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COMPONENT #1: INDUSTRY PROFILE REPORT CZECHOSLOVAKIA

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U.S. EMERGENCY ENERGY PROGRAM FOR EASTERN AND CENTRAL EUROPE

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I. Executive Summary

The Czech and Slovak Federal Republics (CSFR) face unprecedented energy problems including uncertain oil supplies, pollution from coal, and questions about the future of nuclear energy. The Czechoslovakian industrial sector has experienced large increases in energy prices, the latest in January, 1991, as presented in Table A-1 Appendix A. Cost of fuels to the CSFR industrial sector are typical of those in the US. However, heat (steam and hot water) at $4.00 per million btu and electricity at 2.5 cents per kWh are at the very low end of the cost range in the US. Ministry of Economy officials said that there were no subsidies in the prices.

At the same time, the country has embarked upon a fundamental economic structural reform from a centrally managed national economy to a market economy. Energy utilization had been managed on an allotment basis with the State Energy Inspectorate established to mandate energy efficiency improvements and assess penalties for non-compliance. Two main facts have characterized the energy situation in Czechoslovakia over the past twenty years.

1. The entire national economy, including energy, was managed directly through the central authorities. Consequentially economic incentives and tools to achieve efficient use of resources such as prices, tariffs and taxes played a very small role.

2. During this period energy demand exceeded supply. The State Energy Inspectorate was set up to penalize for over consumption and enforce energy conservation, but had insufficient training, staff and enforcement capability to have a significant impact.

Despite the disconnection between energy production cost and energy prices paid by industries, energy intensity has been decreasing over the past several years (as is shown in Table A-2, Appendix A). However, the energy intensity of CSFR industries remains high.

The U.S. Agency for International Development established the Industrial Energy Efficiency Improvement Program to help mitigate the impacts of increased energy costs on the industrial sector. The program provides technical assistance through energy audits and economic support through purchase and installation of energy conservation equipment in selected representative industrial plants.

The Industrial Energy Efficiency Project is based on four distinct tasks:

1. Industrial plant screening
2. Industrial plant energy audit
3. Policy analysis
4. Implementation

Screening of 15 industrial plants was accomplished to provide a basis of selection of the plants to be audited. Criteria used in this selection included;

1) opportunity for energy savings (with a focus on oil savings),
2) potential replicability of energy saving options in similar plants or systems,
3) future viability of the plant in the changing economy,
4) size of the plant, and
5) other activities such as joint ventures or other bi-lateral aid projects.

This process resulted in the selection of eight plants which were the subject of one-week energy audits.

Observations and qualitative data acquired during the screening process and subsequent audits, together with discussions with government officials are the basis for the conclusions and recommendations presented in this report. It should be noted that the largest plant visited in the Czech and Slovak Federal Republics during this project was the Biotika Pharmaceutical plant. Biotika had a nominal steam requirement of 60 tons per hour and an electric demand of 6 MW. Some of the plants visited obtained energy from district heating networks serving multiple plants while most of the plants independently produced their thermal requirements and purchased electricity from the grid. Three of the plants audited had cogeneration systems but none sold electricity back to the grid. It is from this limited sampling of industrial facilities that this industrial profile report is developed.

Czechoslovakia has historically has plentiful energy supplies in the form of coal. The use of coal has contributed to the environmental problems the country is facing which has led to a decision to reduce the reliance on coal, especially brown coal or lignite. This decision obviously puts greater demand on other fuels. Czechoslovakia imports its oil from the Soviet Union, with a pipeline running the length of the country. Due to problems within the Soviet system, it is expected that the Soviets will only be able to supply approximately 80 to 85% of the normal Czechoslovakian demand. Oil burning also has environmental problems.

The country has several nuclear plants, but the older plants have inadequate safety measures (measures that do not meet international standards). Some of Czechoslovakia's neighbors are opposed to nuclear power, which has created additional concerns for the CSFR government.

Energy hopes for Czechoslovakia lies mainly in additional use of natural gas, and the possible construction of a new oil pipeline from the Adriatic Sea. Although the use of natural gas has increased, the infrastructure of gas distribution piping does not yet exist to allow a large shift in gas consumption. The oil pipeline would provide high grade crude oil the Czechoslovakia, but it is a long way from being built. Fuel supplies will continue to be

a major factor in Czechoslovakia's efforts to improve the environment and to conserve energy.

Based on observations at the plants, audits in the selected plants, and discussions with government officials, there were several areas of training, technology adoption and technology transfer where significant support could be provided to the Czech and Slovak industries. Capital investment on the part of these industries will have limited opportunity at this time due to the lack of domestic and foreign capital. Specific recommendations are listed below, and described in Section V.

A. Training

Training needs were evident in a number of areas, including:

1. Industrial energy demand management programs
2. Electric demand management programs
3. Software and training optimizing interactions with district heating systems
4. Methodologies in energy economic evaluations
5. Detailed training in energy audit at the plant level
6. Process energy reduction methodologies
7. Develop mechanisms for enhanced dissemination of information
8. Boiler tune up and boiler efficiency training

B. Institutional Development

Several private sector development opportunities were identified. These include the following:

1. Energy audit capability
2. Suppliers of energy conservation equipment
3. Capital for major equipment installation
4. Building and equipment standards

In addition to these opportunities, there are institutional development needs in the areas of fostering the development of private firms in engineering, auditing, construction, equipment supply, and government provision of building and equipment energy standards.

II. Observations on Industrial Energy Utilization

Energy pricing within Czechoslovakia is being completely remodeled. Energy prices, historically subsidized by the government, had not changed appreciably in the last twenty years prior to the January 1991 increases. The move to a market oriented economy is causing many changes to take place, including establishing cost-based prices of energy. There has not been a sufficient accounting over the years to determine actual cost of each energy source. In addition, the environmental costs of utilizing various fuels have been ignored.

Increases in energy prices to equivalent world prices has put pressure on industrial firms to conserve energy. Changes within the system (energy prices, privatization, etc.) will create a new emphasis on the necessity to increase energy efficiency and reduce energy intensity of production. Along with the industrial audit program, the overall program will provide training on energy efficiency practices and measures and energy management.

Allocation of energy to the large and medium users is based on estimates for the annual and quarterly projections made by the plant. Due to the low energy price, the industries' primary concern was production. The practicality of the allocation system of consumption and demand management, however, was very subjective and did not necessarily reflect the real demand for energy of the individual customer. This system did not support the rational use of energy consumption, but in some cases only mandated savings determined by the State Energy Inspectorate. Finally, there was a high administrative intensity to the system, engaging hundreds of employees in the power industry in consumer interactions and in the state administration.

Electricity prices and tariffs played a minor part in this system, even though the tariff system is not very different from tariffs of the market economy countries, with the exception that prices are highly subsidized. Large customers use either three-part tariff (peak demand, high and low rate) or two-part tariff with a charge for the highest measured demand. The economic ineffectiveness of the tariffs is based on two factors: 1) the low price levels (resulting mainly from subsidies in the construction of new power stations), and 2) large customers could automatically pass on all energy costs in the prices of their products which were centrally allocated within the economy or for export.

Penalties were imposed for consumption both over <u>and under</u> the projected electric energy consumption and for peak electric demand which exceed the projected value. Penalties for under consumption tend to limit effectiveness of energy conservation opportunities. By far the largest penalty was associated with exceeding planned demand. In the case of exceeding the planned demand, the large and medium customers were seriously affected financially (roughly eight to tenfold the normal price under previous price structures). A part of this financial penalty had to be paid directly by the responsible persons (director of the enterprise, person responsible for the energy consumption, etc.).

The electric rate structure, shown in Table A-3, Appendix A, is a sophisticated tariff with a time-of-use energy component and a high demand component. The demand component represents approximately 60 percent of the average cost per kWh. This is significant since there is a growing shortage of capacity. Until the most recent cost increases this had little impact because of the subsidized pricing of energy. Each industrial customer had to nominate or state a planned demand and consumption for the month. A very significant penalty currently is associated with exceeding the nominated demand. Demand is monitored on a 15 minute basis and if the demand for a 15 minute period exceeds planned demand, the demand charge increases from 195 Czechoslovakian Krowns (KCS) per kW ($US 7.00 per kW) to 450 KCS per kW (US $16.15 per kW). Even prior to the price increases, this was a significant penalty and three of the companies audited have cogeneration systems that are used as peak shaving systems to manage peak demand and avoid the possible penalty. With industry being penalized for not consuming the planned energy, the effective take or pay nature of the tariff severely limits the effectiveness of energy conservation improvement equipment.

Almost all industries contacted in this program were in the process of incorporating the ability to burn natural gas in their oil boilers to provide dual fuel capability. There is a major concern about the reliability of the oil supply from the Soviet Union. The result is that industries are willing and able to invest in equipment that allows fuel switching based on availability and price. Using natural gas as a primary fuel will also effect a reduction on air pollution.

One company, TOFA, has the ability to store a 45 day supply of fuel oil. They use this storage capacity as a hedge against supply interruptions as well as a means of dealing with price fluctuations(as was the case during the Gulf Crisis).

Several major concerns have developed over the past two years that are currently effecting management decisions.

1. Increasing energy costs are recognized as a threat to their domestic and international competitive position.

2. Reliability of energy supplies are critical to assure continuous operations. Interruption of the energy supply represents major losses of products in progress. Efforts are made to assure such reliability, even at the expense of increased energy costs, by operating standby energy supplies.

3. Due to the uncertainties regarding future availability of major fuel supplies and energy cost structures, the strategy is to develop multiple fuel utilization capabilities and continue to maintain self generated and purchased electrical power options.

4. Environmental impacts of burning brown coal and heavy oil are of serious concern to the management, and to this end, natural gas is the preferred fuel for steam generation. However, unless firm supplies of gas can be obtained, the coal and oil options must be used. As yet there are no plans to install pollution control measures on their boiler plants.

At most of the plants visited, there were many problems that could be classified as poor housekeeping. Steam leaks, faulty steam traps, poor steam pipe and condensate pipe insulation, and poorly tuned boilers were common. When the visible problems were pointed out, technical directors acknowledged that they should be fixed, but there was no indication that they would be. Part of the problem appears to be that they did not really understand the cost of these apparent small problems. Plant management has no experience in economic evaluation and do not have access to technical literature which demonstrates how to evaluate the effectiveness of housekeeping improvements. In addition, there are management structure problems. There has been a tendency for industry to develop large pyramid-style management structures where departments, such as energy and maintenance, do not communicate with each other until at a very top level where production concerns tend to over power everything else.

For these housekeeping types of energy issues to be addressed, it is necessary for top management to provide direction to the maintenance and production departments. There appear to be several reasons why factory management has not responded to these obvious energy efficiency improvements. Issues underlying the lack of management support are summarized as follows:

1. Long-term experience has been under a system of allocation of energy where energy savings were not reflected in savings to the plant. In addition, initiation of energy savings activities resulted in a reduced allocation of energy.

2. Until the past two years energy was heavily subsidized and the cost savings were not viewed as significant.

3. A base of experience does not exist in doing cost-benefit analyses on components of the factory process. While management does understand the impact of the current high energy prices, they are not able to appropriate into the decision making process as a realistic trade-off of the small expenses associated with housekeeping procedures and the benefits that can be realized by current energy prices.

4. There is a lack of monitoring equipment to provide sub-metered data on the actual energy use of elements of the factory process.

5. There is a lack of skills and experience in project management that will allow management to plan and schedule housekeeping tasks and system modifications to accomplish energy conservation improvements. Past experience has taught management that it is not possible to plan and schedule the completion of project within the time frame required for short pay-back period projects that are consistent with low/no cost energy conservation opportunities.

III. Management and Decision Making Practices

There are a wide variety of management styles associated with energy management, with the best being found at Biotika Pharmaceutical where the cost of energy represented approximately 25 percent of product cost. Biotika's top management is at this main plant which facilitates decision making. Capital decisions at some other plants that were parts of larger organizations, were made away from the site, which slows the decision making process and limits management follow-up. Management and decision making processes at Biotika demonstrate what can be done when attention is given to energy.

Biotika Pharmaceutical produces raw penicillin, Terra-Chloro-Cycline and amino acid cultures for further processing and packaging at another company plant in nearby Martin, CSFR. This plant is perhaps the exception that proves the rule; management has a very good grasp of energy use and economics. Since October 1990, management has instituted a low-cost/no-cost energy conservation program and have reduced energy consumption per ton of product by 15 to 20 percent. Measures have mainly included an intense campaign of steam trap maintenance and leak repair. There have also been electrical conservation measures instituted on large motor drives such as two speed motors for fermentation tanks, gear drives replacing V-belts, etc. The plant has recently completed a repiping of the cooling water system to reduce the use of river water for cooling by cascading the use in the various processes. They have an extensive network of metering of steam, water, and electricity use so that energy use for each batch of product can be closely measured.

Even with the excellent management program, plant personnel displayed some of the attitudes about energy seen generally in Czechoslovakia. Steam traps, for instance, are generally regarded as working if they are not blocked, and concern was not so great if the trap was leaking steam through to the condensate line. A somewhat cavalier attitude was taken toward space heating since the heat supply was from recovered condensate heat and back pressure steam. Since the turbine driven air compressors produce more low pressure steam than can be used by technologies (a general term for the process work) the space heat was regarded as a convenient heat sink. No control of space heat (furnished at point of use by ceiling radiant panels) was possible in the building. Consequently, room temperature control in mild weather is by the "open window method". There is also a general lack of modern test equipment. Computer monitoring systems for the energy systems and process control have been budgeted for but not yet approved.

In general, the audit team felt the Biotika plant had an energy program that could in some respects be the envy of many US plants. The major suggestion at Biotika is that the energy awareness exhibited by the senior management and enforced through the energy division be expanded and communicated to the lower levels. In addition, the plant needs modern test equipment to further it's energy reduction goals by identifying and quantifying opportunities.

Biotika has a strong vertically structured energy awareness and conservation management team headed by the Technical and Investment Director. They have implemented many major modifications to their processes and equipment and have experienced savings from these actions. The results of these efforts are among the best the audit team has seen not only in Czechoslovakia but in the United States. Although the energy management and conservation efforts have not been formalized within the management structure, it was apparent that energy availability, costs, and environmental effects are among the management's top priorities.

Biotika has the highest intensity in product production of the plants in the Czechoslovakian audit program. The level of process technology is also high and has made them aware of what is happening on other pharmaceutical plants in the world. They have had some discussions with joint venture partners and have had portions of their companies excluded from these discussion because of high costs. The combination of these issues has made the Biotika management very aware of the need for a good energy conservation program.

The energy management team has developed a prioritized approach to implement energy conservation measures that has significant savings of energy costs and payback in less than 1-2 years, increases the reliability of energy supply/distribution and improves the quality of their products. The management documents almost every aspect of their energy costs and utilization. Some improvement in documentation could be made by installation of energy monitoring equipment.One area that appeared lacking in their overall energy conservation program was the inclusion of all the workers in an energy conservation awareness program.

Typically, energy management has not been practiced in Czechoslovakia, at least not as it is in the West. There has not been an incentive to conserve energy, either in the commercial/industrial sectors or in the residential sector. This has been due largely to low energy prices and an emphasis on greater production. Many plants in Czechoslovakia consume large quantities of energy in producing their products. Obvious energy wastes (such as steam leaks) are present in every plant, and simple low cost improvements have not been made since the concept of saving energy has not been developed. The recent, abrupt rise in energy costs will assist in developing this energy cost awareness.

One of the most dramatic examples of this lack of concern was evident at the Masný prûmysl písnice, a meat processing plant in Prague. Steam leaks were everywhere, and it was estimated that they return only 25% of the condensate to the boilers. During this past year, plant personnel became aware of the energy waste in the steam leaks. But rather than repair the leaks (which they assumed were too numerous), they raised the steam pressure, assuming that the steam would travel faster and therefore there would be less steam escaping through the leaks. Obviously this conclusion is incorrect, but it points out the need for basic energy management training.

IV. Energy Services Capabilities

Commercial energy services are being offered by several private companies and components of current State agencies that will soon, or no longer, receive state subsidies. These emerging firms are in need of training in the area of economic analysis. Some, such as EKEN (see Appendix B), offer a wide range of services but do not seem to have the expertise to back up their offering. This appears to affect both technical skills as well as management capabilities in planning, scheduling, manpower allocation, and estimating.

Some of these companies are offering audit services, but do not have the monitoring equipment to successfully accomplish the audit. EGU, the state power research institute, has a division they intend to spin-off as a private company that operates ENCONET - Industrial Energy Conservation Network. This division is supported, in part, by the United Nations Industrial Development Program which has provided an "Energy Bus". However, there is not sufficient funding to provide the monitoring instrumentation necessary to effectively equip the "bus". In addition, there is a concern that past operating experience as a government agency will limit the effectiveness of this organization in the private sector.

ENCONET also acts as an agency to disseminate energy conservation information. Because the CSFR has been relatively closed to the western economies, there appears to be only a limited indigenous base for ENCONET to draw on in providing needed information. The previous low priority given to energy efficiency has also limited the availability of energy consumption data at the process level. This limits the potential identification of areas with the greatest potential for energy conservation improvement.

RMA entered into a subcontract agreement for technical support services with two host country firms in the CSFR, one in each republic. These firms assisted in the specifications, procurement, installation, and support for the equipment supplied to the eight plants audited under the USAID program. These firms are Energoprojekt and Electroprojekt.

Energoprojekt, headquartered in Prague, is a very large firm which operates throughout the CSFR, primarily in the areas of engineering design and construction management. The firm now employs 1500 people, down from approximately 2400. It is expected to divide into two entities in the near future, most probably along technical lines: one of the resulting firms would carry out engineering design and the other would manage construction projects. Energoprojekt is also expected to be part of the first wave of privatization in CSFR.

Electroprojekt was at one time nearly as large a firm as Energoprojekt, employing some 900 people. It has now been split up into much smaller firms: it employed 250 people at the start of its involvement in RMA's project, and now employs 56. This reduction has occurred primarily because of division into smaller firms handling specific technical areas. It has also divided to some extent along geographical lines. Electroprojekt in Banska Bystrica carries out engineering design for small boilers and electrical systems. It is

operating independently of the state, to a large extent, depending on fees for all revenues. It is expected to be part of the first wave of privatization in CSFR.

In addition to the two engineering subcontractors, RMA has an ongoing relationship with SEVEn, the Energy Efficiency Center in Prague. SEVEn is a non-profit, non-governmental organization which applies energy efficiency to the twin goals of economic development and environmental protection. SEVEn has participated in all phases of the RMA project in CSFR, offering invaluable support services, as well as office space and other facilities.

SEVEn is playing a key role in cataloging the development of private sector development in energy efficiency services in the CSFR. It is working closely with several consulting firms to facilitate their entry into the energy efficiency field, though the fostering of contacts with foreign firms, international funding agencies, etc. SEVEn is organizing an " Energy Efficiency Business Week" for mid-1992 in Prague, and is working on the participation of U.S. companies.

Energy audit equipment was procured and sent to CSFR at the beginning of the Energy Assistance Program, to be used by the energy auditors in their studies of the eight factories audited under the program. After the completion of the audit phase, this equipment was left in country, and has since been given to the CSFR government under a plan approved by USAID. A firm called INORGA was selected to administer the equipment, leasing it out to other firms and organizations for use in energy audit and efficiency work throughout the country.

The equipment is now in the hands of INORGA ITS, a private subsidiary of the larger state-owned firm, INORGA Ostrava. They are a private company with 14 employees; 11 of the staff members hold stock in the company. The charter of the firm includes design, procurement, installation, and training for automatic energy and environmental control systems. They have already been working in a number of large plants such as steel mills, developing algorithms and system specifications for control systems based on the directives of the technical staff of the customer firms. They have carried out some efficiency improvement work on large furnaces in the steel mills, but did not carry out the original efficiency analysis. The energy auditing equipment provided to INORGA ITS will enable them to carry out data collection and efficiency measurements, and provide a more complete service, from analysis to installation and training. The audit equipment will reside in an independent cost center within INORGA. The main project group will be required to lease equipment from the equipment center, paying the same rates as outside agencies.

Organizations in CSFR have shown considerable interest in gaining access to the U.S. equipment demonstrated in the program. Electroprojekt plans to participate in the leasing program for the equipment provided to INORGA. They intend to get involved in energy audit work, and also to help specify the energy efficiency equipment recommended as a result of the audits. To this end they are obtaining catalog information from a number of

U.S. suppliers who were involved in the USAID project. Several of these suppliers have already shipped catalogs to them. This service will be very valuable in the CSFR marketplace, where it is often very difficult to obtain information on what industrial products are available outside the country. An industrial products registry such as the Thomas Register, with entries for hundreds of thousands of products and companies, would be of tremendous value to them.

V. Program Recommendations

Based on the above discussions, several recommendations have been developed to provide support to the CSFR industrial energy sector in meeting their concerns for energy cost, availability and environmental impacts. These recommendations focus on training with limited direct equipment and demonstration project support. Design of larger demonstration and equipment projects will take a more detailed understanding of the industrial energy economy. Supporting data for the following recommendations can be found in Appendix C.

Education and Information Awareness

1. Industrial energy demand management programs

   A uniform lack of an organized company-wide energy management program was evident at the companies contacted. Biotika, the most energy intensive, has a good start but needs monitoring equipment, data management computer software, and a wider involvement of all workers regarding energy conservation.

   Several companies showed a lack of management structure to provide proper maintenance for their energy distribution systems. This is partially due to the fact that maintenance was in a separate organizational line from energy. A lack of understanding of the need for good energy system maintenance and "micro" energy economics.

   Plant management have no experience in doing energy economic evaluations at the plant and especially the process level. This is partially due to the lack of energy use monitoring equipment. More importantly, there was no reason to do economic evaluation when energy prices were heavily subsidized. With higher prices, there is an immediate need for training in energy economics to optimize the utilization of energy and minimize cost.

   Energy management training programs should lead to a certification of energy managers. Criteria and testing for energy managers should be established to define and identify minimum levels of competence of energy management and energy services personnel.

2. Electrical demand management programs

   Reviewing electric energy billing data indicated that there was a large difference between the peak electric demand and the average demand at these facilities. Penalties regarding power factor have provided economic incentives for companies

to install power factor correction devices. Re-structuring of the electric tariffs and contracts could also provide the economic incentive for improved demand management. There appears to be good potential for energy management systems to provide savings by increasing the load factor at the plants. Cogeneration systems also provide a means to control peak demand and optimize systems.

3. Interactions with district heating economic assessment

Several companies purchase or supply steam to district heating systems. In some cases where small companies supply heating to a local district heating system, that heating requirement had become the driving factor in sizing and operating the plant boilers, yet the economic justification for the industrial plant appeared to be lacking. There is a need for training in evaluating energy economics to determine the supplying plant thermal and electric energy requirements as well as the export of these products.

4. Additional monitoring capability

There is a wide-spread need for energy utilization monitoring equipment and data management systems to provide evaluation and management access to the data.

5. Industrial energy audits

All plants contacted had good records on overall energy purchases, but most did not know the flow of energy within the plant. Training in various levels of energy audits is necessary to provide the methodologies for energy audits so that the plant energy manager can understand exactly where the purchased and produced energy is going. There appears to be a significant lack of understanding of the magnitude and cost of energy losses.

6. Process energy conservation

Process energy reduction was not addressed in this current RMA program. This was due to limited time in each plant to develop a detailed understanding of the process as well as a lack of process energy utilization data. Process energy conservation has not been addressed in the plants visited in Czechoslovakia, and it appears that there is substantial opportunity for savings in this area. Process energy reductions can be identified and demonstration projects can be defined for specific technologies with experts in specific equipment and/or systems. This type of training could have a wide-spread, general audience.

7. Enhanced dissemination of information

The quality and quantity of data on energy conservation and process energy reduction need to be enhanced. EGU - Power Research Institute is the secretariat for the UNDP/UNIDO project "Industrial Energy Conservation Network", ENCONET. The US Department of Energy has extensive information systems and a library of publications that could provide significant support to the ENCONET project. SEVEn could also be used effectively in information dissemination activities. It is currently working closely with emerging private firms to facilitate their entry into providing energy services. Ongoing work includes the establishment of an energy managers association and a network with U.S. suppliers of energy efficiency equipment.

8. Boiler tune up and boiler efficiency training

In all cases but one, boilers at the plants visited were operating below design efficiency. Boiler efficiency improvement workshops could provide training to operating personnel that will result in operating improvements. Access to and training in the utilization of boiler performance monitoring equipment is also necessary to maximize the boiler performance.

Institutional Development

Several private sector development opportunities were identified. These include the following:

1. Energy audit capability

There are few private sector firms to provide energy audit services. Several firms intend to enter into this market but lack training in detailed energy audits, energy economics, and experience in implementing energy conservation measures.

2. Suppliers of energy conservation equipment

Energy efficiency equipment suppliers should be encouraged through demonstration projects funded by third party grants or discount loans. This would help establish an equipment supplier base in the CSFR.

3. Capital for major equipment installation

The former communist system did not allow for the development of private or corporate capital. Therefore, there is a shortage of domestic funds that is an

obstacle for implementation of many energy and process improvement projects. A carefully planned Industrial Loan Fund for industrial energy conservation demonstration programs could help bring in equipment suppliers and demonstrate the effectiveness and reliability of energy conservation equipment. Joint ventures with U.S. firms would also increase access to capital and equipment.

4. Building and equipment standards

As energy efficient equipment becomes available, it would be effective to have standards to ensure that buyers knew that equipment was certified so that the most effective equipment for a given application could be selected. Building space conditioning is a major energy consumer in all of the industries that were a part of this current program. There appears to be no standard with which these buildings were designed or standards for the control of the interior environment. A properly designed set of equipment and building standards could lead to a cost-effective reduction in energy consumption and improvement in the working environment.

Energy Efficiency Technology Adoption

The adoption of energy efficiency technologies and measures requires a restructuring of industry, as well as restructuring the thought process. Every individual should become aware of the cost and impact that energy has on their product and their job. Employers need to direct some resources to making employees energy conscious and to look for ways to eliminate energy waste. The viability of companies can be greatly enhanced by energy cost-cutting measures, so that the facility can maintain production with less energy.

These types of improvements can be very effective and can quickly help a company improve its financial status. But the company must wholeheartedly adopt this concept and then pass it on to the employees. Rewards or incentives can be offered, and typically the return far outweighs the investment in the incentives.

During the transition period, the government can also assist the emerging company in establishing this energy conservation consciousness. In the U.S., the government assisted various industries or facilities with either energy improvement grants, low-cost loans or participated in demonstration efforts. Utilities in the U.S. also offer financial and/or technical assistance for energy conservation, since these programs can reduce the demand for electricity at a cost lower than increasing the equivalent supply, allowing the available supply to go further. This delays the need to add additional power plants, an expensive and time consuming process in the CSFR.

Energy Efficiency Technology Transfer

There is a tremendous need within Czechoslovakia to provide energy efficiency training. This training is essentially non-existent, and although the technical education of the engineers is good, they have not been exposed to energy efficiency concepts. This type of training can be provided through many sources, including outside assistance from the U.S. and other Western countries, in the form of seminars, workshops, or even technical videos and references. Another way in which technology could be transferred is through professional organizations which promote discussion of ideas and concepts. Finally, specific industrial associations could help in discussing process improvements germane to certain industries.

APPENDIX A
ENERGY DATA

Table A-1: Wholesale Fuel Prices

Fuel	Current Price	Price Prior to to 1991	Percent Increase
Sorted brown coal	47.1 Kcs/100 kg	31.4 Kcs	50
Sorted black coal	98.25 Kcs/100 kg	65.5 Kcs	50
Coke	166.11 Kcs/100 kg	113 Kcs	47
Heat	102.96 Kcs/gJ	59.2 Kcs	73.9
Electricity	0.78 Kcs/kWh	0.51 Kcs	52.9
Natural gas	3.35 Kcs/m^3	1.53 Kcs	119

Table A-2: Energy Intensity

Industry and Construction - Total

Tera Joules Energy per Million Krowns of Industrial Output

Prumysl a stavebni vyroba (vcetne zavodove dopravy)
Konecna spotreba energie
Uzemi CSFR

Palivo	jedn.	1975	1980	1981	1982	1983	1984	1985	1986	1987	1988
Vyroba	mil.Kcs		870318	878927	889859	911672	934561	960804	980201	1003998	992806
UVK	TJ	83	120	32	1	1	7	1	613	88	3
CU-energeticke		29423	29279	28715	25500	21776	19569	20799	19642	20571	19267
HU-tridene		42241	35175	34034	32068	29919	28477	28346	27286	26383	25929
HU-ostatni		3019	2176	1785	1842	1613	1620	1686	1648	1610	1595
Koks		197716	198983	198547	199326	197868	199654	201523	197585	202073	200482
OIP		702	583	907	940	1128	1600	1598	1848	2088	1741
Tuha celkem		273184	266316	264020	259676	252305	250927	253952	248622	252813	247027
Benzin		14010	11535	10597	6338	6201	6049	5854	6036	6091	5903
Petrolej		0	0	0	0	0	0	0	0	0	0
Nafta		37777	43967	41973	37179	35503	35661	35797	36888	37607	37713
LTO		9986	12429	12184	10087	8449	7983	7368	6957	7059	6073
Propan-butan		1686	757	695	595	621	619	664	581	469	687
TTO		89963	81589	78703	63841	62701	58036	54642	53468	48945	45041
OKP		802	748	969	2450	1947	2152	2832	2276	2382	2385
Kapalna celkem		154224	151075	145121	120489	115423	110501	107157	106206	102542	97802
Zem.plyn		68199	106625	106191	111483	116344	121882	126398	127141	124555	130533
Koks.plyn		39630	36380	35284	35966	35557	35549	34932	34544	35900	36571
Svitiplyn		13949	14088	14175	14040	14290	13846	13239	12593	12141	10798
Vysokopec.plyn		37902	35746	36514	34924	34219	34075	33312	31640	31761	29327
OPP		15072	21821	26160	27042	25127	24715	26713	25522	26447	26353
Plynna celkem		174753	214660	218324	223455	225537	230067	234595	231440	230803	233572
Elektrina		113993	131914	133053	133060	136913	138552	143395	146056	150207	151933
Teplo		352508	394875	395050	395213	395429	402020	415812	411675	411883	393597
Paliva celkem		602161	632001	627465	603621	593265	591495	595704	586269	586159	580401
Energie celkem		1068662	1158791	1155569	1131894	1125607	1132067	1154911	1143999	1148252	1125931

Merne spotreby TJ/mil.Kcs

Elektrina	0.152	0.151	0.150	0.150	0.148	0.149	0.149	0.150	0.153
Teplo	0.454	0.449	0.444	0.434	0.430	0.433	0.420	0.410	0.396
Paliva celkem	0.726	0.714	0.678	0.651	0.633	0.620	0.598	0.584	0.585
Energie celkem	1.331	1.315	1.272	1.235	1.211	1.202	1.167	1.144	1.134

Table A-3: Electric Rate Structure

Supplies from the high voltage (hv) networks:

Two-part tariff with fixed charge for the maximum load.

- for 1 kW of the agreed 15 minute monthly maximum	195.00 Kcs
- high rate per 1 kWh	0.33 Kcs
- low rate per 1 kWh	0.30 Kcs

Large-scale consumers are charged at an increased rate by the supplier in the event that the agreed monthly 15 minute power output maximum (kW) is exceeded; the rate per each kW in excess being:

390.00 Kcs ... for the A2 rate group
450.00 Kcs ... for the A4 rate group
420.00 Kcs ... for the A5 rate group

In case the overall electricity consumption (kWh) within the contracted period keeps within the -3% to +1% tolerance range of the level agreed upon, the total consumption of the consumer is charged by the supplier at the basic unit rates of the appropriate rating group (as presented in sections I, II and III of the present price list).

APPENDIX B
SAMPLE CAPABILITIES OF COMMERCIAL ENERGY SERVICE COMPANY

An O F F E R

ENERGETICS

- thermical-technical measurement of energetic sources without the regard of the sort of used energy for the purpose of finding out removable energetic losses, with the proposal of solution
- elaboration of methodes for installation technically explained norms of consumption of fuels and energy for the unit of production
- solution of tasks of development of science and technique aimed at the saving of fuel and energy
- education in the sphere of service of energetic and reserved technical machinery
- installment and service of electronic regulator heating for gas boilers, which lowers the consuption of fuel at about 20-40 %
- the control and adjusting the machinery of measurement and regulation
- expert investigation of occurrence of secondary energetic sources as well as untraditional sources of energy with the proposal for utilization
- drowing the actual condition of technology and measurement and regulation, projection of new machinery, utilizing primary waste heat

ECOLOGY

- measurement of emisions of nitrogen oxides, sulphur, carbon and ash into atmosphere, stating efficiency of separating machinery, including the proposal of technical measures for achievement of requested parameters
- measurement of emision of dust and harmful gases in the external atmosphere
- emision of fall down of dust and chemical analysis of fall down of dust
- proposals of technical measures for lowering the emision of harmful matter into external atmosphere
- measurement of microclimatic quantities of working environment (temperature, relativ moisture, the speed of the flow of air at working places, intensity of emision of heat of working places, resulting temperature at working places)
- measurement of dust in working environment
- measurement of noise at working places and in external spaces
- measurement of artificial illumination
- measurement of speeds of exhaustion of harmful substance from technological machinery and intensity of exchange of air at the working places
- measures for securing prescribed values of quantities determining thermical, sound and light comfort at working places
- analysis of water from the point of presence of undersirable matter in them (heavy metals, petrol matter, nitrogen oxides, organic matter) their evaluation of convenience of aplication (drinkable, water, irrigation technical purposes)
- analysis of rain water
- analysis of land from the point view of presence of strange matte in it (heavy metals, residues of pesticides),their evaluation recommendation of convenience of utilization for agricultura purposes (nourishment, value of soil)
- analysis of separated tough matter in separators and measurement of their radioactivity
- making studies for construction of ecological works and for measurements of qualities of waste matter from industry
- expert judgements in the sphere of hygiene of the land and of influence of the emissions upon the land
- projection of ecological works

Contact address : EKEN, engineer activities in ecology and energetics company
Tel: 83 29 29 *Jakubovského 30, 851 05 BRATISLAVA*

APPENDIX C1
ENERGY AUDITING COURSES

Fundamentals of Energy Auditing

June 25-29, 1990
October 8-12, 1990

Course Outline

Day One

8:00 Registration and Refreshments
Lowell Hall
610 Langdon Street
Madison, Wisconsin

8:20 Welcome and Overview

What Is an Audit?
- Types of energy audits
- Examples

Fieldwork/Workshop: Building Energy Equipment Review

Lunch—Lowell Hall

How Buildings Use Energy
- Energy analysis procedures
- Conduction, ventilation and internal loads
- Energy reduction potential

Fieldwork/Workshop: Energy Estimating Basics

Social Hour and Buffet—Lowell Hall

Day Two

Problem Review and Coffee

HVAC Systems Basics
- Single zone
- Reheat
- Multizone and dual duct
- Variable air volume
- Heat recovery and optimization

Lighting Systems Basics
- Sources and fixtures
- Illumination levels
- Power budgets

Lunch—Lowell Hall

Au[illegible] Instruments and Measurements
- Temperature, air flow and combustion analyzers
- Use of continuous readout equipment for improved analysis
- Evaluation and selection

Fieldwork/Workshop: Using Audit Instruments for Energy Use Analysis

Day Three

Problem Review and Coffee

Automatic Temperature Control
- Control fundamentals
- Types of controls—electric, electronic, pneumatic, system powered
- Flow control devices—valves, dampers, electric controllers
- Control systems—economizers, enthalpy, OA/hot water reset and dead band strategies

Electrical Systems Operations and Controls
- NEC/utility constraints
- Control strategies
- Energy saving applications

Lunch—Lowell Hall

Energy Conservation Opportunities Analysis
- HVAC
- Lighting and power
- Building envelope
- Energy codes and standards

Fieldwork/Workshop: Advanced Energy Estimating Techniques

Day Four

Energy Conservation Opportunities Analysis
- Office spaces
- Restaurants
- Retail spaces
- Institutional
- Energy cost analysis

Computers in Energy Auditing
- Available software
- Procedures and pitfalls

Lunch—Lowell Hall

Fieldwork/Workshop: Prepare for a field audit with team assignments and utility bill analysis

Day Five

Fieldwork/Workshop: Practice field audit methodology in multidisciplinary teams identifying al[illegible] relevant building data

Fieldwork/Workshop: Analyze building energy u[illegible] data and prepare audit results

Lunch—Lowell Hall

Fieldwork/Workshop: Present audit report to wo[illegible] shop staff and participants for critical analysis

Final Adjournment Will Be at 3:00 p.m.

Energy Auditing Series

This course is one of four designed to focus yo[illegible] technical experience on the skills required for auditing, rather than designing, various types of building energy systems. This course builds on materials presented in *Residential Energy Auditi[illegible]*. Participants should have auditing experience. Co[illegible] tact Don Schramm, Program Director, for details.

General Information

Fee Covers Notebook, program materials, brea[illegible] refreshments, lunches, one scheduled buffet dinn[illegible] and certificate.

Refund We prefer registration in advance. If yo[illegible] cannot attend, please notify us immediately. We w[illegible] refund your fee, or you can have someone take y[illegible] place.

Accommodations Your enrollment confirmation will include hotel/motel information on the Wisconsin Center Guest House (Lowell Hall). Please make your reservations directly by calling 608-2[illegible] 2621 or by writing to the Wisconsin Center Gue[illegible] House, Reservations, 610 Langdon Street, Madiso[illegible] Wisconsin 53703. Advise us at time of registration you are handicapped and desire special accomm[illegible] dations. Requests will be kept confidential. Northwest, TWA, United, American, Midwest Express, a[illegible] other airlines serve Madison. Please make your ow[illegible] reservations.

Location The Wisconsin Center Guest House (Lowell Hall), 610 Langdon Street, Madison, Wisconsin.

About The Course

Purpose of this course...

The Association of Energy Engineers now offers this intensive two-day seminar expressly designed as a preparatory vehicle for the C.E.M. examination. The course offers a thorough review of the basics of efficiency improvement as it relates to electrical, utility, building, and combustion systems. It is the ideal refresher course for energy managers who want to "brush up" on the basics as well as for those seeking an additional method of preparation for the examination.

You can take the examination immediately following the course.

For your convenience, AEE has scheduled each C.E.M. exam to take place on the day immediately following each of the courses listed in this brochure. That way, all the course material will be fresh in your mind when you sit for the exam! The exam will be administered at the same hotel where the course is held.

The designation "C.E.M." is a nationally recognized credential.

The Certified Energy Manager (C.E.M.) program has been adopted by a variety of entities throughout the U.S. For example, the California Energy Commission has used the C.E.M. for school and hospital energy audits as a part of its technical assistance program. The C.E.M. was also adopted by SAFE-BIDCO for its low-interest loan programs, by D.O.D. for R.F.P.'s for energy audits, and by the Mississippi Energy Department for its auditor certification program.

Deadlines for registering for the C.E.M. exam.

If you plan to take the C.E.M. examination the day following this seminar, *you must return a completed C.E.M. application (not included in this brochure) to the AEE office by the dates indicated on the schedule that follows.*

1991 EXAM SCHEDULE AND DEADLINES FOR SUBMITTING EXAM APPLICATIONS

Seminar Exam Location	*Seminar Dates*	*Exam Date*	*Deadline For Exam Applications*
San Francisco	February 27-28	March 1	January 18
Meadowlands	April 3-4	April 5	February 22
Louisville	May 8-9	May 10	March 29
Washington, DC	September 25-26	September 27	August 16
Miami	December 4-5	December 6	October 25

To obtain your C.E.M. application form or to receive further information on the C.E.M. program, contact:

Rose Marsden
Association of Energy Engineers
4025 Pleasantdale Road, Suite 420
Atlanta, GA 30340
404/447-6415

The Course Outline.

STRUCTURE OF THE C.E.M. EXAMINATION

CODES AND STANDARDS
- BEPS
- NECPA
- PURPA
- ASHRAE

TRENDS IN FUEL SUPPLY AND PRICING

FUNDAMENTALS OF ENERGY AUDITS
- Types of audits
- Innovative financing
- Energy audits for new building design

ENERGY ACCOUNTING AND ANALYSIS
- Energy use profile
- Energy consumption of various facilities
- Microcomputers
- Energy accounting procedures

APPLICATION OF LIFE CYCLE COSTING
- Rate of return analysis
- Present worth analysis
- Annual cost analysis
- Payback method
- Computer programs for life cycle costing
- New tax legislation
- Predicting fuel escalation
- Shortcut methods

INSTRUMENTATION FOR SURVEYS
- Measuring building losses
- Infrared equipment
- Electrical instrumentation
- Boiler test equipment
- HVAC measurement

BUILDING SYSTEM ENERGY AUDIT
- Heat gain and heat loss calculations
- Window treatment
- Insulation
- New products
- Calculation methods
- Building occupancy schedule

ELECTRICAL SYSTEM ENERGY AUDIT
- Electric rate structure
- Negotiating with a utility
- Specifying energy management systems
- Efficient motors
- Lighting optimization

UTILITY AND PROCESS ENERGY AUDIT
- Calculating boiler efficiency
- Air/fuel optimization
- New products

ENERGY EFFECTS OF THE HVAC SYSTEM
- Heating: steam, hot water, and direct gas systems
- Cooling: direct expansion and chilled water
- Ventilation: code requirements and fan laws

GENERATION
- Boilers: boiler types, reduced blowdown, blowdown recovery
- Chilled water: absorption, reciprocating, centrifugal systems
- Direct expansion condensing systems: air, water, and evaporation

DISTRIBUTION
- Air: comparison of distribution systems—terminal reheat, VAV, dual duct, multizone
- Water: variable pumping and reduced flow

CONTROLS
- Economizer: dry bulb and enthalpy
- Discharge reset
- Temperature setback
- Optimum start/stop

APPENDIX C2
ENERGY MANAGEMENT COURSES

Role of the Energy Manager (EM 1)

September 24–28, 1990

Workshop Outline

Introduction to Energy Management

- Energy management for the 1990s
- Organizational structure
- Energy assessment and economic analysis
- New roles and responsibilities
- Justifying and selling EM programs

Charles E. Dorgan

Developing Effective Energy Management Programs

- Identifying barriers/developing solutions
  - problem-solving and decision-making strategies
  - strategies for working with groups
- Techniques for more effective decision making

Sandra Gill

Philadelphia School District Case Study

- Identifying key variables
- Developing data and energy accounting systems
- Monitoring results
- Motivating personnel
- Feedback to maintain savings

Jack Myers

Energy Managers' Structure and Responsibilities—Workshop

- Defining goals
- First organizational steps
- Developing an EM plan
- Identifying in-house resources
- Need for outside consultants
- Re-evaluate goals—methodology and measurements

Jack Myers

The EM Program at Deere & Company

- Key elements
- Typical projects
- Program results
- Strengths and potential weaknesses

Douglas F. Darby

Energy Resources

- Reviewing supply estimates
- Effects of fluctuating prices on supplies
- Why light distillates are critical
- The U.S. and world situation
- OPEC and non-OPEC viewpoints

John S. Steinhart

Energy Availability and Cost—Workshop

- Review of existing forecasts
- Identifying important trends
- Defining conservation potential
- Developing/using forecasts

James H. Mapp

Direct Purchase of Energy Resources

- New role for the energy manager
- Transportation issues to be resolved
- Direct purchase arrangements
- Determining if direct purchase is a viable alternative

Doug Mitchell

Energy Strategic Planning

- Components of a strategic plan
- Importance of a good database
- Forecasting and planning tools
- Strategic planning using existing corporate resources

Ted Reichelt

Developing a Strategic Plan—Workshop

- Commercial/industrial case studies
- Current/future energy profiles
- Integrating into corporate goals

Ted Reichelt

Organization and Implementation of a Corporate EM Program

- Basic program organization
- Review of current equipment available
- Techniques to employ
- Pitfalls to avoid
- Evaluating vendors' claims
- Role of the plant energy coordinator (an integrated approach to plant engineering)
- Evaluating a plant's energy management attitude

Wayne L. Stebbins

Utility Monitoring and Reporting Systems (MRS)

- Evolution of an MRS
- Establishing and justifying the MRS
- Scoring the results
- Practical examples

Wayne L. Stebbins

Registration

Workshop registration will be at 8:00 a.m. on Monday, September 24, at Lowell Hall, 610 Langdon Street, Madison, Wisconsin. Plan to attend Monday's social hour and buffet at 5:30 p.m. The course will adjourn at 2:30 p.m. on Friday.

Course Outline

Monday, April 23

Welcome and Introduction
Keith J. Kempski

Energy Management Performance Analysis
- Distribution of energy in industrial plants
- Performance analysis: variable and service departments, utility equipment
- Numerical and graphical presentation

Wayne L. Stebbins

Energy Management Forecasting
- Laying the groundwork
- Preparing the forecast
- Calculating the results
- Numerical and graphical presentation

Wayne L. Stebbins

High Temperature Waste Heat Utilization
- Sources and uses of waste streams
- Types of heat exchangers
- Selecting equipment: temperature, fouling, corrosion, intermittency

William G. Ross

Tuesday, April 24

Industrial Heat Pumps
- Why technology revisited?
- Solving plant thermal problems
- Types of industrial heat pumps
- Process uses and waste heat sources
- Past performance experience
- Key industry case histories

William G. Ross

Energy-Efficient Motors
- Motor fundamentals
- Analysis of energy-efficient motors
- Advantages and disadvantages
- Matching motors to loads
- Specifying motors

Gary Peterson

Wednesday, April 25

Variable Speed Drives and Motor Control
- Types of VSD
- Features, advantages, and disadvantages
- Identifying VSD applications
- Applications and case studies

William G. Ross

Combustion Efficiency Improvement
- Principles of combustion • Turndown ratio
- Metering • Types of controls
- Preheated air and other process heat recovery systems
- Oxygen enrichment • Workshop problems

Richard J. Reed

Thursday, April 26

Process Energy Analysis and Innovation
- Full process flow sheet
- Identifying avoidable losses
- Developing an approach to innovation
- Group problem-solving techniques

Walter P. Smith, Jr.

Energy Analysis Workshop
- Energy calculation
- Evaluation of energy alternatives

Walter P. Smith, Jr.

Industrial Cogeneration
- Current topping/bottoming cycles
- Advanced systems
- Feasibility/case study

Walter P. Smith, Jr.

Friday, April 27

Optimizing Industrial Process Control Systems
- PLC vs distributed control
- Field devices
- Controllers
- Loop turning
- Applications

Jeff Jamar

Exam and Adjournment

Student Presentations
You will have the opportunity to give a 15-minute energy management presentation. Candidates for the Energy Management Diploma must make one presentation sometime during the four-course series. All participants will be encouraged to share their programs or project experiences.

Building Energy Systems (EM 3)

July 23-27, 1990

Course Outline

Monday, July 23

Introduction to Building Energy Consumption
- Energy usage in buildings/energy indices
- ASHRAE standards
- Existing and new buildings

Charles E. Dorgan

Building Energy Fundamentals
- Psychrometrics • Heat transfer
- Design temperatures and weather data
- Load estimating—peak vs. partial
- Air-conditioning fundamentals

William J. Coad

Computer Tools for Building Energy Analysis
- Load calculation • Equipment optimization
- Duct design • Energy analysis

William J. Coad

Tuesday, July 24

Boilers and Chillers—Emphasizing Controls and Operation
William J. Coad

Cogeneration
- Types of systems
- Economics, evaluation and selection

William J. Coad

Refrigeration Principles and Cooling Equipment
- COP/EER • Chillers/DX systems • Overfeed

Charles E. Dorgan

Thermal Storage Systems
- Partial • Off peak • Cooling/heating
- System potential • Cold air distribution
- Economics

Charles E. Dorgan

Wednesday, July 25

HVAC Systems
- VAV • Heat pumps
- Fans, pumps • Computer rooms

Robert L. Stan

Heat Recovery
- Air-to-air
  -heat wheels; heat pipes; runaround coils
- Double-bundle condensers
  -building heating; domestic water heating
- Heat recovery economics

Robert L. Stan

Introduction to A/C Controls
- Basic control theory
  -terminology and devices; proportional control theory
- Types of control systems

Robert L. Stan

Thursday, July 26

Controls to Improve Energy Efficiency of HVAC Systems
- Comfort vs. energy • Reset
- Occupied/unoccupied
- Economizers • Maintenance

Robert L. Stan

Direct Digital Controls
- Theory of operation
- Technology characteristics
- Hardware/software/firmware functions
- Applications

Robert L. Stan

Air Distribution and Balancing
- HVAC system components
- Room distribution—grilles and registers
- Testing, adjusting and balancing
- Commissioning systems

Keith J. Kempski

Friday, July 27

Lighting Optimization
- Principles and terminology
- Lighting systems
- Energy analysis techniques
- Lumen/energy reduction opportunities
- Maintenance considerations
- Economic evaluation

Paul Von Paumgartten

Indoor Air Quality
- Energy parameters
- System operation
- Codes/standards • Ventilation

Charles E. Dorgan

Adjourn

Workshop Outline

Monday, March 19

Orientation to Data Gathering and Analysis
- Building envelope
- HVAC
- Electrical
- Process

Keith J. Kempski

Gathering Energy Engineering Information
- Components and methods
- Uses of audits
- Comparing and choosing sources
  - —in-house personnel
  - —consultants
  - —contractor
  - —utility

Keith J. Kempski

Using Energy Data
- Comparing data to estimates
- Economic evaluation
- Selecting projects

Keith J. Kempski

Utility Rates and Load Management
- Usage and demand
- Fuel adjustment
- Load management techniques

Richard Panke

Tuesday, March 20

Industrial Energy Audits
- Walk-through, mini, maxi audits
- Scope and duration
- Audit team
- Process and nonprocess analysis
- Updating an audit

Walter P. Smith

Selecting and Using Consultants
- Scope of services
- Evaluation criteria
- Progress monitoring
- Final report acceptance

Walter P. Smith

Industrial Energy Audit Case Study
- Data gathering and analysis
- Economics
- Recommendations

Walter P. Smith

Evaluation of Energy Audits
- Factors affecting quality
- Recommendation

Richard J. Pearson

Wednesday, March 21

Energy Economics
- Time value of money concepts and definitions
- Formulas for escalating cost
- Methods for evaluating projects
- Methods for evaluating retrofits, i.e., payback, ROI, benefit cost ratio
- Assign problems

William W. Wuerger

Industrial Energy Analysis
- Audit procedures
- Auditing and operating instrumentation
- System examples
- Energy conservation techniques for industrial facilities

Edward H. Stewart, Jr.

Thursday, March 22

Energy Audit Instruments and Measurement Techniques
- Instrument selection and accuracy
- Using energy measurements
- Walk-through surveys
- Detailed audits

Darrel J. Hermans

Field Data Collection
- Data loggers and PCs
- Data collection and analysis considerations
- Capabilities as an analysis tool
- Case study

James Elleson

Instruments/Field Data Collection Workshop
- Hands-on use of instrumentation
- Data logger capabilities
- DDC/PC interface

Hermans, Elleson, Panke

Friday, March 23

Energy Economics (continued)
- Review homework
- Effects of taxes and depreciation
- Consideration of inflation and energy price escalation
- Case studies

William W. Wuerger

APPENDIX C3
BOILER OPERATION COURSES

Boiler Plant Operation and Orientation

January 23-25, 1991

Course Outline

Wednesday, January 23

8:00 Registration
The Wisconsin Center
702 Langdon Street
Madison, WI 53706

8:30 Course Sessions Begin

Objectives

Power Production: Introduction and History
- Overview of major power production components
- Heat and its transmission

Major Classifications of Steam Generators (i.e., Boilers)
- Fire tube
- Water tube
- Subcritical drum boilers
- Supercritical once-throughs

Boiler Manufacturers
- Babcock and Wilcox
- Combustion Engineering
- Foster Wheeler

Fuels and Their Transportation
- BTUs
- Ash content
- Sulfur
- Unit trains

Handling and Processing of Coal
- Rotary car-dumper
- Coal conditioners
  - -frozen coal crackers
  - -hammer-mills
  - -ring-mills
- Conveyors
- Flow detectors
- Store-out and reclaiming

Tripper

Coal Bunkers and Silos

Coal Feeders and Scale

Requirements for Combustion
- Fuel
- Oxygen
- Ignition source

Requirements for Efficient Combustion
- Time
- Temperature
- Turbulence

Air Handling and Preparation
- Constituents of air
- Forced draft fans
- Glycol air preheater
- Regenerative air heating
- Windbox

Coal Burning Equipment
- Babcock and Wilcox cyclone furnace
  - -water-cooled tube construction
  - -tube studs
  - -refractory
- Pulverized coal firing
  - -coal pulverized construction
  - -primary air fan
  - -exhauster
  - -inerting and pulverizer explosions

Products of Combustion
- Gases
- Ash

Induced Draft Fans

Ash Removal and Treatment
- Fly ash
  - -electrostatic precipitator
  - -dust silo
  - -hydrovactor
- Bottom ash
  - -slag or ash tank
  - -clinker grinder

Flue Gas Desulfurization

Boiler Construction and Water-Steam Circuits
- Penthouse
- Economizer
- Steam drum
- Waterwall tube construction

outline continues . . .

Outline (continued)

- Circulation
  - -natural
  - -forced
- Boiling and steam blanketing
- Primary superheater
- Secondary superheater
- Reheat superheater

5:00 Adjournment

Thursday, January 24

8:00 Objectives

Stop Valves

Control Valves

Turbine Construction—Tandem or Cross Compound

- High pressure turbine internals
  - -blading
    - impulse
    - reactionary
  - -stationary blading
  - -packing and seals
- Intermediate pressure turbine
  - -combined reheat - intercept stop valves
  - -cross-over
- Low pressure turbine
  - -opposed flow
  - -steam seal system
- Turbine foundation
- Front standard
  - -overspeed trip
  - -zero speed switches and turning gear
  - -oil pump
- Radial journal bearings and lubrication systems
- Thrust bearings and wear detector

Vibration and Balancing

Main Condenser

Cooling Towers or Ponds

Condensate Pumps

Gland Steam Condenser

Heat Exchanger Construction

Low Pressure Feedwater Heaters

- Extraction steam
- Drains

Deaerating Feedwater Heater

Boiler Feed Pump

High Pressure Feedwater Heaters

Steam Temperature Control

- Combustion Engineering - burner tilts
- Babcock and Wilcox - gas recirculation
- Foster Wheeler - reheat control dampers
- Blowing soot
  - -retractable
  - -rotary deslaggers
- Attemperator sprays

Efficiency

- Carnot
- 33 percent total efficiency
- Reduce rejected heat
- Reduce excess oxygen

5:00 Adjournment

Friday, January 25

8:00 Objectives

Babcock and Wilcox Supercritical Boiler Start-Up Circuit

Combustion Turbines

Instrumentation

- Pressure
- Temperature
- Flow

Introduction to Physical Science

- Energy and its conservation
- States of matter
- Simple atomic structure
- Forces of nature
- Electricity and magnetism
- Generator demonstration

Generator Construction and Load Control

- Three-phase power
- Frequency and shaft speed
- Generator rotor
- Excitation
- Cooling
- Hydrogen seal oil unit

Water Quality and Treatment

- Boiler tube failures
- Corrosion and pH scale
- Demineralizer - ion exchange unit
  - -roughing filters
  - -polishing filters
  - -cation exchanger
  - -decarbonator
  - -anion exchanger
  - -mixed bed exchanger
- Condensate polishing system
- Drum blowdown
- Chemical cleaning
- Chemical additives

Plant Air Systems and Classification of Compressors

Motor Maintenance

Fan Maintenance

Pump Operation and Classification

Bearing Lubrication

Valve Classification, Operation, and Maintenance

Steam Trap Operation

3:00 Final Adjournment

APPENDIX C4
GENERAL DEMAND-SIDE MANAGEMENT COURSES

Demand-Side Management: Principles and Applications

An intensive two-week training seminar

Syllabus

Welcome and Introductions

Course Objectives and Review of Agenda

Introduction to DSM

A. Historical perspectives
B. Why is it necessary?
C. Benefits of DSM
D. DSM as a resource option for the 1990s
E. Overall framework for DSM planning and implementation
F. Current DSM activities
G. Summary of utility experience
H. Regulatory Trends
I. Utility incentives
J. Future prospects

Role of DSM in Integrated Resource Planning (IRP)

A. Overview of IRP
B. IRP procedures
   1. Technical elements
   2. Process elements
C. Supply-side options
   1. Traditional options
   2. Non-utility generation
D. Demand-side options
   1. Conservation/load management
   2. Strategic load growth
   3. Fuel switching
E. Integrating supply and demand planning
   1. Key issues
   2. Methods and techniques
   3. Computer models
      - supply planning models
      - demand planning models
      - integrating supply and demand
F. Profitability and pricing issues
G. Risk and uncertainty analysis
H. Regulatory considerations
I. Environmental externalities
J. Case studies

Establishing DSM in Your Company

A. DSM goals and objectives
B. Situation analysis
   1. Identification of data sources
   2. Assessing the external environment
   3. Assessing the internal environment
   4. Problem and opportunity analysis
   5. Critical success factors
   6. Strengths and weaknesses
   7. Organizational issues
   8. Case study and group exercise
C. Screening of DSM options
   1. Typical screening criteria
   2. Defining DSM options
   3. Developing a ranking and scoring system
   4. Information sources for screening
   5. Case study and group exercise

Program Planning and Design

A. Defining program objectives
B. Linking program objectives to organizational goals and objectives
C. Identifying technology options
D. Defining customer end uses
E. Assessing marketing strategies
F. Defining incentive types and levels
G. Targeting market segments
H. Information requirements for effective program design
   1. Technology characteristics
   2. Load shapes
   3. Rate structures
   4. Utility characteristics
   5. Market profiles
   6. Customer acceptance characteristics
I. Case study and group exercise

Evaluating DSM Potential and Impacts

A. Assessing technical potential
B. Estimating economic potential
C. Developing DSM supply functions
D. Assessing impacts of DSM programs
   1. Peak load and energy impacts
   2. Market penetration
   3. Program costs
   4. Customer impacts, benefits and costs
   5. Utility impacts, benefits and costs
   6. Societal impacts, benefits and costs
E. Benefit/cost analysis methodology
F. Case study and group exercise
   1. Technical potential
   2. Economic potential
   3. DSM supply functions
   4. Program benefit/cost analysis

Identifying Customer Needs and Characteristics

A. Qualitative Research
   1. Focus groups
   2. One-on-one interviews
   3. Nominal group process
B. Quantitative Research
   1. Using secondary data
   2. Customer survey approaches
      - mail

- phone
- on-site

3. Measuring attitudinal & behavior factors
4. Perceptual mapping
5. Market segmentation
6. Conjoint analysis

Market Penetration

A. Penetration issues
B. Methods for analyzing market penetration
   1. Decision criteria
   2. Diffusion models
   3. Economic choice models
   4. Markov models
   5. Conjoint and multi-attribute choice models
C. Integrated approaches
D. Lessons and insights
E. Software for analyzing market penetration
F. Case study and group exercise

Market Segmentation

A. Definition and need
B. Bases for segmentation
   1. Demographic/firmographic
   2. Attitudes, needs
   3. Program preferences
   4. Strengths and weaknesses
C. Designing a segmentation study
   1. Analytical techniques
      - univariate
      - multivariate
        - regression
        - factor analysis
        - cluster analysis
        - discriminant analysis
   2. Data collection issues
      - sampling and sample size
      - survey approach
      - screening respondents
      - validation of data
   3. Software packages
D. Evaluating marketing strategies based on segmentation results
E. Case study and group exercise

Load Research

A. Load shape objectives
   1. Utility system
   2. Customer class/subclass
   3. End use
B. Use of load shapes in utility planning
   1. Supply planning
   2. DSM planning
   3. Strategic marketing
   4. Integrated resource planning
   5. Rates - cost of service analysis
   6. Profitability analysis
C. Load shapes data development techniques
   1. "Bottom-up"
      - end-use metering
      - engineering simulation
   2. "Top-down"
      - conditional demand analysis
   3. Hybrid
   4. Data transfer
D. Load research
   1. Methods
   2. Planning
   3. Utility efforts
   4. Equipment and costs
E. Case study and group exercise

Efficient End Use Technologies

A. Residential market
   1. Building envelope options
   2. Efficient appliances
   3. Space heating and cooling
   4. Water heating
   5. Thermal storage - heating
   6. Energy and demand control options
B. Commercial market
   1. Lighting
   2. Space heating and cooling
   3. Thermal storage - heating and cooling
   4. Refrigeration
   5. Fuel switching
   6. Energy and demand control options
C. Industrial market
   1. Efficient motors
   2. Adjustable speed drives
   3. Efficient processes
   4. Fuel switching
   5. Lighting
   6. Industrial electrotechnologies
D. Miscellaneous markets
   1. Agricultural
   2. Street lighting
   3. Transportation (electric vehicles)

Alternative Pricing and Rate Structures

A. Introduction to rate design
B. Using rates to achieve demand-side objectives
C. Innovative rate structures
   1. Demand rates
   2. Time-of-use rates
   3. Inverted rates

4. Seasonal rates
5. Variable levels of service
6. Promotional rates
7. Off-peak rates
8. Conservation rates

D. Utility experience with innovative rates

Computer Models for Program Design and Analysis

A. Why computer models?
B. Review of available models
C. Introduction to COMPASS
D. Integrating supply-side and demand-side models
E. Case study and group exercise

Program Implementation

A. Overview of implementation methods
B. Promotional tools
C. Leveraging marketing resources
   1. Trade allies
   2. Contractors
   3. Key staff
   4. Media
D. Staffing and budgets
E. Pretesting/debugging the program
F. Implementation methods and guidelines
   1. "Two-step flow" communications
   2. Positioning the program
   3. The message strategy
      - using key words and phrases that stress benefits
      - symbolizing benefits
   4. The media
      - print communications
      - trade associations
      - direct sales
   5. Key account programs
   6. Maintaining program interest
G. Internal organization
   1. Guidelines for operations and reporting
   2. Involving senior management and field personnel
H. Measuring program performance
I. Case study and group exercise

Program Evaluation

A. Overview of evaluation
   1. Types of evaluation
   2. Uses of evaluation
B. The evaluation process
   1. Planning
   2. Identifying evaluation issues
   3. Identifying data requirements
   4. Developing a data collection plan
   5. Developing a tracking system
   6. Conducting the evaluation
   7. Feedback to program planning and operations
C. Impact evaluation - the five-step process
   1. Objectives
   2. Issues
   3. Measurements
   4. Methods
   5. Data
D. General measurement issues
   1. Definitional problems
   2. Internal vs. external validity
   3. Confounding factors
   4. Net vs. gross impacts
   5. The aggregate bill problem
   6. Free riders
   7. Self selection
   8. Rebound
   9. Persistence
E. Estimating energy and demand impacts
   1. Statistical methods
   2. Engineering
   3. Metering
   4. Hybrid
F. Progress evaluation
G. Process evaluation
H. Benefit/cost analysis
I. Case study and group exercise

DSM and the Environment

A. Environmental impacts of current systems
B. Environmental benefits/costs of DSM
C. Environmental rate incentives
D. Quantifying effects of externalities
E. Incorporating externalities into planning
F. Role of DSM in protecting the global environment