of the importance of the equipment when they found that each plant produced at about the same efficiency despite the fact that Bucharest West was using high quality natural gas, and Bucharest Sud was using lower quality fuel oil with a very high sulfur content (4.5%).

The Bucharest West (250 MW) plant manager, who had borrowed the USAID-financed equipment from Bucharest Sud, requested comparable equipment, and asserted the plant would achieve at least a 1% efficiency gain. This request could be implemented as part of the program to strengthen private capacity.

USAID assistance for the technical improvements in energy efficiency -- a logical extension of the EEP -- would complement broader USAID technical assistance to RENEL for pricing and management reforms. Such assistance would help overcome the relative lack of attention to financial management and accounting in the system, and absence of incentives to encourage individual performance. For instance, the team was unable to determine any incentives for energy savings in the massive Bucharest SUD plant, other than the personal pride attached to his work shown by the plant manager, who cited difficulties in obtaining financial resources for upgrading plant operations.

b. Private Sector - The GOR policy publicly promotes privatization as a major component of its efforts to realize the democratic and economic transition over the next several years. Creating and expanding competence to deliver services to enhance energy efficiency outside of the direct government involvement will be an important piece in the GOR program. USAID activities support this objective.

Efficient use of energy will be essential for the emerging businesses which are now expanding the base of the Romanian economy. These emerging businesses, primarily small and medium sized enterprises, are unlikely to have the technical competence to introduce changes in process and to purchase equipment sensitive to the new realities of Romania's rapidly changing energy price structure. Yet these same firms will be hard pressed to pay for necessary energy services to improve efficiency.

The current situation provides a challenge in the implementation of a USAID program to create private sector capacity. On the one hand, the current capacity to deliver high quality energy efficiency services is still weak and limited. On the other hand, the market for energy efficiency consultancy services will probably evolve much more slowly than macroeconomic returns to the Romanian economy would warrant. The USAID program to help create private sector energy consultants (referred to as ESCOs in much of the documentation) must take into account this reality, and requires careful attention to the dimensions of market creation.

The USAID program and GOR policy also must take a hard look at provision of foreign exchange, even in small amounts, to encourage energy efficiency. The EEP has demonstrated convincingly the high value returns from provision of low cost equipment. The GOR needs a program to help cement additional efficiency gains identified by the EEP.

4.6.2.3 Institution Building, Subcontractors and Training

Energy efficiency is still a new concept in Romania. It runs counter to experience in an energy inefficient economy where energy costs were so low that efficiency rarely was a central concern to business operations, and centralized decision making limited personal incentives. Because very low prices prevailed in the past, those involved with energy efficiency were not sensitive to the true economic costs. To restructure entities and retrain people who have grown up with another mentality will be a challenging process. Romania appears, however, to have little choice if it is to achieve the economic transition which its seeks.

The GOR policy orientation to promote democratization and economic restructuring argues for creation of private sector capacity in energy efficiency, without which the transition will falter. Government delivery of these successes has seen little success in other countries. USAID is

already supporting these activities. The team finds the emphasis warranted and appropriate as a major focus for continued program funding.

The GOR must decide how to address the existing major users of energy as it moves through the transition. Two institutional actors appear very important to this process. First, to the extent ARCE can provide a strong push within the public sector, the culture of energy efficiency will gain exposure and credence. Second, programs with RENEL, as it moves to pricing consistent with its costs, will have a long run payoff. In this latter arena, USAID's coordination with other donors, especially the World Bank, appear sound, and should be aggressively pursued if it continues with programs in this arena.

4.6.2.4 Information Transfer

Providing widely available and up to date information on energy efficiency opportunities will be crucial to transformation of the Romanian energy sector. However, the evaluation team did not see much evidence of a concerted GOR policy to promote widespread information transfer to end users, although there are apparently government-sponsored meetings among technicians. Despite the striking results of the EEP, and some significant successes in ARCE's own programs with Government institutions, information was hard to find. The evaluation team was unable to find documentation on the September 1991 seminar which concluded the EEP program, though Mr. Breazu, ARCE's chief, referred to the seminar materials when the team asked about the seminar. The team did not encounter plans for another seminar or even a regularly scheduled program of events.

Two possible constraints to information transfer which the team encountered were: (i) the traditional compartmentalization of actors in a pyramidal hierarchical structure, where information often equates with power; and (ii) the current preoccupation with privatization, which carries with it the hesitation to share information which could undercut a competitive advantage with competitors.

USAID's programs could usefully help overcome these barriers by working with organizations like the Romanian General Association of Engineers, RENEL, ICEMENERG, ISPER, the Bucharest Polytechnic Institute, and SOCER. USAID financial assistance for the SOCER October, 1993 conference on Energy Measurement provides an opportunity to showcase results from the EEP and US products, and could also be a forum for promoting the activities financed under the follow-on energy efficiency project. With sufficient advance planning now available, USAID financed consultants -- Romanian and American -- could present papers on the technical aspects of the work that would have a larger audience than those who participated only in the EEP.

4.6.3 BULGARIA

4.6.3.1 Energy Pricing

Bulgaria has undertaken dramatic energy price increases over the past 2-3 years, and they are rapidly moving to world market levels. During interviews to discuss the EEP, plant managers as well as government officials spoke of increases totaling 5 to 6 times. Pressure on Bulgaria to increase prices will continue to come from the IF, which was in Sofia to negotiate a standby agreement during the evaluation team visit in July. Energy pricing -- especially the increases -- receives substantial publicity and is a sensitive subject because electricity prices have impacted at the consumer level.

The GOB still controls energy prices, set by the Committee on Energy, through the Commission on Energy Rate Regulation (CESR). The GOB has not established a date for decontrol. Electricity

prices must be set with consideration not only to cutting subsidies but domestic realities including coal-fired electricity plants, the size and reliability of nuclear energy, and hydro and gas contributions. The government may feel it has a short-term safety valve on supply, pursuant to gas being available through 1997 in exchange for construction services in Russia, and potential commissioning of additional nuclear power at Kozloduy.

Bulgarian plant managers are slowly recognizing the impact of price rises, though the response in conversations is still subdued. The explanation may lie in the close ties of the Bulgarian economy to Russia, the strong centralization of the old system, and the highly subsidized energy prices. Ministry of Industry officials suggested this as one explanation for passive interest in using the monitoring and measuring equipment, despite strong Ministry of Industry advocacy of energy efficiency measures.

A better test of the Bulgarian response may come during the implementation of the Phase II Energy Efficiency project when Bulgarian firms will be expected to pay for the energy audits performed by the private firms and individuals trained for this work. First indications from solicitations of interest in the program suggest there is significant demand, but it is still too early in the program to know.

4.6.3.2 Government and Private Sector Roles

a. Government - The GOB has had a long tradition of centralized technical approaches to energy efficiency. Officials at the Committee of Energy stated they personally had been conducting boiler efficiency tune-ups over fifteen years ago, and this program has continued. The orientation of the program was clearly toward a technical as opposed to a price response because energy prices were very low during this period and inefficiencies therefore had a smaller impact on the expenditure side.

   Another proxy for underlying interest in energy efficiency may be the different programs now being implemented. The Ministry of Industry had at least three programs in energy efficiency: (i), financed by the EC; (ii) Japanese Energy Conservation Center assistance; and (iii) the USAID Phase II activity.

   The Committee of Energy unveiled to the evaluation team a new organization chart (in English) reflecting a reorganizing of the Committee within the past week. Officials were still trying to determine who was in all the position boxes. The Committee plans to sustain the State Inspectorate on Energy Control, and to establish regional centers on energy efficiency. Full funding for the new program is not yet in place.

b. Private Sector - The evaluation team was unable to assess carefully the private sector capacity in Bulgaria. The president of Ecotechproduct, the subcontractor for IRG, was unfortunately out of the country during the team's visit. The team did meet with one of his staff people, but was unable to get a good picture of the potential role of the firm or other's in the private sector.

The team did encounter three positive signals:

- The Committee of Energy personnel emphasized the GOB's interest in privatizing a part of the Committee's function, presumably if funds were available to finance the incorporation and working capital;
- Ecotechproduct was able to generate additional orders for steam traps based on the work it had performed under the EEP; and
- USAID reports a favorable response to ads in the paper seeking potential clients for the firms being trained under the Industrial Energy Efficiency project now being

implemented. In addition, there was healthy competition for selection in the program.

4.6.3.3 Institution Building, Sub-contractors, and Training

The strong centralized tradition of the Bulgarian economy and the transition now underway have left the Bulgarian institutions -- in both the public and private sectors -- in a state of flux. On the government side, there has been no continuity in responsibility for energy efficiency, with enough shifts over the course of the project that original actors in design and implementation of the EEP are no longer in place. The recent announcement of a reorganization within the Committee of Energy will again create more uncertainty as the exact shape of its power and relationship to the price setting and other government participation in the energy sector settles out.

The strength of the private sector also appears limited, despite sound underlying technical capability. The major question mark continues to be whether existing firms, most still under state control, will have the inclination and the financing to pay for energy efficiency services. The evaluation team often found a lukewarm response to energy efficiency in comparison with the preoccupation with identifying financing to permit survival of the activity. Energy efficiency was not considered an important factor in the survival issue.

The team encountered some criticism of and resistance to sub-contractors from the private sector and, indeed, to privatized firms in general. This was not unexpected since virtually all Bulgarian government officials have only experience with centralized government operations. The Bulgarian economy has many cross-currents flowing through it at this time, and it will be some time before privatized firms are widely accepted.

The Bulgaria Industrial Energy Efficiency project includes a training component to work with existing local firms, primarily through financing of seminars and training courses. Effectiveness of the training should be closely followed, to determine whether additional training and the introduction of energy management programs also included in the on-going project will attract clients.

4.6.3.4 Information Transfer

Information about energy efficiency practices and equipment is still in short supply in Bulgaria. The recent increase in energy prices is only just now forcing plants to look to new solutions to reduce energy costs.

The EC program and the EC Conservation Center, the Japanese Energy Conservation program, and USAID's on-going efforts should ideally be pulled together to form a composite for action in the energy efficiency arena. The evaluation team noted little inclination or progress in accomplishing this goal during its short visit.

Information sharing will also have to overcome the disinclination to share good results if the participants thought that productivity gains might give the plant a leg up in the privatization rush. The incentives need to be addressed if wide-spread sharing of information is to become the rule rather than the exception.

4.6.4 THE CZECH REPUBLIC

4.6.4.1 Energy Pricing

Energy Prices have been rising in the Czech Republic since 1990 as the economy adjusts to the changed conditions of Russian oil and gas supply. This process started under Czechoslovakia

reforms, and received added impetus with the velvet revolution split of the two countries in January 1993. The goal is to liberalize prices in three years.

The Czech leaders are very conscious of the importance of energy pricing and reducing energy intensity of their industrial products because they are facing a strong shift in their markets away from eastern bloc countries and the Slovak Republic toward Western Europe. Industrial prices are close to world market levels to encourage the competitiveness of Czech products.

With announced unemployment at about 2.5 %, the Czech leaders seem to be succeeding in the economic transformation process. The second wave of privatization which will take place later in 1993 will test the effectiveness of this policy because it will involve the large industrial firms, some of which will have a struggle to remain competitive in the new market conditions. This may explain why residential price increases have lagged behind industrial prices, as the government struggles to address the social dimensions of the economic transition.

It is indicative of the sensitivity of energy prices that the Prime Minister's Office has closely guarded the responsibility to set rates, relying upon the staff work of the Ministry of Finance. The government is also conscious of the need for diversification of energy supply from previous Russian dependence and provides diversification credits. New links to tap the European pipelines are also a priority.

4.6.4.2 Government and Private Sector Roles

a. Government - The breakup of Czechoslovakia has reduced the bureaucratic layers by elimination of the Federal Bureaucracy. This change has created serious confusion in the follow-up to the EEP, although there do not appear to have been any direct impacts that affected the implementation of the EEP.

   The newly formed Energy Agency of the Czech Republic is one of the Government entities which will play an important role in the implementation of energy policy, though the extent is still not clear. The Energy Agency's predecessor work has concentrated on buildings and residential use. Officials there recognize that with the lower energy prices that now apply to the sector, major increases in energy efficiency will be hard to achieve. They said the project payback -- often running to more than five years -- makes these programs of lower priority than industrial activities.
   The Energy Agency officials have plans to expand to industrial sector energy efficiency, but as yet do not have a budget that would permit them to undertake a major program. They do finance privatization centers which include within their mandate creation of public awareness of the need for great energy efficiency.

   The government is also considering new energy legislation consistent with its discussions with the World Bank which would encourage energy efficiency as one of its many functions.

b. Private Sector - The thrust of energy efficiency is most sharply seen in the private sector, as firms competing on the world market push to reduce their energy costs. The evaluation team's visit to the recently privatized Autobrzdy Auto Parts plant underscored the burgeoning interest in industrial energy efficiency. The energy manager praised the USAID intervention for helping him to attract the attention of the plant's senior management to the economies possible with a much improved use of energy. As a result of the successes with the USAID equipment, he was able to convince management to move ahead with several energy savings recommendations, such as purchase of an on-line monitoring energy

system which cost K 230,000 ($9200), but produces savings of K 36,000 per month ($ 1440) for a rough payback of 6 months.

The Czech government's movement toward privatization has been pushed along by the recent completion of the majority of restitutions (returning property taken by the State after 1948). This process has led to the surge in face-lifting and renovation which is so evident in Prague in the past year. As residential prices rise even further, one would expect a parallel increase in application of energy efficiency measures.

Several private companies already offer audit services, though prior to the EEP they did not have either the monitoring equipment or the techniques to provide audits comparable to U.S. standards. The two EEP subcontractors to RMA -- Energoprojekt and Electroprojekt -- each have a sizable staff with extensive design and construction management work.

The Czech Republic is one country where energy service companies may make a significant contribution to the energy scene. The ESCO's ability to mobilize capital matches the across-the-board need of most plants which believe they have the labor force and technology to compete. The approach depends not only on the ESCOs ability to mobilize investment, but also on confidence that the future income stream from energy savings will be available to the investors.

An American ESCO, ENSERV, has active programs in the Czech Republic, a direct result of a week-long Energy Efficiency Seminar put on by SEVEn in 1992, which attracted the participation of company officials. During discussions with the evaluation team, the company noted it has taken steps to set up a Czech company to manage its programs, a potentially very robust market, and already has six performance agreements. SEVEn plans to hold a seminar in later 1993 directed to the ESCO market which will explore the potential market that ENSERV has tapped.

ENSERV's success depends on its ability to conduct an in-depth energy audit, develop a business plan, and mobilize the capital for the project. Two ENSERV agreements -- the AUTOBRZDY auto parts and BIOTICA pharmaceuticals -- are a direct result of the USAID-financed audit programs. The ENSERV chief operating officer stated that the USAID project primed the pump and made these two companies understanding and willing clients for ENSERV's services.

4.6.4.3 Institution Building, Subcontractors, and Training

The institution building challenge in the Czech Republic is different than in the other Eastern European economies because the pace of privatization and influence of market forces is greater. The key constraint here will be the extent to which a strong market develops for energy efficiency. The push to world market energy prices and marketing in direct competition with western firms suggests that energy efficiency measures should have a solid return, especially when the Czech economy still has a much higher energy intensity than industrialized countries.

Czechs have a reputation for technical competence, which was evident during the evaluation team's visits to the individual plants. Continued movement on industrial energy prices and consolidation of markets should lead to greater concentration on energy efficiency measures, and the subsequent enhancement of markets for private firms. The size and depth of the existing firms in the engineering and design field suggests they can quickly supply the technical services, with outside private help they know how to access if they need it. The Energy Agency in the short run will probably be the major actor in building and residential energy efficiency measures.

The high level of technical competence should shape any USAID-financed efforts in training. The Czech economy is already closely connected to Germany, by proximity, language, and business ties, and this linkage can only be expected to grow. The Czechs express a concern at their economy being too closely tied to the German economy, a reason for continuing interest in closer economic ties to the U.S. These factors suggest any training effort should be targeted to particular areas where Czech's may need some outside help and the U.S. has a comparative advantage, especially in the private sector and selected public energy policy subjects.

4.6.4.4 Information Transfer

Czechs need capital and specific information to implement recommendations for improved energy efficiency rather than general information, according to feedback from evaluation team discussions. Plant managers were able to document clearly equipment in their particular field that they thought would produce good returns, and in many cases proposals had already been submitted to management for financing. Technical people also seemed to have their own channels of information where they had questions. Discussions also produced the somewhat surprising feedback that there were too many seminars, and companies wanted capital to implement what they already knew needed to be done.

SEVEn, the energy efficiency center founded in Prague at the end of 1990, is an independent non-profit non-governmental organization whose goal is to promote the cost-effective efficient use of energy as a means to protect the environment and support economic development. It encourages for-profit activities by energy producers and energy service companies related to energy efficiency, working with government ministries, local governments, utilities, businesses, and a network of energy experts from around the world.

SEVEn has received USAID-financed support during its start-up phase. It plays a unique role in acting as a bridge between the government and the private sector, and has successfully carried out a number of activities to this end. These include: the energy efficiency week seminar; contracting with RMA to facilitate the EEP project though it did not have direct implementation responsibility; studies and analyses of utilities, public policy, and energy efficiency; collecting and disseminating information on energy standards and labeling appliances; formation of an energy manager's association; and supporting the development of performance contracting and the ESCO role in the society. SEVEn also has a program underway to create an industrial energy efficiency data base which will provide relevant information for technical users.

SEVEn's role and its expertise have provided a big lift for the USAID energy efficiency programs in the Czech Republic. The team learned that USAID funding for SEVEn would be terminated, except for contracting, on the grounds that USAID had been successful in helping to launch the organization, and it needed now to move to self-sufficiency.

USAID should give careful consideration to continued core funding for SEVEn, in light of its unique character and the close meshing of its programs and objectives with USAID's short and long term energy program objectives. SEVEn is a technically competent group, with English language skills, an exposure to US people and practices, and a commitment to information transfer and facilitation of government policy and private business that is always difficult to create. To expect that the organization can quickly become self-sufficient as a non-profit in a transitioning and capital short economy is unrealistic. Another few years of funding would help SEVEn to solidify its impact and its programs without forcing the organization to turn too much of its attention to the inexorable requirements of fund raising for survival.

5.0 LESSONS LEARNED

The lessons learned differ from country to country. Identical projects may yield significantly different results in different countries due to variations in local infrastructure, the relative strengths of political and private institutions, and general economic conditions. to name just a few. With this caveat, the following are broad lessons learned from the evaluations in the four countries:

1. Low cost/no cost energy efficiency measures can be put in place quickly and work well when introduced and promoted by energy professionals. The time for wide-scale adoption will be longer than expected if one were to base expectations solely on the high returns possible from the positive price environment.

2. In order to disseminate project results and obtain maximum impact it is necessary to establish a well directed effort in this area; the effort must be furnished with sufficient manpower and funding to assure full and timely completion of project goals. Increased attention to record keeping would also USAID this effort. The team sometimes had difficulty obtaining reliable information from the plants.

3. USAID's orientation to help create energy efficiency capacity in the private sector is a welcome complement to government-oriented programs, and incorporates the privatization movement in the region. Establishing the private sector capacity will take time because the people, organizations, and market acceptance are only slowly coming into place. Indirect USAID financial assistance should be provided to help the transition, including financing of low cost equipment, cost sharing of audits where future follow through is likely, contributions to in-country seminars and more expansive information programs, and targeted training programs.

4. The success in extending energy efficiency measures is a function of the receptivity and strength of plant management, the savings obtained from the initial measures, the economic situation of the firm, and the degree of competition the firm faces in the marketplace.

5. Provision of equipment, in addition to expert assistance, multiplies the impact of the program and keeps it from being "just another paper study". However, projects which include equipment supply should have provisions for full and satisfactory installation and commissioning of the equipment.

6. In situations where USAID supplies equipment and applies U.S. source and origin requirements, USAID and the U.S. private sector must establish much improved in-country equipment servicing capability to assure host country satisfaction and protect the reputation of American products.

7. Efficiency improvements in district heating, which can benefit a broad segment of the population, probably deserve additional attention. Although U.S. firms have has less experience in this field than European firms and the impact of the EEP project in Hungary was inconclusive, the USAID-sponsored District Heating Project in the NIS showed that significant energy savings could be obtained in these widely used systems.

8. The use of portable monitoring equipment also multiplies the impact of the program; for example, the equipment furnished to the bakery in Budapest was later used in other bakeries to obtain additional savings.

6.0 RECOMMENDATIONS

The following are recommendations for the USAID program to build upon the success of activities financed under the EEP:

1. Continue Programs to Encourage Energy Efficiency

   The success of the EEP in obtaining significant energy savings with very modest equipment expenditures demonstrates a large potential for wider application of this concept. Current conditions - energy prices that are at or near world levels and continuing progress toward privatization - create a climate receptive to expansion of industrial energy efficiency efforts. Encouragement of energy efficiency should be directed along two avenues: (i) increased information dissemination to expand awareness of energy efficiency technology, and (ii) assistance with financing of low cost equipment.

   USAID could provide modest financing for selected organizations within each country to organize meetings and seminars and prepare publications for widespread distribution. This should be, insofar as possible, a local effort to encourage the growth of internal capability.

   Many plant managers and owners would make investments in monitoring equipment and low cost energy efficiency equipment if only they could obtain capital. Local banks have little experience in this area and charge high interest rates; groups like The World Bank and EBRD appear to concentrate on larger projects. There is a clear need for financing support for small and medium size loans.

2. Continue to Strengthen Private Sector Capability to Perform Energy Efficiency Projects.

   Private sector capacity to perform energy efficiency projects is still in its infancy in Eastern Europe. Although the engineering community has been separated from Western technology for a long period of time, people with excellent technical ability are available throughout these countries. However, the ability to couple engineering and economics is not widely available and will take time to develop. Market forces will over the long run determine the success of the private energy efficiency business. How fast and how broadly the market for these services will develop is hard to predict, though one can expect that as the movement to world price levels for energy continues, the interest in more efficient practices will escalate. The USAID efforts in this area fit well with broader program objectives to stimulate economic growth and encourage privatization efforts.

3. Assure Expanded Use of Equipment Supplied to Local Government Agencies.

   A substantial amount of monitoring equipment was left with local government agencies in the hope that this equipment would be used at plants which did not originally participate in the EEP. On the whole, this plan was not successful and the current situation needs to be rectified. USAID should work with host country officials to identify one or more groups that have the competence and interest to effectively utilize and properly maintain this equipment. If necessary USAID should provide additional training in this area. This will help to spread energy efficiency awareness and develop local capability to perform energy audits.

4. Correct Equipment Installation and Commissioning Deficiencies.

In several plants the team was told that equipment which was supplied under the EEP had not been installed properly or had never functioned correctly. This casts a very bad light on US products and can have a negative impact on US manufacturer market penetration. It should be corrected as quickly as possible. A listing of the defective installations and equipment should be made up and specialists should be dispatched to the plants to effect the repairs. It may be noted that USAID has addressed this by directing that part of the funds for the Regional Energy Efficiency Project be used to follow up on equipment performance.

APPENDIX A

SCOPE OF WORK

June 9, 1993

EMERGENCY ENERGY PROJECT (180-0015) EVALUATION

I. Purpose of Evaluation

The evaluation is an impact evaluation of the main component of the Emergency Energy Project, the industrial energy efficiency component. The specific objectives are to:

(1) determine the effectiveness of the technical assistance, training and equipment inputs in achieving energy savings and management changes in the industrial plants, and

(2) determine the lessons learned that are relevant to the follow-on industry energy efficiency work that has been initiated.

II. Scope of Work

General

1. Develop detailed understanding of industrial energy efficiency component from design stage through implementation by review of Project documentation monthly reports, outputs, and interviews with project management staff.

Specific Tasks

1. Interview three (3) contractors to determine their management approach, achievements, problems and lessons learned. The interviews should be with both project managers and with one of more of the energy auditors that carried out the plant work (these may be by telephone for those not in Washington). What were the most promising energy efficiency opportunities? What would they do differently to make greater energy efficiency gains? Were the plant selection criteria and/or process in country for selection of plants for audit effective?

2. Review equipment procurement process of each of three (3) contractors; describe process, timeliness, effectiveness and cost of procurement as compared to amount of equipment procured. What were the primary problems in the procurement process? What was the arrangement for services of the equipment by different firms, if any? How was installation handled? What lessons were learned that would lead to improvements or doing it differently in the future?

3. Interview host-country officials/counterparts, embassy, USAID Rep, subcontractors and plant personnel on implementation, approach and effectiveness. What are the achievements of the project? Discuss at least energy savings, plant changes, subcontractor experiences and any policy, institutional or other lessons learned. Did personnel involved understand and accept that significant energy savings could be achieved at relatively low costs? Do the personnel see a role for private sector consulting engineers?

4. Interview subcontractors that participated with U.S. contractor in implementation of Project. What were the benefits to the subcontractor in participation in the project? What were the benefits to the subcontractor in participation in the project? What has the subcontractor done subsequently that relates to the project activity? If nothing why not? What was the subcontractor's role in equipment shipment and installation? What are their views on effectiveness and cost-competitiveness of equipment provided? What kin of follow-up to the eight plants in the country would be useful? And in other plants? What would the subcontractor like to do in the future vis a vis U.S. energy efficiency activities? Have they had any further contacts or relationships with U.S. firms?

5. Review audit reports: critique the audit methodology including observations on quality/approach; make site visits and determination of energy and financial savings resulting from audits and follow-on actions.

6. Visit plants and identify where implementation of energy efficiency management measures and equipment were successful and what were the key characteristics of successful plants (e.g., progressive manager, improved incentives such as rising energy prices and competition, foreign joint ventures, etc.); identify plants that did not perform as well and identify reasons. Differentiate between efficiency work completed under the Project, and where possible, follow-on work by the plants or local subcontractors that was stimulated by the audit/equipment program. Summarize energy savings and recommend improvements if work were to be expanded in the future. What was the operating method of the energy audit team? Did they work with the right people? Was the Plant Manager involved? General Manager? Boiler operators? How was the audit information and recommendations communicated? Mini-seminar? Debriefing? Draft report only? What recommendations do the plant personnel have (given the limited resources available for each audit) based on their experience with the U.S. engineers? Did the plants find the audit experience valuable enough to convince them to pay for such services provided by local (trained) energy engineers to do more work?

--Assess status of equipment; determine how reliable it has been and what service has been provided or absent; specify the company and equipment involved. What do the plant personnel think about the quality, price and service of the equipment?

--Determine energy efficiency plans and assistance needs/interests of the plant managers/owners. Determine what dissemination of results/methods had occurred from participating plants to others.

7. Review and assess energy audit diagnostic equipment leasing arrangements and use of equipment that was turned over to entities responsible for maintaining, using and leasing the audit equipment to private consulting engineers and others. What has been the use of the equipment? What are the rental rates? How have they dealt with maintenance? Have they contacted U.S. manufacturers?

8. Review and assess the wrap-up workshops including U.S. manufacturers participation and exhibitions (Hungary in particular) as mechanism for (a) exchange of experience (b) technology dissemination, and (c) interesting U.S. manufacturers in getting more active in Eastern Europe. Did the local industrialists who attended find it useful? Why or why not?

9. Identify and policy and institutional changes that took place as a result of the project such as reorganization of industry plant activities, acceptance of private consultants as providers of energy services, establishment of energy managers organizations, ministry changes either in their own organizations or in their views about how to approach energy efficiency. Did the thinking, views and activities of energy efficiency officials change with respect to accepting private consulting firms or viewing low-cost, no-cost savings as a legitimate or priority target? Did plant managers change their views and organization or management with respect to dealing with energy? What changes have occurred in the subcontracting entities as a result of the project?

10. Interview a sample of U.S. equipment manufacturers from which equipment was purchased and that participated in wrap-up workshops; assess impact of program on their operations/plans and solicit their views on project and recommendations for future activity. What are their views on project (including wrap-up workshop if they attended)? What impact did it have on their business plans? What do they recommend to make future similar activities more effective in saving energy. and increasing U.S. equipment manufacturers interest?

11. Summarize results, savings, most effective approaches including most effective equipment. Identify "multiplier effect" of the work: what follow-on activities continued after the work such as plant management changes/equipment procurement, subcontracted work, U.S. equipment manufacturers, government policy or program initiatives, etc.

12. Summarize the findings and conclusions of the evaluation. Provide energy efficiency programmatic recommendations for the future based on evaluation findings.

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APPENDIX B

EVALUATION TEAM ITINERARY IN EASTERN EUROPE

DAY	DATE	ACTIVITY
Sat	6/19	Arrive Budapest
Sun	6/20	Meet with EGI (Zoltan Lontay)
Mon	6/21	Meet with USAID, Andras Morenth
Tue	6/22	Paper plant (AM), Yeast & Alcohol Plant (PM)
Wed	6/23	District Heating plant (AM), Bakery (PM)
Thu	6/24	Metal Works (AM), Chemical Works (PM)
Fri	6/25	Meeting with EGI (AM), USAID Debriefing (PM)
Sat	6/26	Report writing
Sun	6/27	Travel to Bucharest, meet with Instapart
Mon	6/28	Meet with USAID, meet with Instapart (AM)
		Milk plant, meet with ARCE (PM)
Tue	6/29	Griro plant (AM), Bucharest Sud power plant (PM)
Wed	6/30	Drive to Cimpulung, visit Cement plant, drive Craiova
Thu	7/1	Visit Fertilizer plant, return to Bucharest
Fri	7/2	Soybean Processing plant(AM), USAID (PM)
Sat	7/3	Report writing, fly to Vienna
Sun	7/4	Meet w/ Virgil Musatescu in Vienna, fly to Sofia
Mon	7/5	Meet with USAID, Ministry of Industry (AM)
		Meet with Ecotechproduct (PM)
Tue	7/6	Milk plant (AM); MOI, Ceramics plant (PM)
Wed	7/7	Steel plant(AM), Committee on Energy (PM)
Thu	7/8	Chemical plant, Vratsa(AM); USAID (PM)
		Min. of Industry (PM)
Fri	7/9	Fly to Varna, Soda Ash plant (AM);
		Cotton processing plant (PM), return to Sofia
Sat	7/10	Report writing
Sun	7/11	Travel to Prague
Mon	7/12	Meet with USAID, Czech Energy Agency, and SEVEn
Tue	7/13	Auto parts plant, Wood parts mfg. plant (AM)
		Fabric Processing plant (PM)
Wed	7/14	Inspect equipment at Ostrava (P. White)
		Meet with Sci. Attc. USEMB (AM), SEVEn (PM)
Thu	7/15	Milk plant (AM), Assn. Energy Managers (PM)
		Meet w/ Chief energy Policy Div. (PM)
Fri	7/16	USAID debriefing (AM), Brewery (PM)
Sat	7/17	Interview Energoprojekt, report writing
Sun	7/18	Return to U.S.

APPENDIX C

QUESTIONNAIRES

EMERGENCY ENERGY PROJECT EVALUATION CONTRACTOR INTERVIEW FORM

Contractor name/address /phone no.

Name(s) of person(s) interviewed:

Date of interview:
Interview location:
Interview done ( ) in person ( ) by phone

Describe role of interviewee in EEP:

List plants audited or evaluated during course of EEP:

Summary of management approach:

Audit goals?

How were potential savings identified in plants?

Was a uniform method used for all plants?

Were schedules and milestones established?

Was a budget established for each task?

How was progress monitored? How frequently?

Were work breakdown structures set up?

Achievements during the project:

Significant savings at plants ?

Changes in management / operation at plants ?

What evidence of increased energy awareness was seen?

Problems encountered during the project:

Technical problems ?

Institutional problems?

Management problems?

Cultural problems?

Communication problems?

Lessons learned:

List the most promising energy efficiency opportunities:

How could greater energy efficiency gains have been made or be made?

Were the plant selection criteria adequate?

Was the plant selection process effective?

Equipment procurement process

Outline/describe the process:

Timeliness:

Typical time between recommendation and equipment purchase:

Typical time between equipment purchase and shipment:

Typical time between equipment arrival in country and installation:

What was cost of procurement?

Cost of procurement vs. Equipment cost?

What problems were encountered in the procurement process?

Describe the performance guarantees, warranties, and servicing arrangements:

Name of co. Or persons who performed installation:

Time of installation:

Manufacturers representatives present or on call during installation?

What were lessons learned from procurement and installation of equipment?

US EQUIPMENT MANUFACTURER INTERVIEW FORM

Name / Address: *date*

Describe role in EEP equipment purchases:

Estimated number units provided to EEP contractors:

Comments on Contractor performance:

Impact of EEP on operations and plans (e.g. became aware of new markets, made marketing sales trips, set up reps, etc.)

Overall view of participation in EEP; favorable and unfavorable impressions; benefits? problems?

Participated in workshops? Role/extent of participation?

Lessons learned and recommendations for future activities.

FORM SENT TO PLANTS IN EASTERN EUROPE

ENERGY CONSERVATION MEASURE REVIEW

Name of Measure:

Date Installed:

Installation Contractor:

Equipment Installed:

Manufacturer of Equipment:

Please provide us with logs of data obtained from any instrumentation that has been installed. How often is the data taken?

How is the data reviewed?

What actions are taken based on the data?

How often is the equipment calibrated?

Please provide us with logs of boiler makeup water flow rates, and condensate return temperatures.

EMERGENCY ENERGY PROJECT EVALUATION
ENERGY DATA SHEET

As part of the evaluation team's review, we would like to include data on plant energy usage and production for the years 1991 and 1992. Please provide energy and production data on the form below. Please indicate the method for arriving at the energy and production data. Also, we would like back-up documentation for the energy and production data; for example ail delivery records, gas meter readings, and electric meter readings. If data is not available on a monthly basis but is available on an annual basis, please input that data on the annual total rows on the table below.

	Oil Tons	Gas (000 M^3)	Coal (Tons)	Electric (MWH)	Purchased Steam (GJ)	Purchased Hot Water (GJ)	Production (Units)
January '91							
February							
March							
April							
May							
June							
July							
August							
September							
October							
November							
December							
Year's Total							
Annual Cost							
January '92							
February							
March							
April							
May							
June							
July							
August							
September							
October							
November							
December							
Year's Total							
Annual Cost							

APPENDIX D

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APPENDIX F

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APPENDIX G

DETAILS OF ON-SITE PLANT EVALUATIONS

This appendix provides detailed reports on the team's visits to twenty-three plants in the four countries and supplements the summaries given in section 4.4. Since the evaluation team's time in each country was limited to one week, it was not possible to visit all the plants (typically eight) within a country that had participated in the. However, the number visited is approximately three quarters of the total and represents a meaningful and significant sample of the plants that were audited.

To the extent possible, four broad areas were covered in each plant report; (1) the status of the USAID-supplied equipment, (2) a description of other energy saving measures that were implemented at the plant, (3) a discussion of energy savings and specific energy consumption, and (4) notes concerning plant management, business and other items. In some cases the savings are presented along with the discussion of the energy-saving measure. It may be noted that energy prices used in the calculations vary from plant to plant in the same country. Plant managers were not always able to provide the team with strictly comparable values. However, in each case, the team used the values provided by the plant personnel to calculate the savings the plant would observe. The savings for the plants in a given country, including the projected savings for plants not visited, are listed in a table at the end of each section.

The team found that, in some plants, plant personnel were reluctant to directly attribute savings to the and, in a few cases, maintained that the energy saving measures recommended by the USAID contractors had already been developed or planned prior to the audit. In other cases, the plants were not able to furnish the team with quantitative information on savings stemming from equipment installation and recommendations. Since the team felt it important to obtain a reasonable estimate of the energy savings resulting from the project, energy savings for these cases were calculated by the team and added to the savings furnished by the plant. For these cases, a range in the actual savings is shown; the lower bound is that furnished by the plant, the upper bound includes the team-calculated savings.

HUNGARY

In Hungary the team visited six plants: Buszesz Yeast and Alcohol, Budafok Paperboard, FSV Sutiopar Bakery, Budapest District Heating Works, Budapest Chemical Works, and Csepel Metal Works. The team was not able to visit the Pannonglas plant because the company was reported to be in bankruptcy nor the Hungalu Motim Alumina plant which is located far outside Budapest. Travel to the latter plant would have consumed considerable time. This is unfortunate because the audit team estimated large energy savings for these two plants (3.4 M$ for Pannonglas and $430,000 for Motim).

1.1 Buszesz Rt. (Yeast and Alcohol Plant)

A. Status of USAID-Supplied Equipment:

1. Steam Meters: The report called for 5 steam meters to be installed, at:
   -- Yeast 1
   -- Yeast 2
   -- Dehydration plant + Alcohol
   -- Building Heating and Domestic Hot Water

-- Power Plant Self-Consumption
The team witnessed the meters in the power plant; they are operating.

2. Combustion Analyzer: The team observed the combustion analyzer. The data for the analyzer on the date of the test indicated 81.1 percent combustion efficiency and 140 percent excess air.

3. Energy Management Computer: The plant installed energy management tracking software on one of its previously purchased computers. The USAID-provided computer is used for various non-energy tasks such as production and inventory control.

B. Other Measures Implemented:

1. Improvement of instrumentation and control systems of boilers (Action C.2 from audit report). These have been installed on each boiler, with the company's own funds. The impetus for this measure was the USAID energy audit report.

2. Replace Molasses Pumps (related to Action B.1 from audit report). A mobile pump for removing molasses from rail cars has been purchased for $38,750. Annual dollar savings, calculated by Mr. Szabo, are $53,913, with steam savings of 9,802 GJ/year.

3. Revise the building heating system (Action B.2). Mr. Szabo estimated 25 percent of building steam consumption was reduced, by installing $5,625 worth of equipment and improving control.

4. Improve plant power factor. This was noted in the Hagler-Bailly report, under Action A.3 (Electricity Management Task Force). The plant has installed 3 200 KVAR switching capacitor banks at a cost of about $200,000. This has greatly improved plant power factor and resulted in savings of $ 25,900.

5. Preheating of distiller's water cycle. This was a plant-initiated project, saving $46,088, based on an initial cost of $9288.

6. Recycling/Utilization of Waste Steam used to Sterilize Molasses. This was a plant-initiated project, saving $17,225 per year, resulting from an initial cost of $5,250.

7. Operation of Small Boiler: Since the plant is no longer cogenerating and exporting steam, the small boiler and its associated smaller feed water pump is now used. This relates to action A.4 in the audit report, which contained recommendations for optimizing boiler operation.

8. Steam Management Task Force: This was already under way when the USAID report was begun. Some of the above projects were identified through this group's efforts.

9. Higher Efficiency Boiler feed water pumps procurement (Action B.5). New boiler feed water pumps have been installed.

C. Savings Estimate

Significant energy savings are attributable to the as indicated above. As a result of the audit Buszesz went on to spend an additional $58,900 of their own money to improve plant performance. The total savings directly attributable to the equipment furnished under the is $233,000. In addition, the savings gained by implementing the recommendations of the audit team are estimated at 2% of the total plant energy consumption ($ 66,400). The

savings are based on a natural gas price of 236 Ft/GJ (about $2.77/GJ) and electricity prices of 2.5 Ft/kWh (night rate) and 3.6 Ft/kWh (day rate). The plant was unable to furnish an estimate of the savings from use of the energy management software. Based on the audit reports this would produce an additional saving of $67,000.

D. Management / Business

1. The majority of this firm is now privately owned by an Austrian firm (the local municipality owns a few percent). The monopoly position in Hungary held by Buszesz was the major factor in the Austrian's decision to acquire the company.

2. The boiler house/power station was established as a separate profit center, selling energy to the production plants and neighboring factories. Energy reporting and management were improved using the USAID-supplied meters and computer.

3. At current prices and production levels, about 20% of the plant variable costs are energy.

4. Future instrumentation and data systems will be bought from Germany to assure compatibility with systems at the parent company.

1.2 PCA Budafok Kartongyar Kft. (Paperboard Plant)

A. Status of USAID-Supplied Equipment:

1. Inverted Bucket Steam Traps: 100 percent of the process steam traps have been installed on the paper machines. In addition, about half of the thermostatic steam traps used for space heating have been installed. It is "not a painful process", but there is a large amount of work involved in adapting the steam traps for metric flanges. The paper company used its own funds to install the adapters.

   Based on doing this installation, Mr. Farkas, Head of Maintenance and Power House, has seen the following results:

   -- Condensate return has increased by between five and ten percent (from about 70 percent to about 80 percent).
   -- Boiler feed water temperature has increased from between 100 and 101 degrees C to about 104 degrees C.

2. Personal Computer, Printer, Software: This has been installed. A computerized spreadsheet model is in place on the computer. On a daily basis, a large amount of plant energy information is entered. Mr. Farkas is able to use this data to track specific energy consumption. When asked if specific control or maintenance actions were taken based on information obtained by logging the data in the computer, Mr. Farkas was unable to give any specific examples. Maintenance is controlled more by his inspecting the plant first thing in the morning, and then reviewing maintenance projects with the maintenance team at a morning meeting.

   The computer is helpful in long-term trend evaluation, however. For example, he keeps a graph on his bulletin board, on which he plots the following data:

   -- Electric MWh/Net 1000 kg (about 1)
   -- Net Production, 1000 kg
   -- Steam Tons/Net 1000 kg (about 3.5 to 4.5)

3. Portable Ultrasonic Tester: The team viewed the device. The meter is used to test steam traps about once a month. Based on the results of the steam trap tests, traps are repaired.

4. Combustion Analyzer: The team viewed the device in the boiler room. They now test combustion efficiency about once a month. This is in contrast with less frequent combustion testing and adjustment done by a French/Hungarian joint venture. Among other advantages of the combustion analyzer, they are able to check the work of the burner technicians. Now they have one boiler set up with combustion controls optimized for 100 percent load, and one boiler set up with combustion controls optimized for 50 percent load. This enables them to track the steam load better. Combustion meter efficiency reports indicated efficiency levels between about 79 percent and 84 percent.

   Mr. Farkas noted that there is no new staff needed, but that the existing staff now have more work to do with the combustion analyzer. On the basis of combustion measurements, the air/fuel ratio of the boilers is adjusted. Mr. Farkas believes that the knowledge of combustion operating parameters also has a safety benefit, in addition to the energy efficiency.

5. Clamp-on Power Factor/Multimeter: The electrical supervisor who had this device was not available. The team interviewed two of the plant electricians, and were told that they do not use the meter, but rather use their own clamp-on amp meters to test motors. One of the electricians stated that it wasn't his job to come up with energy saving measures in the plant. Moreover, he noted that major energy savings will come with process changes; e.g. if the paper process requires less water, less pumping power will be required.

   Based on the results of the interview, the team has nothing conclusive to say about the electrical metering. The electrical foreman may have had more information regarding steps taken.

6. Water Conductivity Meter: This was not seen due to time constraints; however Mr. Farkas informed the team it is working and is used in daily plant operation. Based on the evidence of use of the other equipment, this appears to be true.

B. Other Measures Implemented.

1. Purchased Steam Discontinued: Based on reductions in steam demand, better condensate return, and improvements in boiler efficiency, plant management found that it was feasible to discontinue purchasing steam from the Buszesz cogeneration plant. Since gas costs were at a fixed annual "take-or-pay" amount, the resulting increase in gas consumption from about 2000 tons per month to about 2400 tons per month has resulted in no increase in gas cost. The executive summary of the audit report indicated 34,544,000 Ft/year ($406,400 @ 85 Ft/$) of purchased steam costs. Thus assuming similar production levels, and given the present gas pricing situation, short term savings of the entire $406,400 have been achieved.

   Mr. Farkas reported that the purchased steam from Buszesz had enabled the paper plant to respond to fluctuations in steam demand easily; now, with the better operation of the steam plant, this flexibility was no longer a requirement.

2. Pipe insulation: Mr. Farkas has received a proposal to insulate steam pipes. The cost is about $20 per meter of 2-inch pipe; from this plant staff have calculated a 10-year payback and are therefore not proceeding with this project.

3. Boiler Automatic Control: The next step Mr. Farkas would like to take is to install automatic boiler controls, in order to match steam production to steam load, and to maintain boiler efficiency as the steam load varies.

C. Savings Estimate:

1. Energy cost savings have certainly occurred at the Budafok Paperboard plant. The precise level is somewhat uncertain given the data obtained, variations in production, general improvements in maintenance, etc. However, an estimate may be made as follows:

   Comparing January 1992 and January 1993:

   -- Specific Steam Consumption went from 6.99 Tons/Net Ton to 4.55 Tons/Net Ton, a 35 percent reduction (steam costs the plant 1124 Ft/Ton)

   -- Specific Electric consumption went from 1.16 MWh/Net ton to 0.96 MWh/Net ton, an 18 percent reduction (electricity costs 4.7 Ft/kWh).

   -- Specific Energy Cost went from 10,484 Ft/Net Ton to 8087 Ft/Net Ton, a 23 percent reduction.

   -- Specific Water Consumption went from 95.4 cubic meters/Net ton to 49.0 cubic meters/Net ton, a 49 percent reduction.

   Mr. Farkas sUSAID that weather was similar in the two years. Savings may be more in the winter than in the summer, due to colder conditions and greater heat losses.

   -- Boiler efficiency was similar before and after the program.
   -- Mr. Farkas estimated that the USAID program was responsible for 1.5 percent saving in total energy costs. From the executive summary of the energy audit, total annual energy cost for 1990 was about 256,000,000 Ft, or at 85 Forints per dollar, just over $3,000,000. Thus annual energy cost savings attributed by Mr. Farkas to the USAID program are about $45,000. Adding this to the steam saving described in B.1 above gives a total saving of $451,400.

D. Other Notes

1. The Budafok Paperboard plant has been partially purchased by an American firm, PCA. The American firm currently owns 50% while the state property agency (AVU) and banks own the other half. The team was told that the PCA people read the audit report during the time they contemplated buying the plant.

1.3 FSV Sutiopar (Bakery)

A. Status of USAID-Supplied Equipment:

1. Steam Trap Meter: The meter is used about every three months to test each steam trap. The plant personnel were trained by EGI in the use of the steam trap tester, and the plant is saving about 1,000,000 Forints per year ($ 11,800/year) by the stoppage of leaking steam traps (this is the plant's estimate, and is based on an assumption that one failing steam trap results in a steam loss of 5 kg per hour, for 6,000 operating hours per year). Also, the plant switched from float traps to thermodynamic traps in a number of applications.

The bakery personnel provided us with summary survey sheets for several of the largest bakeries (the organization has seven large bakeries and 35 small bakeries). Thus the steam trap tester is being well-utilized not just in the audited bakery but in others as well, and this results in increased savings.

The improved steam traps also have produced safety benefits--before the traps were improved, the potential for steam being vented into the sewers existed, and an employee was burned once as a result. With the new trap maintenance, this is no longer a problem.

2. Electric Power Meter: This meter has resulted in significant savings from two areas. First, the plant has used the power meter to determine what the actual peak demand is for each bakery. Once the plant knew this value, they adjusted the contract with the electric utility. By reducing the "take-or-pay" contracted electric demand value, the bakery reduced its electric bill by an estimated $ 4000 per year.

   The second savings area is in replacing oversized motors with smaller motors. The staff we interviewed indicated that this had happened on a widespread basis, but they had no specific data regarding savings. The bakery also uses the meter for testing motors in the course of its electrical repairs, and for detecting electrical ground faults.

3. Conductivity meter: We viewed this device. However, we received no information regarding its use.

B. Status of Other Measures Recommended in Report:

1. Heat recovery of exhaust air: A project was envisioned by which air that would be preheated by an exhaust heat exchanger would be introduced to the burner as combustion air. However, the bakery found that the modifications to the burner and ductwork would have to be custom made, and that the cost would result in a ten-year payback. Further investigation may yield a more cost-effective solution; also, as prices of natural gas rise, the annual savings may increase.

C. Specific Energy Consumption.

The plant would not provide us with data regarding absolute costs and production, since the bakery business is becoming increasingly competitive in Budapest. However, they did provide us with data concerning energy costs per unit of total cost. These are tabulated below:

	Gas Fl/Fl	Electric Fl/Fl
1991	0.0637	0.0207
1992	0.0607	0.0214

The data was faxed to us after we left the plant, so we were unable to ask follow-up questions regarding it; we are assuming that the Fl/Fl unit is a relative cost number.

It must be noted again that the steam trap tester and the power meter are used at other bakeries run by the bakery trust (the trust has seven large and thirty-five small bakeries). Although plant personnel were not able to provide records of use at other facilities, it is clear that the savings of $15,800 seen at this bakery will be multiplied several times over when this is taken into account. We selected a factor of five to illustrate this point giving a total annual savings of $79,000 attributable to the.

D. Other Notes of Interest:

1. The plant had tried various means of heat recovery before the USAID program. For example, the oven exhaust was used to preheat boiler feed water. However this did not work for two reasons; first, acids in the oven exhaust condensed and resulted in corrosion. Second, the boiler steam load occurs earlier in the day than the oven load, and therefore the recovered heat is not useful in the form of boiler feed water.

1.4 Fovarosi Tavfuto Muvek (District Heating Works)

A. Status of USAID-Supplied Equipment:

1. Radiator Valves: 190 Danfoss (Danish) radiator valves were installed in the apartment building and are functioning well. The team interviewed one retired apartment dweller regarding the use of the radiator valves. He said that before the installation, the valve had been broken and therefore there was no heat during very cold periods. Now he is able to heat the apartment to about 23 degrees C (73.4 degrees F) during the coldest weather. Previously, the temperature was never higher than 14 degrees C (57.2 degrees F). Thus comfort has improved. Also the individual room control is appreciated; in the morning when the windows are opened to air out the apartment, the valve is turned down to the lowest level.

2. Heat Meters: Each radiator has been equipped with a heat meter, a simple device mounted on the radiator with a liquid inside that evaporates in proportion to the amount of heat provided by the radiator. These have worked well, and detailed data on energy consumption per apartment was collected between February 8, 1992 and April 15, 1992. The heat meter, in common use throughout Europe, is used to determine the percentage of the total building's heating load that each apartment consumes.

   One observed result of this heat meter data is that energy consumption per cubic foot is typically highest for the lower floor apartments. Consumption per cubic foot decreases as the floor level increases, and then increases again on the top floor of the building. This is because of the "stack effect" of the building, in which cold air is drawn into the lower floors and rises through the core stairwells of the building. The roof heating load of the top floor makes its specific consumption higher than the intermediate floors.

3. Domestic Hot Water Heat Meters: One of these was observed and, according to Fotav, they have worked well.

B. Status of Other Measures Recommended in the Report:

During our visit with Fotav, all discussions centered around the two-building test.

C. Specific Energy Consumption.

For the period between January 1, 1993 and April 18, 1993, total energy data was collected for the two buildings. Data provided is tabulated below.

Month	Temperature	Base(lump sum)	Retrofit	% Savings
January	1.54 C	1588	1499	5.6%
February	-0.14 C	1567	1619	-3.3
March	5.42 C	1318	1234	6.3
April	8.59 C	660	576	12.7

This small set of data exhibits a trend that savings increase as outdoor air temperature rises. Since the base method of temperature control was to overheat the apartment and then open the window, this is a logical result. In very cold weather, the unregulated valves do not waste energy, because the regulated valves would be wide open anyway, to meet the design heating load. As outdoor air temperature rises, the regulating valves shut off flow to radiators, and energy is saved. According to the gentleman interviewed, he had not yet had to pay based on his individual consumption. If this is indeed the case, the experiment is not complete. The residents may lower their set points more when they make the correlation between temperature setpoint and cost of heating.

Fotav also furnished data on energy costs to provide both heat and hot water during the period February 8, 1992 through April 15, 1993. These data indicate that the new valves save approximately 30 % of the total energy requirement. This is 1,082,000 Ft and, at 85 Ft/$ gives an annual saving of $ 12,800.

D. Other General Notes of Interest.

1. There are several other issues regarding district heating in prefabricated buildings. These are noted below:
   -- Some of the buildings may be nearing the end of their useful lives, although the team heard differing opinions on this subject.
   -- There is some concern regarding differences in temperatures that will occur when heat in individual apartments is controlled; it is not known what the effect of the random thermal stresses will be.
   -- Caulk and insulation would go a long way toward improving the thermal performance of these buildings.
   -- The measurement approach can be defeated by putting a wet rag or other cool device on the thermal heating element.

2. The PHARE program has conducted a similar test in the Czech republic. This data may be available for comparison purposes.

3. A rough estimate of the total number of radiator valves that could be installed in Budapest is 3 valves per apartment, times 650,000 apartments, equals about 2,000,000 valves.

4. The Fotav plant would like to meter each building individually, and to leave the responsibility for maintenance of the systems in the buildings to the property management.

5. The other municipal district heating systems in Hungary have been turned over to the municipalities for management.

1.5 Illatos Budapesti Vegimuvek (Budapest Chemical Works)

A. Status of USAID-Supplied Equipment:

1. Combustion Analyzer: The combustion analyzer is used regularly--more than once a week--and the plant has experienced good results from its use. For example, oxygen concentration in the exhaust now typically runs at a level of 4.6 percent to 8.6 percent. The flue gas analyzer also helps in testing the boiler for "false air" (infiltration into the boiler).

   The plant energy engineer estimates that about 1 percent of the 7,000,000 cubic meters per year of gas consumption has been reduced, as a result of the use of the combustion analysis equipment. This amounts to about 70,000 cubic meters per year in savings, which at the

rate of 10 Forints per cubic meter, and 85 Forints per dollar, equals 70,000 x 10/85 = $8,200 per year.

2. Steam Meters: The steam meters measure the amount of steam that goes to various points in the plant. These have worked well, with the exception of one meter that was installed vertically. The required orientation of the meter with respect to the direction of flow was not clear, and so some problems occurred with the meter.

   The steam metering has resulted in energy savings from a number of areas, as noted below.

   (a) Quantities of purchased steam are double-checked with the new steam meters.

   (b) Trends in steam consumption are observed, and the data is used to check for when steam traps and condensate systems are not working properly.

   (c) Through the information obtained with the steam meters, the plant has been able to shut down entire sections for the summer, and other parts of the steam distribution system have been shut off entirely, year-round. The audit report estimated that these meters would save about $ 48,000/year;

   (d) A "ripple" in the steam temperature and pressure charts occurred as the boiler feed water pump cycled on and off. The plant energy engineer included a copy of this chart in a document he used to justify installing a variable speed drive on the boiler feed water pump. The variable speed drive project--that cost about $5,800--saves about 4 kW for the months of operation of the summer boiler, for a total of about 16,000 kWh per year electric savings, which at 4 Forints per kWh and 85 Forints per dollar translates to about $153 per year in electric savings. Related steam savings, from less venting of steam from the de-aeration tank, have resulted in about a two-year payback from the project.

B. Status of Other Measures Recommended in the Report:

1. Action A.1, "Institute an Energy Management Information and Control System" is under way as part of a larger computer process control and automation program for the plant.

2. Action B.2, "Replace High-Pressure Feed water Pumps" has been done. The old and oversized pumps have been replaced with new, more efficient pumps. In addition, cooling water pumps were replaced, for a total savings of about 93 kW. Since these pumps operate continuously, the annual savings are about 800,000 kWh which at 4 Forints per kWh, and 85 Forints per dollar equals about $38,000 in annual cost savings.

3. Action B.3, "Install a Steam Pressure Control Valve on the Steam Line to the Feed water Preheater and Deaerator", has been done. The associated saving is about $ 10,000.

4. Action C.1, "Revise the Existing Building Heating and Domestic Hot Water System", has been completed. Space heating consumes about 27% of the total steam used in the plant and the plant uses about 41 T of oil per year. Assuming a 25% saving in the space heating costs provides a saving of 273,000 $/year.

C. Specific Energy Consumption:

Specific energy consumption has increased in recent years, due to lower plant output. Base standby losses remain approximately constant, and are divided by lower amounts of

production. Since the plant produces a number of chemical products, a global number for specific energy consumption was not available from the plant.

The total saving seen in the plant as a result of the is obtained by adding the savings from A.1 and 2, B.2 and 3, and C.1 above. This is $ 380,400.

D. Other Notes of Interest.

The Emergency Energy Project and the USAID assistance resulted in energy savings due to increased status attributed to the energy manager. The energy manager was more able to receive funding for energy-related projects from top level management after the USAID program had occurred.

1.6 Csepel Muvek Femmu (Metalworks Plant)

A. Status of USAID-Supplied Equipment:

1. Terminals for EMS System: The three terminals, one of which we inspected, are additions to the existing plant-wide energy management system. The intent of the terminals is to provide more direct feedback of Energy Management System information to the factory floor.

   Before installation of the new computers, information regarding electric demand was logged at the plant main office. However, this was not as useful as the present system, because the plant foremen did not have "real-time" access to the information. Thus they were unable to take corrective actions based on the electric data that was obtained.

   The new terminals enable the plant foremen to monitor the process during production. As a result of the USAID program, in addition to the "real-time" data acquisition, the plant now tracks specific energy consumption, in kWh/kg, for each product.

   The plant personnel informed the team that the new terminals are quite useful to them. However, they were unable to provide specific examples of energy consumption reduction. The audit team estimated that installation and use of the EMS would yield annual savings of $ 110,000.

B. Status of Other Measures Recommended in the Report:

1. The plant has implemented Action A.2, "Electric Power Management Task Force", with significant results. The electrical demand, which was previously contracted at 13.6 Megawatts, is now contracted at 11.1 Megawatts. This is a result of both monitoring actual demand, and sequencing processes so that demand spikes will be lowered. The plant personnel have determined that the savings on electric demand charges are about 11.5 million Forints per year; in US dollars at an exchange rate of 85 Forints per dollar, this is about $135,000 per year in savings. Note that this measure has resulted in no energy savings, but rather kW demand savings. There may be significant opportunities in other Hungarian plants to achieve savings in a similar manner. The contracted margin for safety, the ratio of contracted demand to actual demand--put in place to avoid financial penalties from exceeding contracted demand--may have larger implications for Hungarian power capacity planning.

2. The plant has also implemented Action A.4 "Heat Loss Management Task Force". They have contracted with EGI to do infrared scans of equipment. The information from these infrared scans provides useful information regarding weak points in the induction furnace walls. The plant cannot insulate the exterior of the induction furnaces because it needs to be able to monitor the status of the exterior metal housing of the furnaces. The audit team estimated that total heat losses cost about 14,000,000 Ft/year.

3. Action A.5 "Create A Combustion Tune-Up Team" has been implemented; the plant does a major calibration and adjustment of the burners once a year now, and more often if problems are observed with the equipment. This is estimated to save $ 6,200 per year.

4. Action A.8 "Optimize Building Heating" is being implemented, since the plant has calculated about a one-year payback on the investments required.

C. Specific Energy Consumption:

The plant provided energy consumption and production data from 1991 and 1992. The annual totals are summarized below:

Year	Gas(000 M3)	Electric(MWh)	Steam(GJ)	Water(GJ)	Prod(T).
1991	1190000	22893	20404	33631	43.090
/ton	27.6	0.531	0.474	0.780	
1992	873000	21257	47755	28194	41.973
/ton	20.8	0.506	1.138	0.672	

Gas, electric, and water energy intensity decreased, while purchased steam energy intensity increased between 1991 and 1992.

A rough estimate of the savings attributable to the may be made by taking one-half of the projected savings for the EMS (i.e. $ 55,000), the savings in electric power (item B.1), one-quarter of the projected heat loss saving ($ 41,000), and item B.3. This gives a total saving of $237,000.

D. Other Notes of Interest.

1. A general problem noted by the plant is that the energy- related data acquisition capability is more developed than the production and process control capability. Thus although some production adjustments can be made in response to energy information, more savings would be available with greater process control and automation.

1.7 SUMMARY

The table below summarizes the savings in the eight Hungarian plants as a result of the technical assistance and equipment supply. As noted above, some savings are given as ranges to include estimates prepared by the team.

ENERGY SAVINGS IN HUNGARIAN PLANTS

AS A RESULT OF THE

PLANT	EQUIPMENT COST (K$)	SAVINGS (K$)	PAYBACK PERIOD (Mo.)
Yeast & Alcohol	29.1	233. -364.4	1
Paperboard	16.7	451.6	< 1
Bakery	11.1	15.8 - 79.0	2
District Heating	30.3	12.8	28
Chemical Works	33.0	380.4	1
Metal Works	18.7	237.0	1
Alumina	29.4	171.4	2
Glass	44.8	3,005.0	< 1

ROMANIA

The evaluation team visited six plants in Romania: Bucharest milk plant, Bucharest South heat and power station, Urziceni soybean oil processing plant, Cimpulung cement plant, Craiova fertilizer plant, and the Griro pressure vessel plant. Time did not permit visits to the other two plants audited (Galati iron and steel plant and Celhart pulp and paper plant). The audits performed were also successful at identifying significant potential savings for these plants ($660,730 for Galati and $400,000 for Celhart).

2.1 CET - Bucaresti - SUD (Combined Heat and Power Station)

A. Status of USAID-Supplied Equipment:

1. **Combustion Analyzer:** The ENERAC combustion analyzer is used about once a month for each boiler to adjust the combustion controls, and to determine where there is excessive infiltration in the boiler combustion systems. The plant manager, Mr. Sofran, estimates an improvement in combustion efficiency of at least one percent, strictly attributable to the use of the combustion meter.

   The smaller Bacharach combustion analyzers are also helpful, but only on the smaller boilers that generate hot water for the district heating system. The Bacharach meters are able to work when the negative pressure in the stack is 50 mm of water or less; the main power plant stacks are typically at -250 to -300 mm of water.

   Annual savings attributable to the combustion efficiency improvements are about one percent of the 653,592,000 cubic meters of gas and 358,247 tons of oil, amounting to 6,535,000 cubic meters of gas and 3,582 tons of oil. At the 1992 prices of 16,450 lei per ton of oil ($22.38 at 735 lei/$) and 13,000 lei per 1000 cubic meters of gas ($17.68 at 735

lei/$), the dollar value of oil savings is $80,200 per year and the value of gas savings is $115,500 per year. Thus total combustion-related fuel savings are $195,700 per year.

In addition to the fuel savings, Mr. Sofran estimates that by reducing combustion air flows by reducing infiltration, continuous power savings of about 300 kW--distributed among 2 forced draft fans and 2 induced draft fans--have been realized. This amounts to 2,628,000 kWh per year. At an estimated internal plant electric rate of 0.057 $/kWh, the dollar savings are $149,800.

2. **Ultrasonic Flow Meter:** The device was used mostly in measuring oil flows within the oil delivery system. It was found that the recirculation oil flows were excessive, and also that the oil flows increased gradually after new nozzles were installed on the burners. The flow increases were as a result of the erosion of the nozzle holes by grit in the oil.

   As a result of these findings, two actions were taken. First, two of the four oil circulating pumps were shut down, and the oil recirculation rates were reduced. This saved about 438,000 kWh per year (100 kW of pumping power * 4,380 hours per year). The dollar value of this savings is about $25,000, at an internal power plant cost of an estimated 0.057 $/kWh. The second action was to institute a program of regular nozzle replacement, once a month. This, Mr. Sofran estimates, has improved oil combustion efficiency by about 0.5 percent. Approximating the annual savings by applying 0.5 percent to the annual oil consumption results in annual oil savings of about 1,791 tons. At $22.38 per ton, the dollar value of these savings is $40,100.

   Mr. Sofran would like to use the ultrasonic flow meter to do other tests of water flows within the plant, but the upper limit on pipe size that the meter he has received can handle is 300 mm. Many of the pipes in the plant are many times this size. The meter has also been used to check flows in pumps after they were repaired.

3. **Infrared Thermometer:** This has been used to check some insulation; insulation repair is an ongoing part of the plant's preventive maintenance program. The plant has tried to use the gun to test wall temperatures in the combustion chambers of boilers. However, this has not been feasible since the meter works only up to distances of 10 meters, and the combustion meters are more than 10 meters wide, between the site glass and the opposite wall.

4. **Dranetz meter.** This meter has been used as part of the plant's electric preventive maintenance program.

5. **Personal Computer and Printer:** Mr. Sofran uses this machine every day. He has taught himself, by use of the manuals, word processing and spreadsheet analysis, and inputs much of the plant data to track performance both from an energy standpoint and from a materials and labor standpoint.

B. Status of Other Measures Recommended in Report.

All the implemented measures are listed above.

C. Specific Energy Consumption.

For a power plant operating at varying temperatures and with varying hot water and steam loads for district heating, this number may not be meaningful. However, we have computed the energy value of fuel entering the plant, as compared to steam, electricity, and

hot water leaving the plant. The ratio for 1991 was 0.722, and for 1992 the ratio was 0.700.

The savings described in A.1 and 2 above total $ 410,600. The team also estimated that the plant was saving another 1/2% of the total fuel bill with the thermometer and Dranetz meter. Since the total fuel bill is approximately $ 19,600,000, the saving would be about $ 98,000 annually. Therefore the yearly saving due to the actions of the are in the range $410.6 - 508.6 K$.

D. Other Notes of Interest.

1. The plant is hampered by the use of 3 percent sulfur fuel oil; not only does this cause corrosion problems as sulfuric acid eats away at components, but also sulfur deposits clog the boiler tubes, creating a higher pressure drop. This pressure drop makes the capacity of the boilers gradually deteriorate through the winter time, from about 460 tons of steam per hour in October to about 360 tons of steam per hour in April.

2. The plant has no major water leaks, according to Mr. Sofran. However, the district heating pipes have major leaks. The cost of these leaks are passed on to the heating customers by the municipalities that distribute and collect revenue for the heat. Also, the capacity of the system is about 3,000 GCal per hour, while the coldest days require about 5,000 GCal per hour of heat. Thus the apartments are able to sustain a temperature of only about 12 to 14 degrees C.

2.2 S.C. Cimus S.A. (Cement Plant)

A. Status of USAID-supplied Equipment:

1. **Combustion Analyzer:** The ENERAC device is used as many as six times per day. The plant has a dedicated crew that operates this equipment. It has been used to detect whether or not there is air leakage in the cement kilns. They have used this to reduce the amount of air leakage, over time, into the kilns.

   A review of the plant combustion data logs revealed that the excess air was at about 100 percent in the early days of the use of the equipment, and it is now down to about 30 percent, a more reasonable value.

   The plant is about to run out of ENERAC oxygen cells, filters, and printing paper. Thus they need to have replacement supplies. In addition, a new printer head is needed for the ENERAC.

   The Bacharach combustion analyzers are used at the boiler plant to check for excess air in the boilers.

2. **Thermometers:** The infrared thermometers, one operating to 2000 degrees C and one operating up to 1000 degrees C, are used for a number of plant applications.

   First, the plant measures the temperature of kiln tubes to find where refractory bricks are eroding. This enables the plant to make repairs to refractory bricks where the repairs are needed, and early on in the erosion process. This saves on both maintenance costs and energy costs. They also gain information on the burning process from the use of this thermometer.

Second, the low temperature thermometer is used for measuring the temperature of "clinkers". The knowledge of this temperature enables the plant to adjust the speed of the conveyer into the kiln. Also, if the clinker temperature drops significantly, it indicates the presence of air leaks in the kiln.

Third, the thermometers are used to measure the temperatures of bearings and motor casings. This gives quantitative precision to the preventive maintenance program, which prior to the use of the thermometers was performed "by feel". By better maintaining the motors, the up-time of the motors is enhanced, and productive time compared to total plant up-time is increased. This approach has also improved plant safety, as the manual method of testing motor casings resulted in occasional burns.

A total of about 36 temperature measurements are performed each day. A sign of the success of the temperature measurements is that the plant has ordered 5 more of these devices.

3. **Oil Flow Meter:** This device is used both to track hourly fuel oil consumption, and to adjust the combustion in the clinker kiln. This adjustment, which was previously done strictly by the appearance of the flame, is now done with the use of the oil flow meter. The plant is ordering more flow meters, in order to equip the other kilns with these devices.

4. **High Temperature Thermometer:** This device is used to control the burning in the refractory-lined kilns and in the clinker kilns. Plant personnel watch the flame temperature, as well as the refractory brick temperature in the burning zone. By adjusting the air flow and looking at the thermometer readings, the flame is optimized. These measurements are performed about ten times a week.

5. **Dranetz Meter:** This is used to measure kW, kVA, and kVAR of various electric motors. It is also used to check electric motors that have been repaired, and to monitor process motors for 24 to 48 hour periods. The data collected in the latter operation is reduced in the computer that was supplied by USAID. Direct energy savings available from downsizing motors have not been realized, due to lack of capital for changing the motors. However, the indirect savings resulting from the increase in up-time of motors have already occurred.

6. **Computer:** The computer is used for energy tracking, plus for economic applications such as tracking expenses and salaries.

7. **Steam Flow Meters:** These were on an original list and deleted from the final list; the plant would like to know why the steam flow meters were deleted.

B. Status of Other Measures Listed in Report

1. The condensate return improvement project has been initiated, but the plant is limited by lack of capital for major repairs.

2. Another project proposed by the plant was to install a waste heat boiler to produce steam from a waste heat load that is now cooled in a cooling tower. A rough estimate on available power was 700 kW.

C. Energy Savings Estimate

The plant estimated that the sum of specific energy and maintenance costs, per kg of product, has decreased by about two percent. For the first six months of 1993, the plant

estimated savings of about $75,000. This is at about a 50 percent full load utilization rate. Thus if the plant were operating at capacity, the annual savings would be about $300,000, and at present production levels they are about $150,000.

For 1991, specific electric consumption was about 184 kWh per ton, and for 1992 it was 172 kWh per ton (a decrease of 6.5 percent). Their electricity price is 24 Lei/kWh (3.27 cents/kWh). For 1991 specific fuel consumption was (assuming 8.5 Gcal per ton of oil and 7.9 Gcal/1000 cubic meters of gas) 912 Gcal per ton, while for 1992 it was 812 Gcal per ton, a decrease of 11 percent. The gas price is 24 Lei/cubic meter.

Based on the above savings in electricity and fuel, it appears the plant may be underestimating the savings. It seems like a value of 4 to 5 % may be more reasonable. Using 5% would give an annual saving of $ 375,000 at the current load conditions.

D. Other Notes of Interest.

The plant is less efficient than other plants within the group that were modernized under the former regime, as "showpieces". Also, the rate that the plant is paid for first quality cement is about $25 per ton, as compared to a typical world market value of $70 to $80 per ton. Of the $25 per ton about $11 to $12 goes to rail fees to transport the cement to Constanza on the Black Sea.

2.3 SC Griro S.A. (Large Vessel Fabrication Plant)

A. Status of USAID-supplied Equipment:

1. **Combustion Analysis Meter:** The plant personnel said they use the ENERAC meter every two to three days, and sometimes once per day. It has worked well for them, but they need new filters and new printing paper to keep the device operating. They also use the Bacharach meters, for places where it is too hot to set up the ENERAC meter.

   They have found that monitoring the combustion and reducing the excess air has led to fuel efficiency improvements of about 10 percent; from about 60 percent to about 70 percent. Ten percent of the plant's actual gas consumption for 1992 is about 2,700,000 normal cubic meters. At an average rate of about $18.70 per 1000 cubic meters, the cost savings from better combustion efficiency is about $50,400 per year.

2. **Gas Flow Meters:** One of the two flow meters works, and one does not work. The objective of Griro in installing these meters is to check the gas company billings. Each boiler has one meter attached to it, and the target is to compare the sum of the two meters' readings with the gas company's billed data. The present gas bill is obtained by integrating a circular consumption chart by use of a planimeter. Griro would like to check this reading from the gas company by means of a more direct measurement.

3. **Infrared Thermometers:** The high temperature thermometer is used at the foundry to measure the temperature of the metal inside. With the knowledge of this temperature, overheating in the electric arc furnaces and the induction furnaces is reduced. This results in lower furnace residence times and also better product quality and less material waste, since product composition is a function of temperature.

   Annual savings are estimated at:
   6 % x 1800 kWh/ton base x 1900 tons/yr = 205,200 kWh/year.
   Cost savings are estimated at $11,700, using an average kWh cost of 0.057 $/kWh.

Infrared thermometers are also used for the furnaces in which plates are heated prior to being rolled. By knowing the temperature of the plate, production rates have been increased, a 10 percent reworking rate has been eliminated, and an estimated 20 percent of this process's gas consumption has been reduced.

This 20 percent reduction amounts to about 100,000 cubic meters per year; the dollar value of this gas is about $1,870 per year.

Thermometers were also used to determine temperatures of material that was to be welded. The previous way to determine whether the metal was at a temperature sufficient for welding to occur was to mark the metal with thermal chalk. In-house estimates of fuel savings are about 50 percent of this usage of natural gas, or about 1500 cubic meters per month. The annual total of 18,000 cubic meters amounts to a dollar value of about $337 per year.

4. **Ultrasonic Flow Meter:** This device was recommended to measure oil flow. Since the oil supply system is being rebuilt, the meter has not yet been used for this purpose. However, it has been used to measure boiler make-up water flows and to check other water flow meters within the plant. The plant is billed for water drawn from wells just as if it were drawn from city water pipes. Thus the plant is checking flows from the wells and comparing the value of the city meters to the values from the ultrasonic meter.

5. **Dranetz Meter:** This electric power analyzer is used to measure power factor of motors. The plant is planning to do an overall energy audit of all motors, for which it will use the Dranetz meter. No specific energy savings have yet been identified from this meter.

B. Status of other Measures Recommended in the Report

None of the other measures were implemented.

C. Specific Energy Savings.

The team received 24 months of energy data for the Griro plant. Overall steam plus electric energy out as compared to fuel energy input was 1.22 for 1991, and 1.36 for 1992. Both these numbers should be less than one; this indicates a problem with either the metering or the heating values assumed for the fuels. However, assuming that any errors were the same for both years, the data do indicate an efficiency improvement of 12 percent between 1991 and 1992. Using this value of 12% gives annual electricity savings of $ 31,800 and annual gas savings of $ 182,800. The total yearly saving is therefore about $ 279,000.

D. Other Notes.

The plant is still providing heat to the district heating system for 10,000 apartments, and is therefore required to operate its steam-generating equipment throughout the winter, regardless of demand.

2.4 SC Doljchim S.A. Craiova (Fertilizer Plant)

A. Status of USAID-Supplied Equipment:

1. **Computer and Printer:** This device is the most-used of all the equipment. The plant uses the meter to reduce electric data for performing plant electric energy balances.

Through use of this data, the plant is able to determine if specific consumption for processes is rising. For example, when it was found that electric energy for one process was too high, the plant determined that a cooling tower was overcooling a process waste heat load. Electric energy was saved by shutting off cooling tower fans. The plant uses, on a typical day, about 2400 MWh of electricity. Assuming operation for 250 day per year and an electricity price of 0.049 $/kWh, a 1% electricity saving gives an annual saving of $ 294,000.

2. **Dranetz Meter:** This electric power meter is used to record power factor of the plant, and to make adjustments to the synchronous air compressor motors to improve power factor before the power factor drops to a level at which financial penalties could be charged. Also, the plant uses the meter to obtain information regarding the startup loads of electric motors. The plant has identified oversized motors, but has not been able to afford to replace these motors with more appropriately sized motors.

3. **Steam and Natural Gas Flow Meters:** These are installed on the 50 Ton per hour boiler, and have worked well.

4. **Oil Flow Meter:** This has been installed, but has not been used since oil has not been used in the plant since the meter was installed.

5. **Combustion Analysis Meter:** The ENERAC unit has not worked at all. At first the power supply did not work, and then there were problems with the oxygen cells. Therefore, the meter has not generated any savings.

6. **Infrared Thermometer:** The meter has been used to check insulation of vessels and pipelines. In addition, it has been used to measure the temperature of electrical connections, to see if they are becoming loose and thereby generating wasted heat.

7. **Contact Thermometer:** This is used to measure surface temperatures in the boiler room, as part of the semi-annual energy balance on the boiler room.

B. Status of Other Measures Recommended in Report

1. **Condensate Return:** At the time of the USAID audit, excessive amounts of condensate were dumped, and not returned to the boilers, because of the potential of pollution of the condensate by one of the processes. As a result of the report, instrumentation and alarms have been installed that alert the boiler plant personnel that the condensate from the process is polluted. Corrective actions are taken, and the condensate waste is minimized. Plant personnel estimate that this measure has saved 15,000 Gcal in 1992, while the plant was operating at 30 percent capacity. 15,000 Gcal translates to about 60,000 MMBtu. At a typical present gas cost of about $1.06 per MMBtu (based on the Cimus Cement Plant value of $33 per cubic meter), the annual savings from this measure is about $63,600. At full capacity this saving would increase to $ 212,000.

2. **Air Compressor Optimization:** Based on the use of Dranetz meter data, the plant engineers were able to convince the chemists that it was a good idea to shut down one of the two partly loaded air compressors. The improvement in efficiency resulting from running one compressor closer to its optimum operating point resulted in annual savings of about 1,800,000 kWh. At a typical assumed in-house electric rate of $0.049 per kilowatt hour, this results in annual savings of about $88,200.

Totaling the savings noted in items A.1, B.1, and B.2 gives an annual saving due to the of $ 445,800.

C. Other Notes

Production of the plant is well below prior levels. The plant is encountering problems with the availability of natural gas (feed stock). The government allocates the gas it is able to buy (foreign exchange is a problem in Romania) to power plants and other consumer-related sectors.

2.5 SC Miorita S.A. (Milk Processing Plant)

A. Status of USAID-supplied Equipment:

1. **Natural Gas Flow meter:** Problems that occurred after installation of this meter have not been corrected. For example, the static pressure reading of the meter is much lower than the actual static pressure reading obtained by a manometer. Thus the meter has not been put into service and provides no useful information to the plant.

2. **Steam Flow Meter:** Similar to the gas flow meter, the meter provides no useful data. Actual steam pressure, as measured by a manometer, is 4 bar, and measured data from the steam flow meter is significantly different. Also the temperature and flow rate data are not correct. The meter provides no useful information to the plant.

3. **Combustion analyzer:** The portable Bacharach device works well, and the plant uses it every two to three days to readjust the natural gas-fired burners. The plant uses the meter only for natural gas firing of the boiler because oil firing causes soot interference with the operation of the meter. Most of the fuel consumption of the plant is natural gas. Variations in the quality of delivered natural gas account for the readjustment of the boiler every two to three days. The team did not witness the device, since it was in the office of the boiler operator, who had already left for the day when we visited the boiler room.

   The plant estimates, they have improved combustion efficiency from about 86 percent to about 91 percent. This will account for actual fuel savings of about 6.4 percent. Multiplying this by the 4,329,000 Normal cubic meters gas consumption in 1989 yields savings of about 277,000 normal cubic meters per year. At the July 1993 price of 24 lei per cubic meter, and 735 lei per dollar exchange rate, the value of the fuel savings is :

   277,000 cubic meters x 24/735 = $9,044 per year.

4. **Digital Thermometer:** We did not observe this device.

B. Status of Other Measures Recommended in the Report

None of the other measures were implemented.

C. Specific Energy Savings

The plant provided us with monthly energy data from 1991 and 1992. Specific gas consumption went from 175 cubic meters per ton in 1991 to 148 cubic meters per ton in 1992 (a decrease of 15 percent). Specific electric consumption went from 251 kWh per ton in 1991 to 223 kWh per ton in 1992 (a decrease of 11 percent). Using the value in the audit report for total electricity consumption (at 100 % operating capacity) and noting the plant is now operating at about 33% capacity, the reduction in the plant's electricity bill is approximately $ 13,800. The total savings is then $22,844.

D. Other Notes

The plant is now running at about 1/3 capacity (215,000 liters per day vs. 600,000 liters per day full capacity). With private ownership of farms, less land is used for food for cows, and more land is used for food for direct human consumption. As a result, the cow population has decreased significantly.

Also, since the dairy industry is vertically integrated, increases in fuel costs for the care of cows, transportation fuel costs for raw materials and finished products, and production energy costs result in an amplified impact of increased energy costs on the price of the final product.

2.6 SC Expur S.A. (Soybean Oil Processing Plant)

A. Status of USAID-Supplied Equipment

1. **Flow meters:** Vortex flow meters for steam, gas, and water flow measurement were installed as part of the program. None of the three meters work, and they have not worked since they were installed. The plant energy engineer was disappointed with the poor performance of the meters. A general note regarding the vortex flow meters is that simpler meters may have been installed with less problems with reliability and start-up. For example, all the steam meters that were installed in Hungary have worked well, whereas almost none of the vortex flow meters in Romania worked.

2. **Portable Thermometer:** This unit is operable, but is not used very much by the plant.

3. **Bacharach Combustion Analyzer:** This instrument is used the most of all the meters. Boilers are tested about once a month with the combustion analyzer. With this meter, the plant manually adjusts the burning process. The estimated savings from the use of this unit are about $ 33,000 per year.

   Given the knowledge of the increased combustion efficiency available, the plant has installed a new combustion air blower and is in the process of installing automatic combustion controls for an existing burner. They are also investigating buying a new burner. Their plan is to install one solution on each of two boilers, take test data, and then install the better solution on all three boilers. The new lower saves about 1000 $/year.

B. Status of Other Measures Recommended in Report

1. **Cooling Tower:** A study of the cooling tower is being done as a Ph.D. thesis by a Romanian graduate student. A new cooling tower, based on the thesis design, may be installed. Another option that is being investigated is to pipe the waste heat to the nearby town for space heating of houses and apartments.

2. **Hot Water Pump Seal Leaks:** These have been repaired, with funding from the PHARE program. This program has also provided the plant with spare parts and steam traps. It is estimated these save about $ 600 per year.

3. **Toaster-Dryer Control:** The toaster dryer, which evaporates gasoline from soybean chips has been outfitted with a steam control valve that maintains the dryer exhaust temperature at 80 degrees C (the gas distillation curve ranges between 65 degrees C and 85

degrees C). The PHARE program allowed the plant to obtain foreign exchange with which to buy the required equipment.

4. **Automatic Boiler Water Level Controls:** These controls, using conductivity probes, have been installed.

5. **Boiler Blowdown Heat Recovery:** This has been installed and saves about 28,800 m3 of gas per year. At 33 $ per thousand cubic meters this system saves about $ 925 per year.

C. Specific Energy Consumption

Below are annual totals for energy consumption and production of soybean oil.

	Gas (000 M3)	Electric (MWh)	Production (Tons)
1991	6,626	2,277	109,673
/Ton	0.060	0.021	
1992	5,152	2,500	75,459
/Ton	0.068	0.033	

As shown, specific energy consumption, both in gas and electricity has increased. This is primarily attributable to the decrease in production.

The total of the savings listed above is $ 35,500. When the new automatic boiler controls are installed, an additional saving of $ 33,000 per year will be seen for a total of $ 68,500.

D. Other Notes of Interest

1. The plant is considering installing dual fuel burners, so that they will not be dependent on Russian gas exclusively.

2. The plant may start importing soybeans from South America. Due to a drought last year and adjustments resulting from recent restitution of land to original owners, Romanian soybean production has dropped significantly.

2.7 SUMMARY

The table below summarizes the savings in the eight Romanian plants as a result of the technical assistance and equipment supply. As noted above, some savings are given as ranges to include estimates prepared by the team.

ENERGY SAVINGS IN ROMANIAN PLANTS

AS A RESULT OF THE

PLANT	EQUIPMENT COST (K$)	SAVINGS (K$)	PAYBACK PERIOD (Mo.)
Power Plant	34.8	410.6 - 508.6	1
Cement	24.3	150.0 - 375.0	< 1
Pressure Vessel Fab.	35.8	279.0	2
Fertilizer	30.2	445.8	1
Milk Processing	10.2	22.8	6
Soybean Processing	14.4	35.5	5
Iron and Steel	31.3	660.7	< 1
Pulp and Paper	30.6	399.5	1

BULGARIA

The evaluation team visited six plants in Bulgaria: the Sodi Devnya soda ash plant and the Parvi Mai cotton processing plant in Varna, the Kremikovtsi iron and steel mill and the Serdika milk plant in Sofia, the Chimco chemical works in Vratza, and the Izida Ceramics plant in Elin Pelin. Time did not permit visits to the Pharmacia chemical and pharmaceutical works or to the Poultry slaughterhouse in Tolbuhin.

3.1 Izida Ceramics (Ceramic Plant)

A. Status of USAID-Supplied Equipment:

1. **Combustion Analyzer:** The plant is very happy with the ENERAC unit. They use it about once a month, or more often if there are changes in operation. Before using the ENERAC, the typical combustion efficiencies were about 68 to 72 percent, and after using the ENERAC, the plant is keeping combustion efficiency at about 80 to 82 percent. For the one gas boiler that operates at about 230 cubic meters per hour, the effective savings are about 33 cubic meters per hour. Annual savings for this boiler will be about 116,667 cubic meters (3500 hours operation), and at 2 leva per cubic meter, the cost savings are 233,333 leva per year, or at 25 leva per dollar, about $9,300 per year.

2. **Air Flow Meter:** This has not yet been installed. It is intended for installation on the glazing furnace, but since the furnace process is being changed, this has not been installed.

3. **Pressure Reducing Station:** This has been installed. It is a pressure regulating valve for gas, and is an integral part of the new gas-fired furnace. Natural gas replaces the wood pyrolisis fuel that had been used for the furnace. The fuel conversion was a project that the

plant already was considering; the USAID-provided gas flow regulator helped move the project along.

4. **Natural gas flow meter:** This is a portable instrument that has not yet been used, according to the plant personnel.

5. **Slurry Analyzer/Centrifuge:** This has been provided; however, the device that was provided is more appropriate for less viscous materials than the clay that the plant has. The plant has requested more information regarding this device, or replacing it, but has not received more information.

6. **Steam Traps:** The ten traps that were installed were an overwhelming success. The plant liked the performance so much that they have ordered 166 more traps from Armstrong, through Ecotechproduct. The traps that the plant is ordering and installing are capable of being disassembled and cleaned, whereas the USAID traps are one piece and cannot be disassembled.

   The plant estimates that the steam traps have reduced steam consumption by about 300 to 400 kg per hour. Assuming 800 pounds per hour, an 80 percent boiler efficiency and about 2,000 hours per year of process steam use results in annual savings of about 2,240 MMBtu. At 103,000 Btu per CCF, this will be about 21748 CCF, and at 3.35 cubic meters per CCF, this translates to about 73,000 cubic meters of gas per year. At 2 leva per cubic meter, annual savings are 146,000 leva, which translates to $5,840 at 25 leva per dollar. Installation of the new traps will probably save the plant about $ 97,000 per year.

7. **Portable Temperature Indicator.** This Wahl temperature device enables more "real-time" adjustment of the various thermal processes. Now the plant is able to adjust the process and see the result in temperature changes with a much quicker response time than was available before.

8. **Thermocouple Calibration Unit:** This is used with the portable temperature indicator.

B. Status of Other Measures Recommended in Report:

1. The plant told us that they had implemented a number of the low-cost measures recommended in the report--for example the cleaning of fluorescent fixtures, the cleaning of windows, and the closing of furnace doors. The audit tam estimated that the savings in this area would be about $ 13,400 annually and this appears to be a reasonable estimate. In addition the plant is upgrading some of the insulation. The team saw much bare pipe during our brief tour of part of the plant so there should be more opportunities for this work.

2. There is now ductwork in place above the carts at the exit of one of the furnaces: thus the preheating of the furnace air is now being done by cooling off these carts, according to the plant's personnel. This was a measure recommended in the report.

3. Fuel switching of furnaces. There are three glazing furnaces that are electrically heated. The plant has been investigating replacing these furnaces with new technology that would cost about $3,000,000 to $4,000,000. The energy savings are estimated at about 5,000,000 leva ($200,000), and the plant estimates an overall payback of about 5 years. The team did not determine where the additional savings came from to bring down the payback period.

Most significantly, the avoided electric load from this project would be 1,280 kW, or 1.28 MW. This single project would result in one to two tenths of a percent reduction of Bulgaria's large nuclear generating station's load. This measure may warrant further investigation.

C. Specific Energy Consumption

The forms the team requested to be sent had not been successfully transmitted by the fax machine. The plant was requested to prepare specific energy consumption data for the past three to four years but no further information was received. The total value of the energy savings implemented as a result of the audit is $ 28,640.

D. Other General Notes of Interest

1. The plant informed the team it is operating at full capacity. It must be doing relatively well financially, since it exports products and has been able to invest in additional steam traps.

2. The team learned that there is a Japanese foreign aid program ongoing in Bulgaria . This program involves investments in process technology that is more energy efficient. The Japanese are doing about 5 plants throughout Bulgaria.

3.2 Kremikovtsi Iron and Steel Rolling Mill

A. Status of USAID-Supplied Equipment:

1. **Combustion Analyzer:** The ENERAC meter is used on the cold rolling mill burners, the blast furnace, the rotating furnace for pipe manufacturing, the furnaces in hot rolling mills, and the boilers in the power plant. Plant personnel informed the team they have reduced excess air quantities, but that it is not possible to generalize about typical percentages of excess air reduction. In part, this is because the mixture of fuels--natural gas, coke, tar, furnace gas, and other fuels--varies continuously as a function of the process that is operating. The plant uses the amount of oxygen in the flue gas as an indicator of excess air quantities. Using the values for gas flow in the audit report, and assuming a saving of 3% is attained, the annual savings would be $ 45,000.

   On the boilers, the plant measures combustion gases at 5 points; the exit of the boiler, the exit of the first stage economizer, the exit of the second stage economizer, the exit of the make-up air preheater, and the entrance to the stack. They have found that sulfurous acid condenses in certain parts of the exhaust system under some conditions. This may set a lower limit on excess air.

2. **Mass Flow meter:** The "Dart" brand meter is an orifice plate type meter. It is intended for installation at the natural gas boilers, to check the amounts of natural gas that are billed.

   The meter has not yet been installed because it has not been approved by a Bulgarian standards institute. The plant would like assistance in obtaining certification for this meter. The meter had a USAID sticker on it, but both the transducer and the electronics were manufactured in West Germany (Hartmann and Brown meter, Dieterich Standard electronics).

3. **Portable Gas Velocity Measurement:** The "Kurz" air flow meter is used to check air flow rates for air conditioned equipment, such as electric equipment rooms that have high

internal heat gains. In addition, it is used to measure relatively low (less than 250 degrees C) exhaust flows.

4. **Industrial Stethoscope:** This is used to check for steam, gas, and air leaks. Often the plant has located leaks in valves, and followed up by disassembling and cleaning the valves. The method employed is to isolate various branches of the piping system and check the valves one at a time. The team estimates that the plant may save 1 - 2% of the steam or about $ 5,000 annually.

B. Status of Other Measures Recommended in Report

1. After the USAID program was complete, a list of 37 measures to be implemented within the plant was prepared. Some of these measures were inspired by the USAID report. Prior to the USAID study, the plant produced an energy spreadsheet that tracked energy consumption per unit of production for each of the plant's divisions. The plant informed us that they incorporated into their energy accounting system some features that were included in the USAID report.

2. Load management, in which electric furnaces are run at night rather than during the day, has shifted 10 megawatts of electric load. The plant did not furnish an estimate for this saving but one can obtain a good estimate by assuming the shift occurs over 10 hours per day, 250 days per year. The difference between day and night rates is 0.0108 $/kWh so the saving due to load management is $ 270,000.

3. The plant has implemented batch processing of aggregates, in which aggregates are stored up for full-load processing for days at a time rather than continuous part-load processing.

4. The plant has also shut off unloaded transformers in various parts of the plant, in order to eliminate the standby losses of the transformers. This action was brought to their attention by the USAID team. We estimated that this saved 0.5% annually of the electricity. Using the average rate of 0.0258 $/kWh gives a saving of $ 8300. The total of the above savings for this plant is $328,300.

C. Specific Energy Consumption

The plant provided us with energy data for the past two years. However, since it produces a variety of products that vary over time, it is not possible to make comparisons of the specific energy consumption.

D. Other Notes of Interest

1. Plant personnel informed us that 40 percent of the hot rolling plant's raw materials used to come from the former Soviet Union, and none of these come from there now. Therefore the hot rolling plant's production is limited by raw material availability. The cold rolling mill operates at about 50 percent capacity, because of shortages of raw materials.

2. During the plant visit there was evidence of a very large compressed air leak in a section of the cold rolling plant. We noted to the plant personnel that considerable energy savings could probably be attained by valving off idle sections of the plant to eliminate parasitic air losses.

3.3 Sodi Devnya (Soda Ash Plant)

A. Status of USAID-Supplied Equipment.

1. The furnished a variable speed drive and control for level control of a process. The project was commissioned in December of 1992, and worked for 52 days, but then the variable speed drive failed. The project saved 39 kW in pumping power (from a base of 140 kW for the pump, a savings of 28 percent), by eliminating a constant recirculation flow. The total dollar savings attained to date from this project are about $1,258. Annual savings, at the average rate of $0.0258 per kWh (0.646 leva average rate per kWh for 1992, at 25 leva per dollar), should be about $8828 per year. At an equipment cost of $46,005, this project yields a 5.2 year payback, assuming it runs continuously.

   When the drive failed, the plant contacted the Austrian plant of Lenze, the drive manufacturer. Since the drive had been purchased through a US company, Lenze of Austria first did not want to respond to the plant's inquiries. Also, the plant was not provided with documentation of its ownership of the drives. This caused difficulties in obtaining warranty service for the drives. The drive was sent to Austria on April 23, 1993, and had not yet been returned by the time of our visit (July 9). As an interim measure, the plant, which will be buying a similarly sized variable speed drive for another process, will install that drive on the pump for which the USAID drive was provided. The repaired drive from Austria will then be used on the new drive application.

   The drive manufacturer has provided a quotation for a service contract for the drive. Sodi wanted to know who would be responsible for providing this service contract, and suggested that it would be helpful for all projects to include a service contract for a set period of time.

   The ultrasonic level probe that controls the drive has not worked from the time it was delivered. The Sodi plant was able to use the variable speed drive by using its own level instrumentation. The Sodi plant instrumentation lab looked at the ultrasonic probe to see whether it was serviceable, but found it was hermetically sealed and not serviceable. Together with a telex regarding the variable speed drive, Sodi sent a telex regarding the ultrasonic probe to the manufacturer in May, but has not yet received any response.

B. Status of other Projects Recommended in Report

1. The plant has implemented a number of measures that the plant had studied prior to the visit by the USAID team. The motivation to perform these changes was found in 1992 when coal, gas and electric prices started to rise. For example, the plant has:

   --lowered calcination pressure from 32 atm. to 28-29 atm., and introduced regulating controls to reduce the output product of the calcination process from about 225 degrees C to 205 degrees C.

   --installed automatic level controls on the condensate receiver for the calcinating rotating furnaces, thereby saving 3.5 tons of steam per hour per calcinator.

   --reduced the temperature of the steam going into the calcinator from 410 degrees C, at 36 atm., to the saturated steam temperature, by use of a pressure reducing valve. (note: turbines to replace pressure reducing valves are a good idea).

   --with the above measures, the specific steam consumption has gone from 2.4 Gcal/ton to 2.3 Gcal per ton. If the plant were running at full production, the specific energy

consumption would go down more, because there are base heat losses that occur regardless of production levels.

--for the distillation column, the plant has installed automatic temperature controls for the steam valves. Previously, the typical outlet temperature was 68 to 74 degrees C; now the outlet temperature is typically 62 to 64 degrees C.

--The plant has restored insulation on high pressure (36 atm) steam distribution piping, mainly on distribution piping. The plant said it does not have funding to insulate 32 mm and 50 mm steam pipes.

--The plant has instituted a water treatment program. By cleaning heat exchangers and introducing chemical water treatment, the typical heating steam consumption has gone down from about 8 to 9 tons per hour of steam to 6.5 tons per hour.

--Freeze protection heating of plant instrumentation has been equipped with steam traps and condensate return; before, the steam was vented.

2. The plant has purchased about 160 steam traps from Armstrong, through Ecotechproduct. In this way the plant has eliminated significant steam leaks. Also, the steam traps have been supplied with special traps for winter operation to eliminate freezing of steam traps. The USAID team and Ecotechproduct told the plant about the steam traps. The plant will be putting thermodynamic traps in areas where the condensate is superheated. Inverted bucket traps do not work well with these, because the condensate flashes downstream of the trap. Based on savings seen in other plants, the team estimates that these new traps will save the soda-ash plant about $ 93,400 annually.

3. The plant requested that the USAID team provide follow-up literature regarding energy efficiency in the Solvay process for producing soda ash. However, they have not received any data regarding this. Specifically, the plant would like information regarding rebuilding its distillation column. Rather than rebuilding it to the same specifications that have already been used, they would like to incorporate any state-of-the art process changes. There is a large waste heat production in the 1200 cubic meter per hour mixture of water and various salts, at 104 degrees F.

   The plant is also interested in the Green River, Wyoming plant in the U.S. that operates a Solvay process plant at energy efficiency rates rivaling those of plants that use raw materials that do not require the energy-intensive Solvay process.

C. Specific Energy Consumption

1. As noted above, the plant has instituted changes that have reduced the specific energy consumption of soda production from 2.4 Gcal/ton to 2.3 Gcal/ton. Taking the total of the savings due to the variable speed drive and the steam traps (since the impetus for these came from the), gives a total yearly saving of $ 102,300.

D. Other Notes of Interest

1. About 56 percent of the plant's total operating costs are now electricity and fuel costs. The fuel, thermal energy costs are the dominant cost.

2. The plant indicated frustration with Western groups that frequently request large amounts of information but rarely respond to requests for information. The PHARE program was cited in this context.

3. The major difference that the plant cited in their operation with the change from a central economy is that they now perform payback analysis on all capital improvement projects.

3.4 Chimco-Vratsa (Chemical Plant)

A. Status of USAID-Supplied Equipment

1. **Emissions Gas Analyzer:** The plant has two ENERAC combustion analyzers, which were provided to them via the Committee on Energy. One is used mainly for the power station, and the other is used for adjusting some process burners from time to time, while it is also used as a backup for the power station burners. The plant is quite happy with the ENERAC's' performance and utility.

   Combustion efficiency before the plant started to use the ENERACs--which they use two to three times a week--was about 83 to 84 percent. Now the combustion efficiency is typically 87 to 88 percent. The portability of the device and the ability to check oxygen concentration at different points in the breaching and boiler exhaust system has enabled the plant to identify and repair air leaks and reduce/eliminate "false air". Oxygen concentration in the boiler exhaust was about 10 to 12 percent and now it is about 3 to 4 percent. The plant also uses the ENERACs to adjust the load of boilers for maximum efficiency.

   The plant was disappointed that there were no NOx sensors included with the ENERACs. The audit report specified that NOx sensors were to be supplied, but when the devices were delivered, there were no NOx cells included. The NOx measurement is for environmental quality rather than energy efficiency. In addition, the other cells--oxygen, sulfur dioxide, carbon dioxide--are almost spent, and they will soon need replacements. The plant has been offered replacement oxygen cells from Ecotechproduct.

   For training in the use of the combustion analyzer (as well as the other equipment), the plant had the operating manuals translated and taught themselves how to use the equipment. Later, Mr. Spassov of Ecotechproduct visited them and provided more instruction on the use of the equipment. The plant noted that IRG was very responsive to their requests for information and assistance.

   Applying the improvement of from 83.5 percent to 87.5 percent boiler efficiency to the plants boiler gas consumption yields savings of about 5.5 percent, multiplied by the 1990 base consumption of 703,088 cubic meters per year, which yields about 38,700 cubic meters per year of savings. At the present price of 1.568 leva per cubic meter, this gas is worth about 60,700 leva per year, or $ 2400 per year at the present exchange rate of about 25 leva per dollar.

2. **Infrared Thermometer:** The plant is not as happy with this device as they are with the combustion analysis meters. First, there was some confusion as to which of two or more infrared thermometers--that were in the possession of the Committee of Energy and/or Ecotechproduct--was to be delivered to Chimco. Chimco informed us that they felt they were delivered a less precise instrument than they were expecting.

   Secondly, the emissivity charts for the instruments do not contain information about all of the surfaces that the plant would like to measure. The plant has written to Davis Instruments, the equipment supplier, to request more data, but they have received no response from Davis.

Also, the form from IRG (which had been signed by a plant representative) indicates that two Infrared thermometers were to be provided, while the plant claimed that it had received only one.

3. **Portable temperature indicator:** This contact thermometer has been put to good use by the plant. This has been used to measure casings of vessels, pipes and valves (including compressed air systems) to indicate the temperature of the fluids inside. It has also been used to test steam traps, and to check pipe insulation. Their only regret regarding this meter was that they did not receive more of them. The audit team estimated that these would save about $ 5520 annually.

   A general note is that very few of the meters in Bulgaria were marked with USAID stickers.

B. Status of Other Measures Recommended in the Report

1. The plant informed us that they worked together with IRG to determine what additional measures, beyond the use of the instrumentation, would be included in the report. Most of these measures have been implemented, while a few projects have been determined not to be worth doing.

2. The plant would like some more precise gas meters to measure their gas consumption internally. Now they have on-site meters, as does the gas supply utility. Each month the readings differ somewhat, and the plant and the utility meet to reach a consensus on what the actual consumption was. Gas prices change every two weeks, and the price for the period between July 1st and 15th is 1,568 Leva per 1,000 cubic meters. The highest rate in the past year has been about 2,000 leva per 1,000 cubic meters, and the rate has recently dropped by about 142 leva per 1000 cubic meters. The plant informed us that a common practice in Bulgaria is to shut down when the gas price is too high. Thus a market price response on the part of gas suppliers may be developing.

C. Specific Energy Consumption:

The plant had filled in the form requesting information regarding its instrumentation supplied by USAID. It did not have information regarding specific energy consumption. Since there are multiple chemical products produced at this plant, this information would not be meaningful.

The total savings, as noted in items A.1 and A.3 above, is $ 7920.

D. Other Notes of Interest

1. The Urea plant is operating at about 80 percent capacity and will operate at about 100 percent once some new equipment is commissioned.

2. Ammonia in waste water is still a problem. Perhaps there is a waste minimization/recovery opportunity here.

3. Electric rates have three categories, a peak rate of about 1.355 leva per kWh, a day rate of 0.638 leva per kWh, and an off-peak rate of 0.368 leva per kWh. On July 8, the plant required 67 megawatts, of which it generated 27 megawatts. Its winter peak power requirement is 83 megawatts. The central electric utility is a winter-peaking utility, with much electric heating in place.

3.5 Combinat Serdika 1 (Dairy Products Plant)

A. Status of USAID-Supplied Equipment:

1. **Fluorescent Light Fixtures:** There are 15 3-lamp four-foot T12 fluorescent enclosed fixtures in the ice cream factory area. These work well, with the exception that two ballasts have failed, and there are no replacements. Also, there are no replacement fluorescent lamps available. As a general note, greater energy efficiency would have been attained had the contractor specified three T8 lamps with one 3-lamp electronic ballast. It is estimated these save about $ 100 per year.

2. **Steam Traps:** Almost all of the steam traps have been installed. According to the plant, there was a misunderstanding, and each of the eight plants received an equal number of steam traps, regardless of individual plant conditions. The steam lines and condensate lines in this plant are old and in need of extensive repairs. The plant technical manager believes that, although the steam traps work well, there is little impact on energy costs due to the leaky pipes. He said that it was "like sewing a new button on an old suit". In addition, almost all the condensate is dumped to drain, so the steam traps do not provide as much savings as if the condensate were returned. The audit team estimated annual savings of about $ 86,000. This seems high based on results seen in other plants. Although it is only a rough estimate one could ratio the savings seen at the ceramics plant (15/10 x $ 5840) to obtain a saving of $ 8760.

3. **Oxygen Analyzer:** This meter, made by Universal Enterprises, is not used by the plant. Since they do not know from day to day what the heating value of the fuel oil will be, they are not able to adjust the burner. Also, the technical manager said "they are not a laboratory", and felt that the measuring instruments would be more appropriate for a laboratory.

4. **Industrial Stethoscope:** This has been loaned to an energy consulting company for their use. The plant did not use the device.

5. **Dranetz Meter:** As with the industrial stethoscope, the plant has loaned the Dranetz electric power meter to the energy consulting company. The plant did not use the device.

6. Infrared Thermometer: The plant had the device on-site, but had not used it. It had no batteries inside it.

B. Status of Other Measures Recommended

None of the other measures recommended in the report have been implemented.

C. Specific Energy Consumption:

The plant had received the energy data form, but had not filled it in. They promised to send it in later but never did. Thus it is not possible to review trends in specific energy consumption.

The total annual savings from the equipment furnished under the is $ 8860.

D. Other Notes of Interest

1. The equipment just "arrived at the airport and we picked it up". No instructions were given on the operation of the equipment, and the instructions were not translated into Bulgarian.

2. Mr. Nanev, the technical manager, felt it would have been more appropriate for the audit team to have conferred with the plant to make a list of equipment appropriate for the plant, and then set priorities from the list, in consideration of the available budget. For example, a steam pressure reducing valve for the pasteurizers would have been a valued addition for the plant.

3. A contractor representative returned about July 1992 to check equipment operation. At that point the plant claims it expressed its concerns about the applicability of the equipment.

4. The plant is operating at about 30 percent of capacity. As in Romania, there are many fewer cows now than there were before the economic changes.

3.6 Parvi Mai (Textile Plant)

A. Status of USAID-Supplied Equipment:

1. **Infrared Thermometer:** The plant uses this device to measure thermal insulation, to look for major steam leaks, to do surveys of equipment before major overhauls, and to determine where thermal losses are that are not easily visible. Assuming energy savings of 0.5% of the plant annual total energy bill (approximately 10 million leva), the saving attributable to this device is estimated to be 2000 $/yr.

2. **Oxygen Analyzer:** The plant is very happy with this device. They adjust the boiler with it, and find that its small size and light weight makes it very convenient to use. They noted the double advantage of energy efficiency improvements and ecological protection. The plant did not give us an estimate of what the oxygen concentration was before and what it is now; therefore we are unable to make an estimate of energy savings. The audit team estimated savings of 258,600 kWh/year (they converted all energy savings to kWh/yr). With the average electricity price of 0.0258 $/kWh this gives a saving of $ 6670.

3. **Fluorescent Lighting:** These have worked well for the plant. There have been some ballast burnouts and some lamp burnouts, but the plant was supplied with enough spare lamps and ballasts to replace the burned out lamps and ballasts.

   The cost on the data sheet for these fixtures was about $290 per fixture. This seems on the high side but they are 220v/50 Hz units. A three-lamp parabolic fixture in the US costs about $100, including three T8 lamps and an electronic ballast. With the run hours of 2,000 hours per year, the payback for the energy savings will be very long. The payback may be calculated as follows:

   2,000 hrs x (94W - 70W) = 48 kWh per year per lumiaire saved

   Assuming the maximum electric price quoted in Bulgaria of about 5.4 cents per kWh, the annual dollar savings are $2.60 per year.

   The simple payback of this measure is then :
   $ 290 / 2.60 $/yr = 112 years.

   The plant stated that it had expected more steam traps but instead received lighting fixtures.

4. **Pressure Recorder:** This pressure meter is used to log steam pressure data, and it is moved from point to point in the plant. The plant has used this information to determine the levels of consumption of various steam loads.

5. **Industrial Stethoscope:** The plant has found that this is an excellent device, especially for testing steam traps. They have repaired or replaced many steam traps already. They have also used the stethoscope to locate faulty valves and then repair or replace them. The audit team estimated the savings from this device at $ 4200 per year; this seems reasonable. The plant would like to replace many more steam traps than it can afford. They requested that we look into sending some of the unused steam traps from the dairy plant to their facility.

6. **Portable Temperature/Humidity Meter:** The plant uses these devices to check temperature and humidity, and to control these parameters in their spinning and weaving areas. For example in the spinning area they want to keep the relative humidity down, to prevent the fibers from sticking together, whereas in the weaving area, they want to keep the relative humidity high, above 75 to 80 percent. The plant then controls humidifiers based on the relative humidity and temperature measurements it does.

B. Status of Other Measures Recommended in Report

1. The waste heat recovery projects mentioned in the report have not been implemented, due to their high costs.

C. Specific Energy Consumption

1. The plant did not have any data available regarding changes in specific energy consumption.

D. Other Notes of Interest

1. The plant is doing a pilot program of exporting 200,000 shirts to the US. As a general note, an American private consultant we met said that a strategy for privatization is to start an export business, show revenues from exports, minimize costs, and then show a present value of net cash flow to potential buyers.

2. The plant is now operating at less then 30 percent of full production.

3. The plant now produces only if there is an order for its product, whereas before it produced to meet production goals.

4. Hard currency is not a problem for this company. This was repeated by many of the other plants we interviewed in Bulgaria.

3.7 SUMMARY

The table below summarizes the savings in the eight Bulgarian plants as a result of the technical assistance and equipment supply. As noted above, some savings are given as ranges to include estimates prepared by the team.

ENERGY SAVINGS IN BULGARIAN PLANTS

AS A RESULT OF THE

PLANT	EQUIPMENT COST (K$)	SAVINGS (K$/YR)	PAYBACK PERIOD (Mo.)
Ceramics	21.0	28.6	9
Iron and Steel	15.4	328.3	< 1
Soda Ash	49.3	103.2	6
Ammonia/Urea	8.3	7.9	12
Milk Processing	30.3	8.7	40
Cotton Processing	31.7	13.2	28
Pharmaceut/ Chem	26.0	158,3	2
Poultry	32.2	110.7	3

THE CZECH REPUBLIC

Eight plants were audited in Czechoslovakia during the course of the. However, on January 1, 1993 the country was peacefully split into two new countries; the Czech Republic and Slovakia. The evaluation team visited the five plants which reside in the current Czech Republic. These are the Pragolaktos dairy plant, Branik brewery, Tofa wood products plant, the Cerny Dul fabric plant and the Autobrzdy auto parts plant. The other three plants which were audited are located in Slovakia. All eight plants showed significant potential savings as a result of the audits.

4.1 Autobrzdy s.r.o., (Auto Brake Plant)

A. Status of USAID-Supplied Equipment.

1. **Insulation of Valves and Fittings:** This is in place and working well. The pipes were already insulated, but the USAID program resulted in insulating the rest of the heating distribution system.

2. **Automatically Controlled Valves for Heating System:** These have been installed and are working well; they reset the hot water distribution temperature downwards as outdoor air temperature rises and heating requirements go down.

3. **40 Radiator Valves:** These have been installed and work well in many cases. However, in several places in the plant, some valve actuators were removed by plant employees. Plant facility staff then removed the remaining valves in the production areas to prevent removal. The valves that are not in service are not generating the savings that they would otherwise generate, since the valve actuator is what opens and closes the valve in response to temperature conditions.

B. Status of Other Measures Recommended in Report

1. **Insulate walls of Building D-2:** This has not been done, because the plant determined that the simple payback of the measure was too long to make it economical.

2. **Recover Heat from the Air Compressors:** This also has not been done, because a detailed analysis by the plant resulted in a payback period that did not make the measure economical.

3. **Install an Air-to-Air Heat Exchanger to recover heat from the electroplating processes:** Plant personnel informed the team they are looking into this project in conjunction with an American energy service company.

4. **Install an Air Curtain at a Truck Loading Dock:** This has not been done.

C. Specific Energy Consumption

Overall data were not available for this plant. However, the plant did have the following data regarding heating consumption before and after the measures were installed. This data is tabulated below.

1988	68,335 GJ	
1989	64,998 GJ	
1990	74,232 GJ	
1991	55,150 GJ	Improvements Complete.
1992	56,566 GJ	

Total typical savings are about 14,000 GJ per year. Of this, the plant estimates that about 1/3 may be directly attributable to the heating system improvements. Rounding this value to 5,000 GJ, at the 1992 rate of about $7 per GJ, the annual dollar savings would be about $35,000. The other 2/3 of the savings are attributable to new windows in the building, double doors, vestibules, and other similar measures. The may correctly take credit for all these modifications, bringing the total saving to about $ 105,000 per year.

D. Other Notes of Interest

1. The plant has been acquired by ATESO, a joint-stock holding company from Germany.

2. The plant is operating at full production, partly due to orders from the Skoda plant, which was recently acquired by Volkswagen AG.

3. A U.S.-based energy service company has signed an agreement for additional energy saving measures.

4. The plant personnel noted that the energy group now has more status in the eyes of the company's management, partly as a result of the USAID program.

5. The plant personnel noted that the increase in energy prices played a major role in their decision to proceed with the energy measures. Also, they commented that they are aware of potential projects, but are in need of capital to implement them.

6. The plant is installing new globe valves in the compressed air distribution system. This will reduce standby air leakage losses.

4.2 Cerny Dul (Textile Plant)

A. Status of USAID-supplied equipment

1. **New Burner:** A new oil-fired burner was installed. However, the plant has since switched to natural gas-only combustion.

2. **Steam Traps:** These have been installed, and work well.

Since the evaluation team arrived after the closing time of the plant, the team was not able to obtain specific data regarding the other measures. However, the team was able to meet

with the plant's production manager at his home in the nearby town. From our conversation with him we determined the following:

--The plant has been changing its production and is now manufacturing a variety of products, including handkerchiefs.

--Although the plant is aware of the importance of energy efficiency, the plant is focusing more of its attention on developing sales and surviving as a viable concern.

--Energy began to take on more importance as an operating cost after 1990.

The plant management, in a fax sent to the USAID office in Prague, said they could not supply us with energy cost data since they considered these data proprietary.

The plant is located on the side of a mountain, and has a stream flowing through it. It is likely that there is an abandoned water wheel in the plant. There may be potential for installing a small hydroelectric turbine in the plant generating electricity on-site. This electricity could be used to satisfy the plant's own power needs or exported to the electric grid. In a subsequent discussion with Milan Cerny of the Czech Ministry of Industry and Trade, we learned that there are about 15,000 abandoned small hydro power sites in the Czech Republic, of which only about 100 have been developed. The total power generating potential of these sites is about 2,000 megawatts under normal water flow conditions.

The audit report team estimated that the equipment (costing $12,425) would yield annual savings of approximately $ 40,600.

4.3 Tofa Albrechtice (Wood Products Plant)

A. Status of USAID-supplied equipment

1. **Danfoss Valves:** The valves were installed in early 1991 and have worked flawlessly since that time. The only negative point mentioned was that the traps below the valves collect some debris (thought to be rust) and are a minor maintenance problem. In fact, because of the very favorable experience with them, Tofa just bought and installed four Danfoss ultrasonic flow meters to measure steam supplied to external customers. Mr. Jiri Hubner, manager of the technical department, would like to install Danfoss valves in the apartment buildings (144 units) that they own. They would like to do this under a government-supported program and include additional insulation and individual metering in the plans. The employees in areas fitted with Danfoss valves feel their offices are now much more comfortable.

2. **Piping and Installation:** Installation of the new condensate piping was completed in the second half of 1991 and did improve the percent condensate return by about 10 percent. However, they still have high leaks, evidenced by the still low level of 70% return, and could use further piping upgrades.

B. Status of other measures Recommended in Audit Report

Tofa completed installation of gas burner units on their two 12T/h boilers in May and have completely stopped oil firing. They still, however, burn scrap wood from time to time.

The plant still has needs for continuous supplies of hot water and hot air for dryers. To satisfy these needs they are looking at two options: (1) a heat storage technology using pressurized hot

water, and (2) installation of an automated boiler system for nights and weekends. They have two bids from engineering companies to implement this; one from Energoprojekt (the principal subcontractor on the), and one from City Plan s.r.o. (this firm was recently founded by Ivan Benes formerly of Energoprojekt).

The contractor used an ENERAC 2000 unit to measure combustion efficiency and tune up the boiler during the audit. They did not note any large losses and Mr. Hubner is not too concerned about this aspect of energy efficiency.

C. Specific Energy Consumption

The Danfoss valves have resulted in fuel savings of about 11,000 $/yr. The savings in energy due to higher condensate return rates is difficult to estimate but a rough estimate is about $3100 for a total saving of 13,100 $/year.

Tofa has a number of electric motors in the plant totaling about 2500 kW. Their average power consumption is in the range 680 to 750 kW. They have no plans to install variable speed drives; they say they can't afford them.

They have no problems getting gas, oil, or electricity. There has been some talk of gas limitations but they can switch to oil when it's necessary. All transactions are in local currency (which is convertible) and have been for about two years.

D. Other Notes of Interest

1. After installation a contractor representative visited the plant in July 1991. Tofa sent a report on the work to the contractor in November 91.

2. A small installation problem was encountered with the Danfoss valves; the Danfoss units are a little longer and have tapered connections (the old ones had straight connections).

3. There was basically no follow-up from Energoprojekt.

4. They had an energy inspection from the State Energy Inspectorate in February 1993; Mr. Hubner claims the inspectors had a very positive view of energy utilization at the plant.

5. Tofa got calls from two other plants regarding the use of Danfoss valves with steam; these plants had gotten Tofa's name from the State Inspectorate.

6. Mr. Petr Hubner is the plant energy manager. He and Mr. Jiri Hubner generate the energy saving ideas in the Tofa plant.

7. Production is down now due to reduced demand for piano mechanisms. The normal value is 24,000 pieces/yr but is now 18,000 pieces/yr. This is due to a combination of the generally poor economy in Europe and competition from electronic units. Toy production is going fine. Wood prices have gone up a little since most of the wood comes from Slovakia and is now subject to import duties and other fees imposed since the breakup of the country.

4.4 Pivovar Branik (brewery)

A. Status of USAID-supplied equipment

1. **Piping Insulation:** The supplied the brewery with a boiler feed water preheater, valves, and piping insulation. They felt the insulation upgrade was the most valuable part of the program.

The USAID program really got them thinking about insulation and they have added more insulation subsequent to the completion of the USAID program. They felt it was very good that both technicians AND managers became more aware of energy savings. They had no estimates on energy savings due to insulation upgrade but the audit team estimated savings of $10,000 for this.

2. **Boiler Feed water Preheater:** The feed water preheater unit was installed but was only operated for a short period of time. New boilers they installed came with feed water heaters; the USAID- supplied unit will be installed on an old upgraded unit. Therefore, the estimated $ 35,000 saving will be realized at a later date.

3. **Valves:** Mr. Novak, head of the mechanical engineering department. said the USAID valves were installed in the building heating system but didn't know which ones they were. He had no information on their performance. He did say that the Czech valves they had been using didn't handle fluctuating steam pressure very well.

B. Status of Other Measures Recommended in the Report

1. They have done a lot to try and reduce steam leaks but said it's an uphill battle. The piping is old and the recent construction disturbed some pipes which have sprung leaks.

2. The brewery is in the process of switching over from oil to gas. They have done a lot of remodeling in the last year or so. This work had been planned for some time so it is surprising that this plant was chosen to be included in the audit program.

C. Specific Energy Consumption

No quantitative data were available.

D. Other Notes of Interest

1. Unfortunately, Mr. Ruzek, who had worked closely with the USAID team, was not available for discussion since he had left the company about six weeks earlier. Initial discussions were held with Mr., Novak who knew nothing about the USAID program. Later, Mr. Smejkal, who had participated in the program with Mr. Ruzek, was able to join the meeting later and supply the information needed.

2. Through the work on the USAID program and commercial contracts with German firms for brewery equipment they learned that more could be demanded from their local contractors.

3. They thought the USAID contractor did a good job; they caught on quickly, gave good recommendations, and followed up.

4. For the boilers they have requested that the burner suppliers and the SEI come and inspect the burners.

5. When asked if there was any interest in an energy service company, Mr. Smejkal said it would depend on the numbers.

4.5 Pragolaktos (Milk Processing Plant)

A. Status of USAID-Supplied Equipment:

1. **Automatic Temperature Control System:** This system, provided by Johnson Controls and Ecotherm of Bratislava, was completed in September of 1991, and has worked without any problems since that point. The plant is very happy with the system.

The system starts and stops zone circulating heating pumps, and provides outdoor air temperature reset of the heating circulating water. It lowers the temperature setpoint of the office areas after 5:00 p.m., and raises the temperature in production areas at night to improve worker comfort. Thermostatic control valves on the radiators also are a part of the system.

The system cost about 1,000,000 Czech Krone (about $33,000), and the plant estimates that it has saved about 20 percent of the heating-related annual energy consumption, amounting to about 80,000 Kcs per year (about $2,700). The dollar savings are relatively low because the steam rates are fairly low (about $2.30 per MMBtu). As a point of reference, steam rates in major US cities in district steam systems are typically about $10 to $15 per MMBtu. Similar rates in Prague would yield yearly savings of approximately $ 15,000 The low steam rate is a result of a new rate setting policy for district steam, in which rates are set based on local power plant operating costs, rather than overall system costs.

B. Status of Other Measures Recommended in Report:

1. **Check Valves on Cooling Tower Pumps:** These have not been installed. The plant recently replaced its thirteen old cooling towers with eight more efficient cooling towers. This project was done with Pragolaktos' own funds.

2. **Repair Leaks in the Main Pressure Reducing Station:** This has not been done. In order to do the repairs, the plant informed the team that they would have to shut down, since this is the main steam service to the plant. The team suggested various ways that the plant might make provisions to minimize the down-time during the repairs, such as renting a temporary boiler.

3. **Repair Pump Packing Leaks:** This has not been done.

4. **Repair/Replace Check Valves:** This has not been done.

5. **Repair of Automatic Control of Condenser Pumps:** This has not been done.

C. Specific Energy Consumption

The plant did not provide the team with energy data. Since the plant makes numerous products, numbers for specific energy consumption would not be useful unless they were broken down by product.

D. Other Notes of Interest

1. The plant was very happy with the program, and was looking forward to the possibility of more funding for capital-intensive projects.

2. The plant had already begun replacing fluorescent lighting with HID lighting, and as electricity rates have risen, it is doing this at a faster pace.

4.6 SUMMARY

The table below summarizes the savings in the eight Romanian plants as a result of the technical assistance and equipment supply. As noted above, some savings are given as ranges to include estimates prepared by the team.

ENERGY SAVINGS IN CZECH PLANTS

AS A RESULT OF THE

PLANT	EQUIPMENT COST (K$)	SAVINGS (K$)	PAYBACK PERIOD (Mo.)
Auto Parts	9.6	105.0	< 1
Textile Processing	12.4	40.6	4
Wood Products	11.1	13.1	10
Brewery	9.8	10.0	12
Milk Processing	35.5	2.7	157

APPENDIX H

A Success Story at the Bucharest South Combined Heat and Power Station

"These are my Jewels".

With these words and a broad smile, Ing. Gavrila Sofran, plant manager of 550 MW Bucharest South power plant, proudly began his description of the monitoring and measuring equipment financed under USAID's Emergency Energy Project in Romania. Patiently and in precise self-taught English, Mr. Sofran moved from instrument to instrument and last to his personal computer to explain how important each item was to his operation.

The Bucharest South plant supplies 50 % of the electric power in Romania's capital city as well as 50% of the hot water that feeds the centralized heating system (district heating) for Bucharest. The plant consists of six generators for electricity fueled by natural gas or fuel oil, the first four Russian equipment put into operation in 1974 followed by two additional Czech units of 125 MW each installed in 1975-6. The system contains 16 hot water boilers. The plant produces 1300 MW for heating and 400 MW in winter. The fuel mix shifts from 60-70% fuel oil vis-a-vis natural gas in winter to entirely natural gas in summer. South Bucharest's fuel bill is estimated at $19,600,000 per year. The 550 MW plant would have a replacement cost at $1.5 Million of $825,000,000.

Based on efficiency improvement estimates provided by the plant, an independent evaluation team calculated that the Bucharest South plant has saved $411,000 per year from the introduction of measuring and monitoring equipment (flue gas analyzer, heat thermometer, flow meter, electronic power analyzer). These savings provide a payback of one month for the equipment which cost $35,000. The massive energy savings at the plant resulted from having accurate and up to date information which enabled Mr. Sofran's management team to fine tune the operation of the system.

Significant changes in plant operations made possible by availability of the USAID-financed equipment include:

- The plant now changes its burner nozzles once per month because it discovered that the pressure from the burning process erodes the nozzles and the fuel efficiency drops thereafter. The fuel flow meters enabled the management team to identify this problem of which it was totally unaware. The recommendation to change burner nozzles has now been made to all power plants in the Bucharest system.

- The plant eliminated the use of 2 recirculating pumps from the fuel oil supply and saved about 300 kW of fan power when combustion air quantities were reduced.

- Mr. Sofran has developed his own monitoring and information system on the PC, which now contains historical records and current information on plant operations. As a result, Mr. Sofran now knows almost instantaneously when there are problems in the plant's operations requiring adjustment or repair. As with his English, Mr. Sofran taught himself to use the computer with no outside help or training.

Mr. Sofran recently conducted a test comparison of the performance of the Czech generators with the same equipment installed at the same time at Bucharest West. The test results, accepted by both plant managers, demonstrated the reruns from the technical improvements made possible by the measuring instruments. The tests showed the same production efficiency at each plant, despite the fact that South was burning low quality fuel oil with high sulfur content (4.5%), and West was burning high quality natural gas. The West plant manager, in a separate interview to assess West's comments on the test comparison, confidently stated he could save at least 1% on energy use with the USAID-financed equipment.

The success from the introduction of the measuring equipment is all the more remarkable because Mr. Sofran's production group (South, West and three other plants in Bucharest) apparently gives him no incentives to save energy. He does, however, bring a professional and personal commitment to the successful operation of his plant, a commitment quickly seen by a visitor in the clean and well-maintained though aging plant. Bucharest South plant does not control the type of fuel it burns nor can the plant independently purchase equipment under the still rigidly centralized system. Financial data is not kept officially at the plant level, and therefore the extent of savings from more efficient operations is probably even higher than indicated from the evaluation team visit.