INDUSTRIAL ENERGY EFFICIENCY
IMPROVEMENT IN ESTONIA:
Policy Options and Institutional Roles

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U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT
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# INDUSTRIAL ENERGY EFFICIENCY IN ESTONIA:
Policy Options and Institutional Roles

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by EnPro Engineers Bureau

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EnPro Engineers Bureau, Ltd.
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ACKNOWLEDGEMENTS

RCG/Hagler, Bailly, Inc. and EnPro Engineers Bureau, Ltd. gratefully acknowledge the assistance and cooperation shown by USAID/Tallinn, the Estonia Ministry of Industry and Energy, Estonian State Energy Department, Eesti Energia, Termest, Tallinn Technical University, and the industrial and district heating plants in Estonia visited as part of this program.

RCG/Hagler, Bailly, Inc. would like to recognize the guidance and technical contributions of Mr. Robert Archer, Deputy Chief of Energy and Infrastructure, USAID Bureau for Europe. Mr. Archer’s analysis of energy efficiency policy and institutional roles in many countries in Eastern Europe over the past two years served as the basis for many of the ideas included in this report for Estonia.

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<table>
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<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>CIS</td>
<td>Commonwealth of Independent States</td>
</tr>
<tr>
<td>DHN</td>
<td>district heating network</td>
</tr>
<tr>
<td>DoE</td>
<td>Estonian State Department of Energy</td>
</tr>
<tr>
<td>EE</td>
<td>Eesti Energia (Estonian Electricity Company)</td>
</tr>
<tr>
<td>EFTA</td>
<td>European Free Trade Association</td>
</tr>
<tr>
<td>EBRD</td>
<td>European Bank for Reconstruction and Development</td>
</tr>
<tr>
<td>GDP</td>
<td>gross domestic product</td>
</tr>
<tr>
<td>GoE</td>
<td>Government of Estonia</td>
</tr>
<tr>
<td>HFO</td>
<td>heavy fuel oil (mazout)</td>
</tr>
<tr>
<td>IMF</td>
<td>International Monetary Fund</td>
</tr>
<tr>
<td>ITEP</td>
<td>Institute of Thermophysics and Electrophysics</td>
</tr>
<tr>
<td>LFO</td>
<td>light fuel oil (middle distillate)</td>
</tr>
<tr>
<td>MIE</td>
<td>Estonian Ministry of Industry and Energy</td>
</tr>
<tr>
<td>NUTEK</td>
<td>Swedish National Board for Industrial and Technical Development</td>
</tr>
<tr>
<td>OPET</td>
<td>Organizations for the Promotion of Energy Technologies</td>
</tr>
<tr>
<td>TTU</td>
<td>Tallinn Technical University</td>
</tr>
<tr>
<td>USAID</td>
<td>US Agency for International Development</td>
</tr>
<tr>
<td>WB</td>
<td>World Bank</td>
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INTRODUCTION

In November 1991, the U.S. Agency for International Development launched the 1991 U.S. Emergency Energy Assistance Program for Estonia. Component #1 of this program relates to industrial energy efficiency (the prime contractor for Component #1 is RCG/Hagler, Bailly, Inc. of Washington, D.C., and its subcontractors are EnPro Engineers Bureau, Termox, and Tallinn Technical University). The program's other component is energy price reform.

Under the industrial efficiency activities (Component #1), the RCG/Hagler, Bailly team was assigned the following tasks:

1) Screening of plants in the industrial sector to identify four representative and appropriate plants for the energy management programs to be funded under Component #1.

2) Performance of energy audits and training in each of the four plants, focusing on the identification of short-term measures to be implemented at no cost, or at low cost with quick payback.

3) Identification of low-cost equipment for procurement for each of the four plants under the program (such as energy monitoring instruments, up to about $30,000 per plant).

4) Assessment of national institutional and policy issues related to energy efficiency.

5) Procurement of equipment and delivery to the plants.

6) Return to each of the plants to monitor the results of the program and assist with any problems related to the equipment.

7) Preparation and presentation of a one-day wrap-up seminar in Estonia for the management and technical staff of the four plants, and presentations by each of the four plants at a regional industrial energy efficiency conference sponsored by USAID in Lithuania.

From November 8 through December 20, 1991, RCG/Hagler, Bailly placed a team of three senior industrial engineers in Estonia to implement Tasks 1, 2 and 3. From May 11 - 20, 1992, RCG/Hagler, Bailly's Project Director worked in Estonia on Task 4. EnPro and
INTRODUCTION

RCG/Hagler, Bailly continued work on Task 4 from May 20 - July 1, 1992. Tasks 5 through 7 are still in progress.

This report summarizes the experiences of the RCG/Hagler, Bailly energy policy expert and the industrial engineers regarding Task 4 above. The objectives of Task 4 were the following:

- provide an analysis of the policy and institutional factors (including financial institutions) influencing energy efficiency investment decision-making
- develop recommendations to address the findings and conclusions of the study.

The primary basis for this report is a series of visits and meetings held by the energy policy expert with government officials, industrial managers, management of financial institutions, staff of universities and technical institutions, NGOs, and private companies. The report also includes the observations and experience of the audit teams that worked in the industrial plants.

This report is organized in several sections:

- Chapter 1 discusses the factors affecting energy efficiency at the national level, including government ministries, technical and financial institutions, and non-government and private organizations. Laws and regulations, and the impact of the restructuring under way in the Estonian economy are also discussed.

- Chapter 2 presents observations on energy efficiency at the plant level, including management practices, investment decision-making, and barriers to energy efficiency.

- Chapter 3 discusses industrial energy efficiency concepts and techniques, and then develops policy and program options which are appropriate for consideration by Estonia.

- Chapter 4 discusses the role of various institutions in accelerating improvements to industrial energy efficiency in a market economy, with particular emphasis on the role of government, non-profit non-governmental organizations, and the private sector.

- Chapter 5 provides recommendations for improving industrial energy efficiency, and for a long-term industrial energy efficiency program for Estonia.
CHAPTER 1: POLICY AND INSTITUTIONAL FACTORS AFFECTING INDUSTRIAL ENERGY EFFICIENCY IN ESTONIA

by EnPro Engineers Bureau

1.1 BACKGROUND

1.1.1 Economic Situation in Estonia

Estonia's economy (GDP) declined in 1991 by 10.8 percent, and a further decline of 20 percent is being predicted for 1992. The cost of living rose more than ten times over the year 1991, based on an index of combined prices (certain basket of goods).

The financial system is very weak. The Bank of Estonia has estimated that inflation is as high as 4 percent per day (April 1992). In addition to large mutual debts between enterprises, a significant number of companies are insolvent in real terms. The shortage of banknotes leads to long delays in cash payments (e.g., 40 percent of payments were delayed in March 1992).

Some changes must take place in the nearest future, and the financial system is in a state of flux. On April 27, 1992 Estonia was admitted as a member of the IMF. On May 20, 1992 the Estonian Supreme Council (Parliament) passed three laws on monetary reform, making the Eesti kroon (Estonian crown) the only legal tender in the country once it is issued (on or about July 1, 1992). The stabilization fund for the kroon includes US$120 million. At present, negotiations are in process to reclaim Estonian pre-war gold reserves (approximately US$140 million), deposited in state banks of several countries -- UK, US, Sweden and Switzerland. During the same period of time (starting from February 1992) Moscow Vneshekonombank (the former Central Bank for Foreign Monetary transactions) froze (without any official notice) the hard currency resources of the Bank of Estonia on corresponding accounts worth up to US$100 million. The blocking of accounts seems to have connection with Estonian supposed share in foreign debts of the former Soviet Union.

Estonian foreign-trade balance has been negative. Exact amounts are not known, but in 1991 the total deficit was estimated to be from US$300 million to US$700 million. In 1990, the geographical distribution of foreign trade was as follows:
1.2 FACTORS AFFECTING INDUSTRIAL ENERGY EFFICIENCY IN ESTONIA

<table>
<thead>
<tr>
<th></th>
<th>Exports</th>
<th>Imports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia</td>
<td>56.4%</td>
<td>56.1%</td>
</tr>
<tr>
<td>Latvia</td>
<td>5.9%</td>
<td>5.2%</td>
</tr>
<tr>
<td>Lithuania</td>
<td>3.2%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Other USSR</td>
<td>30.9%</td>
<td>24.3%</td>
</tr>
<tr>
<td>Non-USSR</td>
<td>3.6%</td>
<td>10.9%</td>
</tr>
</tbody>
</table>

Shortages and the loss of confidence in the rouble have led Estonia to negotiate bilateral agreements with former Soviet republics. A major energy-for-food deal has been signed with Russia covering the first two quarters of 1992. But these agreements have not functioned well. Trade with the West is therefore becoming more important. Estonia has signed an agreement to liberalize trade with Finland and is seeking similar agreements with other EFTA members.

Unemployment, currently at 6 percent according to unofficial figures, could rise as high as 30 percent by the end of the year. After the implementation of the kroon regime, a sharp rise in unemployment figures is predicted -- up to 270,000 persons by autumn 1992. As the economic situation deteriorates social security systems are being restructured. Unemployment benefits -- for six months at 80 percent of the minimum wage -- have been introduced. Subsidies on rent, transport, health care and other social services are being revised.

1.1.2 Current Situation in the Industrial Sector

By World Bank estimations (January 1992), Estonian total production decreased in 1990 by 10 percent and in 1991 by 15 percent. In 77 percent of enterprises the production volume decreased during the first quarter 1992 (in stable prices) if compared with IQ'91. During the first four months of 1992, total production has decreased by 36 percent if compared with the same period of 1991.

One of the reasons for the reduced level of production is the shortage of raw materials. For example, in just the light industry division (textiles, etc.), the republics of the former Soviet Union owe Estonian light industry companies various raw materials worth more than 138 million rubles (May 1992). One of many reasons is the lack of an effective system of financial transactions between Estonia and the CIS -- Estonian companies have transferred the
FACTORS AFFECTING INDUSTRIAL ENERGY EFFICIENCY IN ESTONIA

money but suppliers in Russia have not received these sums. In order to survive and to pay out wages, companies are trying to borrow money from commercial banks where the interest rate can be as high as 100 percent. But currently possibilities to get loans are practically nonexistent, because of the insolvency of the borrower.

Up to now privatization concerned only small enterprises in service and trade sectors. State-owned enterprises are responsible for most of Estonia's industrial output, with less than 10 percent of the total is produced in numerous by small new private companies. Recently new rules for liberalizing the privatizing process were adopted.

1.1.3 Current Situation of Energy Supply and Demand

As regards the official statistics on supply and demand of energy, it must be noted that the statistical practice is still different from Western standards. Consumption classification by sector is different; electricity production is indicated as the gross production, i.e., includes plants' own use (auxiliaries and losses in generator transformers), which in turn is included into industrial consumption; there is no primary energy indication separately; almost all data on heat consumption are the results of estimations, etc.

The total fuel consumption in Estonia decreased from 450 PJ in 1990 to 416 PJ in 1991, of which 42 percent (the same percentage for both years) was imported. Natural gas was the only fuel, supply and consumption of which has been on the same level -- 51.1 PJ in 1990 and 51.3 PJ in 1991. Electricity production (net) decreased from 15.5 TWh in 1990 (of which 4.2 percent was exported) to 13.2 TWh in 1991 (of which 36.4 percent was exported).

After gradual decrease of energy demand during 1991, beginning in January 1992 a sharp decrease took place as the consequence of cutting off oil supplies from Russia. The other reason for smaller consumption was the lower financial ability of enterprises and individuals to pay for fuels and energy.

1.1.4 Identification and Structure of Estonian Agencies Working in Energy Efficiency

On state level, the Ministry of Industry and Energy (MIE) is responsible for energy policy implementation. The energy policy (among other problems in energy field) is being elaborated by the State Department of Energy (DoE), which reports to MIE.
Consumption (excluding households) of main petroleum products, thousand tons
(for 1991 and 1992 preliminary data)

<table>
<thead>
<tr>
<th>Year</th>
<th>Heavy Fuel Oil</th>
<th>Distillate Fuel Oil</th>
<th>Diesel Oil</th>
<th>Gasoline</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989 Total</td>
<td>1464.2</td>
<td>108.5</td>
<td>570.5</td>
<td>373.0</td>
</tr>
<tr>
<td>1Q</td>
<td>510.8</td>
<td>28.3</td>
<td>75.9</td>
<td>84.8</td>
</tr>
<tr>
<td>2Q</td>
<td>307.8</td>
<td>19.0</td>
<td>102.5</td>
<td>91.9</td>
</tr>
<tr>
<td>3Q</td>
<td>148.7</td>
<td>27.6</td>
<td>106.6</td>
<td>94.9</td>
</tr>
<tr>
<td>4Q</td>
<td>497.5</td>
<td>33.6</td>
<td>285.5</td>
<td>101.4</td>
</tr>
<tr>
<td>1990 Total</td>
<td>1507.5</td>
<td>98.0</td>
<td>548.1</td>
<td>337.6</td>
</tr>
<tr>
<td>1Q</td>
<td>424.2</td>
<td>27.2</td>
<td>89.5</td>
<td>81.5</td>
</tr>
<tr>
<td>2Q</td>
<td>350.5</td>
<td>21.4</td>
<td>171.3</td>
<td>91.7</td>
</tr>
<tr>
<td>3Q</td>
<td>210.6</td>
<td>24.3</td>
<td>144.2</td>
<td>80.9</td>
</tr>
<tr>
<td>4Q</td>
<td>522.2</td>
<td>25.1</td>
<td>143.1</td>
<td>83.5</td>
</tr>
<tr>
<td>1991 Total</td>
<td>1460.7</td>
<td>66.6</td>
<td>520.8</td>
<td>292.5</td>
</tr>
<tr>
<td>1Q</td>
<td>410.5</td>
<td>18.5</td>
<td>84.9</td>
<td>70.5</td>
</tr>
<tr>
<td>2Q</td>
<td>340.3</td>
<td>14.5</td>
<td>163.0</td>
<td>79.6</td>
</tr>
<tr>
<td>3Q</td>
<td>204.5</td>
<td>16.6</td>
<td>137.0</td>
<td>70.2</td>
</tr>
<tr>
<td>4Q</td>
<td>505.4</td>
<td>17.0</td>
<td>135.9</td>
<td>72.2</td>
</tr>
<tr>
<td>1992</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1Q</td>
<td>307.1</td>
<td>6.3</td>
<td>76.6</td>
<td>43.9</td>
</tr>
</tbody>
</table>

Supreme Council (Parliament) has created several temporary committees, which deal (among other problems) with energy issues, especially concerning environmental impact and the economics of the oil-shale industry. Local municipalities have also created committees and groups who deal with energy problems, especially with fuel supply and district heating.

EnPro Engineers Bureau, Ltd. August 1992
The Estonia Academy of Sciences (mainly Institute of Thermophysics and Electrophysics (ITEP)) and Tallinn Technical University (TTU) have carried out many projects in the past several years in the area of energy efficiency. Some engineering firms offer energy auditing services, but this practice is not yet widespread.

Foreign experts are also participating as advisors in MIE and in some committees connected with government and Supreme Council (Parliament).

There is no exhaustive information about activities of agencies described above. A list of some activities (compiled from various sources) is given in Appendix A. A lot of reports have been produced but it seems that so far all agencies have minor influence on energy efficiency matters in reality. The most important result of these activities have been the collection and spreading of information.

1.1.5 Activities in Energy Efficiency in Estonia Funded by Foreign and International Organizations

Energy officials and experts from Estonia's neighbor-countries often cooperate with Estonian side in energy savings projects. For example, some of the projects in cooperation with Finnish companies include: increased use of domestic peat (production and consumption); fluidized bed combustion equipment; desulfurization plant for Baltic Power Station. The biggest electricity companies from Finland - Imatran Voima Oy and from Sweden - Vattenfall AB (Swedish State Power Board) are interested in cooperation with Estonia. A memorandum of understanding was signed in February 1992 between MIE, Eesti Energia, Imatran Voima Oy and Vattenfall AB to establish a joint venture in the energy field. At the preceding stage to starting the new company, by November 1992 they will prepare a Master Plan for Estonian energy issues. This master plan has begun by investigating the past and present situation in five areas:

- Energy supply and pricing
- Energy consumption and conservation
- Technical survey of existing systems (heat and power)
- Environmental impact of energy
- Macroeconomic scenarios
The master plan will next elaborate recommendations to carry out Estonia's energy policy objectives. These are expected to include maximization of the use of indigenous fuels, reduction of imported fuels, and projects for specific technical fixes, such as improved boiler efficiency.

IVO and Vattenfall also have a preliminary agreement with Eesti Gaas (Estonian gas supply company) to make an energy survey in a natural gas-fired boiler house of a state farm, and then, to reconstruct the boiler house to demonstrate energy efficient equipment.

In April 1992, talks with Danish energy experts took place in Tallinn, at which the main topic was energy conservation. Building an energy saving home as a demonstration model in Estonia is being considered.

As part of the EC's assistance to Estonia, activities have begun within THERMIE program. An Energy Centre as a part of wider network of OPET's has been established in January 1992. Among other things, the aim to promote wider use of efficient energy technologies has high priority. The first actions undertaken by the EC Energy Centre include a series of energy audits covering industry (6 sites), buildings (2), district heating stations (2) and one transport company. There are plans to build up databases of the energy situation in Estonia, energy producers, energy users, etc. There is also an idea to establish an Energy Users Club. EC has financed some projects in Estonia within a framework of UN program Energy Efficiency 2000. Under this program the Swedish National Board of Industrial and Technical Development (NUTEK) carried out several energy surveys in energy-intensive industrial companies and in office building.

EBRD has had two missions to Estonia, and is seeking projects which can be implemented in the short term.

In May 1992, Estonia became a formal signatory to the European Energy Charter.

A summary listing of the many organizations, projects and activities active in the general field of energy efficiency in Estonia is included below.

WORKING GROUPS

Working Group on Fuel Reserves
Comment: To carry out an inventory of stationary tanks for petroleum products, establish certain methodology for monitoring the stocks, as well as proposing a system for financing of fuel imports and larger precautionary stocks.
Financed: GoE
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Executing agency: ITEP

Working Group of Energy Pricing
Comment: To work on energy pricing and taxing policy, to analyze proposed prices of indigenous fuels as well as ones for electricity and district heat. To scrutinize the households ability to pay for energy in crisis situations, discuss the practice of subsidies in energy field.
Financed: (GoE? not decided yet)
Executing agency: ITEP
Technical assistance: USAID (RCG/Hagler, Bailly)

Estonian - Russian Working Group on Power Exchange
Comment: The group is headed by the ministers of energy of both countries.
Financed: Governments
Executing agency: Estonian and Russian Ministries of Energy.

Estonian - Latvian -- Lithuanian Working Group on Power Exchange
Comment: The group is being planned.
Financed: Governments involved
Executing agency: Ministries of Energy of Baltic states.

Estonian-Finnish Advisory Group for Energy
Comment: The advisory group was found in February 1991 to provide consultations for solving long-range energy problems in Estonia and to promote Estonian-Finnish cooperation in the energy field.
Finance: Government of Finland, Imatran Voima Oy, A. Ahlström Oy.
Executing agency: Finnish Academy of Technology and Estonian Academy of Science.

Oil Terminal Advisory Group
Comment: The group studies problems of the new oil terminal under construction in Tallinn new port (Uussadam).
Financed: GoE, Denmark.
Executing agency: Danish Oil Company.

STUDIES, SURVEYS, PROGRAMS AND COOPERATION

Emergency Energy Program - Component 1: Industrial Energy Efficiency
Comment: Energy management programs consisting of energy audits and low-cost assistance with equipment in three industrial plants and city of Tartu.
Financed: USAID
1.8 FACTORS AFFECTING INDUSTRIAL ENERGY EFFICIENCY IN ESTONIA

Executing agency: RCG/Hagler, Bailly, Inc. in cooperation with Estonian firms Termox, Ltd., EnPro Engineers Bureau Ltd., TTU.

Comment: Program of training, information and conference coordination on aspects of energy pricing in a market economy.
Financed: USAID

Energy Audits
Comment: Energy audits and no-cost advice on energy savings in several industrial enterprises (6 sites), district heating stations (2), schools, hospitals, etc. carried out through OPET Energy Centre in Tallinn.
Financed: EC (THERMIE programme).
Executing agency: March Consulting Group (UK), some audits by COWIconsult (Denmark).

Energy Surveys
Comment: Energy survey of six energy-intensive industrial companies and an office building.
Financed: ECE (within a framework of UN program Energy Efficiency 2000).
Executing agency: NUTEK - The Swedish National Board for Industrial and Technical Development.

Energy Efficiency 2000
Comment: Energy survey of a Glassware Factory carried out as a part of ECE and UN program Energy Efficiency 2000.
Executing agency: NUTEK - The Swedish National Board for Industrial and Technical Development.

Energy Conservation Plan
Comment: Initiated by Minister of Construction Activities. Plan to reduce energy consumption in residential sector by installation of heat metering systems and creating economic situation attractive for saving energy.
Financed: not financed (yet?).
Executing agency: Ministry of Construction.

National (State) Energy Conservation Program
FACTORS AFFECTING INDUSTRIAL ENERGY EFFICIENCY IN ESTONIA

**Masterplan for District Heating**  
*Comment:* Tartu  
*Financed:* Danish Government (?).  
*Executing agency:*

**Multi-fuel Boilers**  
*Comment:* Project for development of methods and equipment for two-stage combustion of oil-shale. The gasification process takes place in fluidized bed and the combustion of hot gases is organized in reconstructed furnaces. It enables to increase the consumption of Estonian oil-shale in small and medium sized boilers instead of imported HFO or natural gas.  
*Financed:* GoE (+ contracts).  
*Executing agency:* ITEP (in cooperation with Finnish companies).

**Energy Master Plan (EMP)**  
A memorandum of understanding signed on February 11, 1992, between MIE, Eesti Energia (Estonia) and Imatran Voima Oy (Finland), Vattenfall AB (Sweden) to establish in near future, a joint-venture for executing the EMP for Estonia. EMP must be prepared in the period April to November 1992.  
The EMP should include the following studies.  
- survey of energy use and supply; energy sector legislation and organization; energy management;  
- technical and economical surveys of the energy systems;  
- economic and environmental development survey and scenarios;  
- energy demand forecasts up to 2010;  
- energy policy scenarios for all energy subsectors.  
*Financed:* Finland, Sweden (Eesti Energia?)

**Economy Review**  
*Comment:* World Bank Economic Mission Phase II (completed on January 28, 1992); report includes an introduction, a summary and six appendices on Energy, Environment, Housing/Municipal Services, Telecommunications, Tourism and Transport.  
*Finance:* WB.  
*Executing agency:* Head - Mr. Biderman: Energy - Mr. Arturo Roa.

**Technical Emergency Assistance**  
*Comment:* World Bank Economic Mission Phase II (completed on Jan. 28, 1992); report includes an introduction, a summary and six appendices on Energy, Environment, Housing/Municipal Services, Telecommunications, Tourism and Transport.

EnPro Engineers Bureau, Ltd.  
August 1992
FACTORS AFFECTING INDUSTRIAL ENERGY EFFICIENCY IN ESTONIA

Finance: WB.
Executing agency: Head - Mr. Biderman; Energy - Mr. Arturo Roa.

Estonian Danish Cooperation
A 17-member delegation from Denmark visited Estonia from April 26-28, to discuss Denmark’s assistance to Estonia, particularly in energy conservation. Building a model 'energy conservation home' to Estonia is being considered.

Energy Advisor
Comment: The advisor (Mr. K. Larsson) started work in the MIE in March 1992 and has three month contract.
Finance: BITS (Sweden).
Executing agency: Energiplan (Sweden).

PHARE Program
Comment: Expert on energy planning at local level. Will stay in Estonia for six month.
Finance: EC.
Executing agency: Private consultant from Luxembourg.

TEMPUS Joint European Project (proposed program)
Comment: Economic Modelling for Energy Management in Estonia. Training of Estonian academic staff, post graduates, top executives, graduate engineers and government officials.
Planned date of commencement - September 1, 1992.
Planned date of completion - August 31, 1995.
Involved organizations: University of Piraeus (Greece), Continental Enterprises Ltd. (UK), European Economics and Financial Centre (UK), ITEP.

ASSOCIATIONS

Estonian Association for Energy Economics (EAEE)
Comment: Association for persons dealing with energy economics. Incorporates more than twenty specialists from 12 institutions. EAEE is an affiliate member of International Association for Energy Economics (IAEE, Washington, D.C.)
Led by M. Mõtus (ITEP) as president.

Estonian Association for Heat and Ventilation Engineers
Comment: Considers very important to be active in the field of saving heat energy. Plans to take part in projects for reconstruction of DHN substations.

Estonian Association for Electrical Engineers

EnPro Engineers Bureau, Ltd. August 1992
FACTORS AFFECTING INDUSTRIAL ENERGY EFFICIENCY IN ESTONIA

Comment: Recently (March 1992) established. Has set the license policy for electrical engineers and cooperation with foreign colleagues as its main goals.

**Baltic Power System Research Association**

*Comment:* Incorporates scientists and engineers engaged in power systems functioning and development control problems.

*Executing agency:* Led by L. Krumm (ITEP) as president.

**BALTEL**

*Comment:* Association of persons dealing with energy supply in Baltic states. Project of bylaws approved on March 22, 1992 in TTU.

1.2  **CURRENT MANAGEMENT PRACTICES IN INDUSTRIAL ENTERPRISES**

1.2.1  **Ownership and its Effect on Management Structure**

Ownership problems are considered very important for management efficiency, including energy management. State ownership is still overwhelming in Estonia, but there is much speculation about privatization and creating municipal, cooperative, private ownership by selling or simply handing-over many state-owned enterprises. The legal basis is currently under discussion in the Supreme Council (Parliament).

At the moment, probably the biggest problem in management of enterprises, is not connected to ownership itself, but to survival in an uncertain situation. Many managers are not confident about their future and therefore do not put much effort to their tasks.

1.2.2  **Management Organization and Allocation of Responsibility for Energy Efficiency**

Larger enterprises have energy departments responsible for operating the energy systems. In principle, the energy department must take care of efficiency as well. These departments are usually subordinate to the chief engineer. In smaller enterprises, there is a person appointed to be responsible for energy issues, usually the chief engineer.

Information available on energy systems' performance and energy efficiency is collected regularly, but data are poor and poorly used as well. Usually, there is no system to analyze energy efficiency continuously. The usual practice is to check periodically (once in 1 - 5 years), such as the efficiency of boilers. This kind of checking is prescribed by Regulations and performed by special organizations. In some cases, experiments are carried out to estimate the losses (for example, in district heating networks).
1.2.3 Command and Control Procedures Used by Energy Companies to Allocate Scarce Energy Supplies

Energy companies have detailed action plans for the situations in which there is shortage of fuels, heat or electricity. According to these plans, all consumers are divided into priority groups, with prescribed "regimes" to allocate the impact of energy shortages to them on a rational basis. When certain amount of fuels, heat or electrical capacity is lacking, the restrictions on supplies are introduced according to these regimes. Consumers are informed about their place in these consumer priority lists.

Usually, limited regimes of consumption are introduced by informing involved consumers beforehand. For example, five years ago, during a very cold winter, the information on electricity consumption restrictions was broadcast by radio daily, simply by announcing the list number of regime for the next day and each consumer affected was obliged to act according to the plan of restrictions. This system usually functioned quite well. Only in some extreme situations, several regions were totally switched off without warning, because there was not enough time to inform customers. The economic consequences of these actions, particularly lost production, were later evaluated as serious.

There are also certain plans for emergency situations in case of extreme shortage of petroleum products.

1.2.4 Accounting Procedures for Measuring Production Cost and Profit or Loss

Costs are calculated in every enterprise, with the usual accounting periods being monthly, quarterly and annually. The selling price is calculated by adding profit and taxes to the costs, according to an allowed margin. If the price is fixed by government or by local budget (for example, some food products, public transport, rents, some services, and, up to now, heat energy). At present, many enterprises are practically bankrupt, because their prices were kept low by authorities and there is not enough money to take from the budget for subsidies. The government policy is now directed toward reduction of subsidies. As inflation is high, enterprises are in difficulties to keep track of their expenses, incomes and profits due to the lack of appropriate accounting procedures.

1.2.5 Procedures for Measuring Plant Output and Energy Efficiency

In general, there is no difficulty in measuring plant output, but energy efficiency is calculated only in some cases. When energy was cheap and the economy was (supposed to) run by
plan, energy efficiency was usually not an important measure for enterprise managers, except for very obvious cases of energy waste.

Currently, Eesti Energia company is considering new computerized control equipment, because existing aged electricity meters have low precision and do not allow operative control. It must be noted that Eesti Energia does not read electric meters in the residential sector, but rather relies on customers to read their own meter and report the consumption. Every year or so, Eesti Energia inspects actual readings to determine if the consumers have been reporting accurately or not.

1.2.6 Incentives for the Plants to Minimize Energy Costs and to Raise Energy Efficiency

Most enterprises have realized that after the energy price increase the expenditures on energy are becoming a burden to their financial budgets, and so are seeking ways to reduce the energy costs. Thus these new higher prices are the main driving force to raise efficiency. In many cases, enterprises consider proper metering of energy (including heat) consumption as the first priority because they believe they pay for more than they actually consume. Usually this is true, but in some cases, actual consumption of district heat can be greater than is paid for, and so these enterprises keep silent.

In many cases, industrial plants are monopolies which are allowed to pass their costs directly to the consumer. Incentives to energy efficiency in such plants are limited.

1.2.7 Incentives for Individuals to Suggest and Implement Energy Efficiency Improvements

Generally there is no system by which an industrial worker has an incentive to suggest energy efficiency improvements. Some plants have become privatized, with workers as shareholders, and it is believed that suggestion/incentive systems are in operation in some of these, and that these may include energy efficiency ideas.

People whose apartments are connected to district heating networks (DHN) usually do not worry about energy saving as far as they feel comfortable, because the heat consumption cannot be controlled individually today and they pay anyway for the average consumption. Lowered temperatures in DHN last winter, forced people to think how to insulate their apartments better and in such a way, to raise the level of comfort (temperature).
Last winter the authorities paid little attention to the recommendations on activities for energy saving and increasing comfort in apartment houses.

Obviously, people want to know more exactly how much they consume, and as well, to have information to draw comparisons. Also standard solutions must be propagated how to improve the insulation of apartments and how to behave (to what extent use additional electric heating, etc.). There are already several cases where dwellers of not state-owned (cooperative) apartment houses have bought and installed heat meters for their houses to meter the exact heat consumption.

Although district heating tariffs are based on heat consumption (Gcal), since there is no metering this is only a theoretical construct. If meters were installed there would be better incentives for consumers to improve efficiency.

1.2.8 Perceptions of the Importance of Energy Efficiency Relative to Other Objectives

Attitudes in enterprises depend on the share of energy costs in their production costs. In some fields for several enterprises, energy costs have become too high for production to be competitive.

In a typical industry, the relative priorities of management concerns today are:

1. Survival of the company in the short run - including protection of the jobs of managers and workers, making payroll, and collecting accounts receivable

2. Marketing of the product - finding ways to sell what is in inventory, and expand into new hard currency markets in the West

3. Securing supplies of raw materials and energy (mainly from Russia) - in order to keep the business going

4. Survival of the company in the long run - dealing mainly with the issue of privatization, joint ventures, or restructuring

5. Typical Western management concerns, which include improvements in quality, productivity, and efficiency. Certainly, with the new high energy prices, energy is finally receiving sufficient attention in this group.
FACTORS AFFECTING INDUSTRIAL ENERGY EFFICIENCY IN ESTONIA

For most individuals, heating bills are already very high. The abolition of subsidies beginning June 1992, will raise these bills sky-high. Predicted heating bills will certainly exceed the capabilities of most people to pay for them at current levels of income.

1.3 INDUSTRIAL INVESTMENTS DECISION-MAKING

1.3.1 Sources and Availability of Capital

In Estonia at this writing (June 1992), the economic situation and financial affairs are still worsening. Very recently, it was announced that it is impossible for industrial concerns to get any credit from the banks, as the money transfer is restricted due to the almost paralyzed banking system.

Usually in Estonia (and elsewhere on the territory of the former USSR), local rouble and hard currency accounts were kept strictly apart. This was still the situation in June 1992. The choice to buy something in roubles is quite limited, but even buying in hard currency is not easy due to the disorganization of the banking system.

Available sources of capital are private investors (becoming more important now), enterprises, banks, local authorities, state budget, foreign investors. At this writing, it can be claimed that sources of capital are quite limited. But it seems to be relative and reflects the overall instability. When government manages to stabilize the situation and to create a more confidential atmosphere (it depends also on entrepreneurs, etc.), capital may become more available.

By May 1, 1992, a total of 259 foreign companies and organizations had been granted permits to open their offices in Estonia. About 1,500 foreign firms from 50 countries had invested in the Estonian economy as of February 1992. These foreign investments make up to US$150 million of the capital stock of businesses registered in Estonia. More than half of investments have been made in industrial production, 20 percent in hotel or tourism businesses, and approximately 7-8 percent in commercial service and trade sectors.

Estonia has signed treaties on the mutual protection of investments with Finland and Sweden. Negotiations are in process with other Nordic countries and with Germany, Netherlands, Switzerland, UK, etc.

The Nordic Investment Program was begun in April 1992, jointly by the European Bank for Reconstruction and Development (EBRD), the Nordic Investment Bank and the Nordic Project Fund. This program aims to provide loan guarantee and risk capital to help set up small and medium sized private businesses.
On May 12, 1992, the top managers of the Bank of Estonia and Suomen Vientiluotto Oy (Finnish credit company) signed documents for loan of 50 million Finn Marks (FIM) to be used for financing of middle- and long-term investments in Estonia. Higher priority will be given to private sector.

According to a recent International Monetary Fund Report (dated April 1992), a very large financing gap in the external accounts will probably emerge, principally because fuel supplies obtained under barter agreements with Russia will have to be supplemented by purchases from world markets. This will entail substantial import compression and a large decline in living standard.

1.3.2 Investment Criteria

The main criteria for commercial banks are the credibility, security and financial outlook for the borrower. State-financed or guaranteed loans can be received on more favorable terms for certain projects. Energy efficiency projects can possibly be included here. Due to the present high inflation, nominal rates are high.

The main criteria used by industrial companies are the priorities of their needs and their threshold pay-back time. Up until today, energy efficiency have not been the first priority to investment. Investment decision-making is usually a long and complicated process depending of course on the importance and magnitude of the project.

In the present uncertain environment, any energy efficiency project that does not offer a payback time of less than one year is likely to be deferred.

1.4 AVAILABILITY OF TECHNICAL SERVICES AND EQUIPMENT RELATED TO ENERGY EFFICIENCY

There are certain aspects concerning efficiency in every energy-related project, and historically these considerations have been included in the design. However, with the recent increase in energy prices, the relative weights of the trade-off decision have changed.

Specific technical services and equipment related directly to a market for "energy efficiency" is in the initial stage of development in Estonia. The key factor in the limited market for energy efficient equipment and services is the demand for the product. But the situation seems to be changing rapidly. At the moment, several joint-venture companies import and offer equipment for raising the efficiency of energy use: heat metering equipment, heat
exchangers (substations for DHN), heaters (water and electric), control devices, air/air heat exchangers, etc.

Also some local companies are starting to produce more efficient equipment. There have been many contacts and negotiations between local and foreign companies and inquiries about technology transfer to Estonia and joint projects to start production here for example preinsulated heat pipes, valves, control equipment, etc. but so far little have appeared on the market.

Obviously the volume and diversity of local production of efficiency energy equipment should be much larger for economical reasons and there is enough market space to develop in Estonia and further in Russia and other Eastern countries. There are no restrictions for Estonian companies to import foreign energy efficient equipment, provided they have hard currency, but by local scale this is too expensive. If produced locally, the equipment of comparable quality is presumably much cheaper.

One of the problems is, that at the moment, none of the local consulting companies is capable of making investigations and designs of complicated energy systems as cogeneration plants, control systems of large heating networks.

The possibilities of privatization are not of first importance in this field because technical services related to energy efficiency are offered mainly by small-scale private consulting firms. Among state-owned firms, TTU and ITEP have laboratories capable to offer some kind of technical assistance in the field on energy efficiency.

1.5 INDUSTRIAL REFORMS UNDER CONSIDERATION

1.5.1 Estonian Energy Pricing Practices and Trends

In the former Soviet Union, domestic energy prices and fixed by government for long periods. These prices remained almost unchanged between 1982-1990.

Up to the year 1991, all of Estonian fuel imports came from Soviet sources, with minor exceptions (namely, coal from Poland in some years). In the first half of 1991, Estonia continued to import mainly from Russia, but at far higher prices. In the winter of 1991/92 Estonia did not manage to import sufficient quantities of fuels from Russia. The main reasons for that were: decreased fuel production in Russia, unbalanced Estonian-Russian trade, price increases, and in some cases embargo on political bases (after Estonian independence declaration). From January 1, 1992, Russia implied high export duties on fuels exported by non-governmental contracts:
heavy fuel oil: 24 ECU/tonne  
diesel fuel: 51 ECU/tonne  
gasoline: 57 ECU/tonne  
natural gas: 24 ECU/tonne oil equivalent

In April, after trade and cooperation treaties were signed between Estonia and Russia, these  
taxes were lifted for Estonia. However the situation after the kroon regime begins in July  
1992 is uncertain.

The average price increase (change in index data from State Statistics Office) for all fuels  
sold in Estonia was 199 per cent for 1991 to 1990, and 2,411 percent for 1Q'92 to 1991.  

Average User-Prices of Main Fuels in Estonia (rbl. per ton)

<table>
<thead>
<tr>
<th>Fuel/Period</th>
<th>1990</th>
<th>1991</th>
<th>1Q'92</th>
<th>Apr.'92</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>29</td>
<td>46</td>
<td>640</td>
<td>4,110</td>
</tr>
<tr>
<td>HFO (mazout)</td>
<td>38</td>
<td>90</td>
<td>4,110</td>
<td>8,250</td>
</tr>
<tr>
<td>Diesel Oil</td>
<td>150</td>
<td>330</td>
<td>11,940</td>
<td>15,908</td>
</tr>
<tr>
<td>Gasoline</td>
<td>355</td>
<td>594</td>
<td>23,389</td>
<td>31,448</td>
</tr>
<tr>
<td>Natural gas (per 10³ m³)</td>
<td>28</td>
<td>61</td>
<td>1,700</td>
<td>5,390</td>
</tr>
</tbody>
</table>

In Estonia, the price for domestic fuels (mainly oil shale), electricity and district heat must  
be approved by MIE together with State Price Department.

The only taxes implied on energy are the general turnover tax (10 percent) and excise tax for  
motor fuels. The excise tax for motor fuels is very low (e.g., fixed sum of 164 rbl. per ton  
for gasoline, i.e., 0.52 percent of user-price in April). The new rate for excise tax for motor  
fuels is established at 10 percent (an increase of 50 times), but it was not yet applied as of  

After stopping the subsidies to district heating enterprises, the heating bills for apartments  
have increased enormously (in 1990 heat sold for 10 rbl./Gcal, whereas in Apr. 1992 the  
price was 950-1,150 rbl./Gcal). As in the same time, rents for apartments, as well as  
telephone, gas, electricity and water tariffs, increased substantially. Government decided  
April 27, 1992 to begin subsidizing families with low incomes (defined as less than twice the
total bills for rent and services, including energy for their apartment). The new (May 1992) system of calculating district heat prices by regions leads to differences in prices up to 4 times (due to the different fuel costs -- oil shale as compared to HFO).

Differences in fuel prices depend on delivering companies as well. For example, gasoline is supplied by state enterprise Eesti Kütus (which supplies approximately 80 percent of the market) and by more than 20 small companies (purchasing gasoline from Russia), mainly by direct contracts. In the beginning of 1992, there was a practice to organize auctions on motor fuels. Estonia's first gasoline auction was held on January 10, 1992. A total of 28 private firms participated in the auction offering 1.25 million liters of gasoline, which was bought from Russian oil producers at commercial prices. The highest bid was 56 rbl/l (for AI-93 grade).

Recently, there have been periods when state had only one week's (in some cases for only some days) supply of gasoline in stocks. In such cases, it was distributed only among critical life-supporting services such as police, emergency medical aid and food transport. During these periods, the state-supplied gasoline was not sold to private car owners.

Another separate system of gasoline supply is provided by foreign (Western) companies who operate gasoline stations, namely Neste (Finland) and Statoil (Norway). In these stations, the gasoline is sold for hard currency and the prices are not controlled by Estonian government. Therefore, the prices can be quite different, for several reasons. Prices have generally ranged from 1.20 to 3.00 FIM per litre.

1.5.2 Russian Energy Pricing Practices and Trends

In Russia, fuel prices are expected to increase by at least 8-10 times in the near future. The fastest price increase will probably be in metallurgy and petrochemical industry. The Russian government plans to free petroleum product prices for internal markets in the autumn of 1992 at the latest. Experts forecast that after decontrol, the prices on Russian oil will reach 17-18,000 rbl. per ton during the next two months.

During the first five months of 1992, Russia supplied only 11-12 percent of fuel quantities fixed in Estonian-Russian governmental agreements for 1992. These were barter arrangements of food for energy, based on world market prices in hard currency, and Estonia supplied products from its side according to the terms of the agreement. There was a clearing rate of rubles per dollar which was below the market exchange rate, however this applied to food as well as energy.
This situation of agreements which are not honored puts Estonia in a very difficult position, particularly considering recent history and military installations which still are in place in Estonia. Therefore, Estonia must orient its fuel import more to world markets.

1.5.3 Decontrol of Markets in the Industrial Sector

Imported western goods are available for some consumer items. Competition from these goods are putting strong pressure on some local suppliers, such as electronics. However, limited consumer ability-to-pay is the primary limiting factor. Heavy bulk goods and energy-intensive products are not yet available from western sources.

Expected privatization will lead to further decontrol of markets. Government possibly still tries to keep some regulation of prices for basic commodities and also, to influence the situation by taxing and investment policy.

1.5.4 Privatization and Industrial Restructuring

By May 1992, more than 500 service, trade and catering facilities (most with assets not bigger than 500,000 rbl.), have been privatized. Although some progress has been made in the privatization of these smaller enterprises, issues of citizenship and property ownership, together with debate over the desirability of selling property for roubles, have caused the reform process to stall. Privatization has also been complicated by claims from former owners whose property was expropriated by the communists in 1940. It is expected that the review of these claims will not be completed until 1993. General elections in the summer (or autumn) of 1992 are also expected to speed up privatization.

Starting from May 21, 1992, all enterprises with fixed assets not greater than 6 million rbl. in all sectors can be privatized. Privatization of larger enterprises must be approved by Supreme Council (Parliament). The preliminary list of larger enterprises (131) to be privatized in the next round includes 51 enterprises now controlled (at least partly) by MIE. It was proposed that the government be given the right to make decisions on selling enterprises to foreigners.

Up to now the practice was to arrange "business plan contests" among new owners (candidates) for privatizing former state enterprises. Now it is proposed to privatize using simple free auctions.

The large state enterprises will be placed into holding groups headed by government-appointed directors who will monitor their profitability and restructuring, or privatization.
This is the stepwise process toward turning state-owned companies into state-owned shareholding concern run by boards of government appointees.

There are forecasts made by industrial experts that claim about fifty percent of state factories in Estonia will fail following privatization. That figure can climb if trading relations with Russia disintegrate. Therefore, the restructuring of industry is very important. The best results can be hoped in timber, as well as in pulp and paper industry, textile and cement industries which all can use mainly domestic raw materials. High technology equipment and instruments manufacturing industry are considered promising, too.

1.5.5 Energy Sector Restructuring

Most energy producing and supplying companies are still state-owned (state enterprises) -- Eesti Energia (Electricity and district heat company), Eesti Põlevkivi (oil-shale company), Eesti Kütus (petrol products supply company).

There are ideas to reorganize these enterprises at first to state-owned stock companies and afterwards start selling shares to other companies or to individuals.

State enterprise Eesti Gaas (natural gas supply) was reorganized in April 1992 as a joint stock company Eesti Gaas. The shares of the company are distributed as follows:

71.44 mill. rbl. (69.36 percent) owned by Estonian Ministry of Building Industry,
20.9 mill. rbl. (20.3 percent) by Gazprom (Russian concern of gas producers)
10.66 mill. rbl. (10.24 percent) by Lentransgaz (Russian gas transmission company).

There is interest from a Danish gas company to be involved later.

There are plans to sell/give the district heating systems to municipalities. But, due to poor technical condition of boiler houses, and especially, of heat networks (pipelines), no municipality still wishes to buy or even to receive one.

1.5.6 Impact of Industrial Reforms

The basic aim of all industrial reforms is to raise the efficiency and to make industry more competitive. Many activities in this direction are simply following the practice in other countries and the success is not always clearly and immediately apparent. But, it is widely recognized, also by international agencies (e.g., IMF), that Estonia is generally on the right path toward a market economy.

EnPro Engineers Bureau, Ltd.

August 1992
1.6 1992 EXPERIENCE IN DISTRICT HEATING ENERGY RATIONING
(Forced Energy Conservation)

1.6.1 Brief Description of Tallinn District Heating System

Tallinn, the capital of Estonia, with population nearly 0.5 million, has extensive district heating network (DHN), supplying approximately 75 percent of the total heat consumption. Heat is supplied mainly by Eesti Energia (electricity supply and heat generation company) operating two cogeneration plants (190 MW and 11 MW) and five boilerhouses. The other major heat supplier is Termest (Municipal Heating network enterprise) operating 49 smaller boilerhouses and distribution networks. Total heating capacity in Tallinn is approximately 2.5 GW, and the length of the DHN is 500 km. Fuel consumption in 1988 was 4 PJ (including 17.6 PJ of HFO and 22.6 PJ of natural gas), of which 95 percent was imported. Design parameters are mainly to supply hot water at 150°/70°C and 95°/70°C in smaller networks.

Heat consumption is controlled mainly by changing the temperature of water on outlets of boilerhouses, which is set twice a day according to the reference temperature (average of the temperature at the time of calculation, min and max forecasts). Certain measures are also taken in substations which are of mixing type or have heat exchangers. In general, the existing control system does not allow precise setting of room temperatures, which are often below or above the normal. Only very recently the first data on heat consumption efficiency became available from energy audits and other investigations.
1.6.2 Traditional Supply Temperature Regime "Grafik"

This "grafik" was the official Soviet basis for controlling the heat supply to consumers. "Grafik" sets the DHN water temperature on the outlets of boilerhouses and cogeneration plants in dependence on the ambient air temperature, as indicated. The "grafik" equation for supply temperature is:

\[
\begin{align*}
\text{for } T_{\text{amb}} > 6^\circ\text{C: } T_{\text{supply}} &= 70^\circ\text{C} \\
\text{for } T_{\text{amb}} \leq 6^\circ\text{C and } > 0^\circ\text{C: } T_{\text{supply}} &= 70^\circ\text{C} + 2.67^\circ\text{C} \times (6 - T_{\text{amb}}) \\
\text{for } T_{\text{amb}} \leq 0^\circ\text{C: } T_{\text{supply}} &= 86^\circ\text{C} + 2.91^\circ\text{C} \times (0 - T_{\text{amb}})
\end{align*}
\]

There are also some corrections made according to the wind speed. In practice there are deviations from the "grafik," in particular, the maximum temperature of 150°C was never achieved, for technical reasons.
1.6.3 Actions taken in 1991/92 Heating Season to Ration Heat Supply

As fuel prices increased from December 1991 and supplies decreased, it was decided by Tallinn Municipality that the outlet temperatures of boilerhouses must be lowered to save fuel.  

During most of the winter the outlet temperature in DNH was kept at just 50°C (in some cases 45°C and 60°C when the new HFO supplies arrived) disregarding the weather conditions. Fortunately, the winter was milder than usual. As the result, the radiators in buildings were heated up to as much as 40°C. Room temperatures were below normal, but were on the order of 15-19°C.

By the order of government, some HFO stocks in Estonia were redistributed to the areas where the stocks were running out. During January - March 1992 there were usually HFO reserves of only 2 to 5 days. In times of extreme crisis, supply of domestic hot (in reality warm) water was cut off for several periods, or limited only to weekends.

1.6.4 Effect of These Actions on Energy Consumption

A regular watch of energy consumption was organized only in two houses where it was assisted by Swedish experts. The data from these and some other sources indicate that temperatures in apartments varied largely -- between 12° and 20°, depending on location of the apartment. In some regions the temperatures were clearly lower than in other locations, it really shows very poor control.

As for energy conservation effect, Termest estimates that they used only about 30 percent of the normal level of fuel consumption. Fuel consumption for heating and for DHN systems are not available separately and requires separate investigation.

The reference temperature in Tallinn (fixed in building codes and for design calculations) of the coldest five days is -22°C, the average temperature for the coldest month (Jan.) is -4.7°C and the average temperature of heating season (221 days) is -0.8°C. The lowest temperatures recorded in Tallinn have been around -30°C and the absolute lowest in Estonia -43°C.

In November 1991, extensive discussions were held between EKSE (now TERMEST) and RCG/Hagler, Bailly to debate the merits and impacts of this decision. RCG/Hagler, Bailly supported EKSE’s idea to adopt the rationing scheme.
Monthly (also 10 days) average temperatures are calculated by the Department of Meteorology. Several recent winters have been milder than usual. There is still no practice of calculating "degree-days" as the measure of average temperature during heating seasons.

The long-range average temperature of the heating season in Tallinn is -0.8°C. Actual average temperatures during recent heating seasons have been:

- 1987/88: +3.6°C
- 1988/89: +2.5°C
- 1989/90: +3.2°C
- 1990/91: +3.6°C

1.6.5 Other Effects

In general, people tolerated this discomfort quite calmly. One effect was that more electricity was used to heat rooms. Lowered temperatures probably resulted also in lower worker productivity. Complaints came from hospitals. In general nothing very bad happened directly, except discomfort.

Some people showed their ingenuity to improve conditions in their apartments. For example, one family erected a tent in their apartment. Inside the tent, body heat kept temperatures warmer. Other families improved the insulation and weatherstripping on their windows and walls.

This crisis was foreseeable already in the last autumn, but little was done to meet it better prepared. In 1991/92, Estonia was lucky to have a mild winter, otherwise, the consequences may have been far more serious (e.g., freezing of systems, etc.). On the coldest days, one of the ministers of government was talking in desperation about the evacuation of population from Tallinn, but that wouldn’t have done any good.

1.6.6 Plans for Rationing District Heat in 1992/93

There are many uncertainties regarding how Estonia will meet the next winter. Most of them can be expressed in some words -- lack of money to purchase fuels, spare parts, new equipment. Government is trying to secure some loans for that purpose.

As the heat prices have gone up, many "freespending" heat consumers are thinking about metering their consumption and how to save energy. Eesti Energia company is proposing a new "grafik" with lowered outlet temperatures, but the design is still under discussion. In a
critical situation, as in last winter, probably there will be no other choice but to establish minimum temperatures in networks to avoid freezing. The real situation will mainly depend upon the ability to purchase fuels. At the moment, it is clear that many tenants are simply not going to be able to pay heating bills in full.
CHAPTER 2: OBSERVATIONS ON ESTONIAN INDUSTRIAL ENTERPRISES

by RCG/Hagler, Bailly, Inc.

2.1 ORGANIZATION

All industrial companies have certain generic functions - marketing, production, finance, management and administration, and research & development. Whereas each of these functions usually represents a division in an American company, in Estonia, organizations are structured differently. In most of the companies surveyed, there are only two primary divisions: technical and economic. The heads of these two divisions are sometimes referred to as deputy general directors, and report to the general director.

The technical division has as its departments the various production units, as well as energy, maintenance, and (if found) research and development (often designated as investment and construction). The economic division has as its departments personnel, finance, accounts, commercial (or sales and purchasing), planning, social (offices and other communal buildings), and perhaps other administrative units.

The organization in Estonian industries is very hierarchical, and decision-making is concentrated at the top. Typically it is not possible to get information across departments; information and orders move only vertically. This creates decision bottlenecks at the General Director and Technical Director levels, and results in delays in executing tasks related to efficiency (such as equipment maintenance) which would be considered more urgent in a Western company. This problem is growing worse, as the Technical Directors are often taking on new responsibilities related to privatization or technical sales for export markets, with extensive travel.

The ownership of Estonian industry is still dominated by the state. However, there is an active privatization campaign underway, and nearly every company has plans for privatization. In most cases, these plans revolve around the hope that a Western joint venture partner will be found.
In the past, there was a notion that energy, like production, should be consumed according to plans. These plans were developed by the planning department, based on historical energy consumption, expected production, and normatives (multipliers to convert projected production into expected energy consumption). The plan was used to develop an allocation by the energy supply companies.

In many cases, the normatives are not realistic. Today, in most cases they are too low, since they were developed based on the original equipment design ratings. Since that time, production levels have been reduced, equipment efficiency has deteriorated and energy losses (such as in distribution systems) have increased. Further, the normatives are simple multipliers, and do not consider that there are fixed energy requirements (to keep the plant hot or rotating equipment turning) and variable energy requirements (per unit of production). Thus in times of operation at reduced capacity, fixed energy requirements are more dominant, and the normatives underestimate energy consumption.

2.2 MARKETING

As could be expected, the marketing function appears to be a fundamental weakness in most companies. In the past, orders for products simply appeared, without any effort on the part of the company. This has created tremendous inertia, in two ways.

First, because of the certainty of former orders for its products, the size of the company's sales staff is minimal and is mainly made up of individuals skilled at administrative tasks. There is no network of external sales staff. In the organization, there are none of the "salesmen" as we know them, that is, personalities strongly motivated to generate sales.

Second, because of the former system of orders being made directly to the company, there is a definite tendency to continue to rely on a similar phenomenon. Simply put, the "sales" staff is sitting in the office waiting for orders. Because of the current strong interest of various Western companies to learn about entering the Eastern European market, there are a number of buyers who are making the rounds and visiting the manufacturers. This temporary phenomenon is unfortunately perpetuating the "myth" that sales can be made without travel and effort. It also is locking the manufacturers into deals that may not be the most favorable to them. The most that companies are doing is setting up a network of agents or representatives in the various market countries.

Generally, top managment recognizes their company's naivete regarding the "marketplace". In the majority of plants surveyed, general managers indicated that assistance in helping them learn "how to enter the market economy" was the one of the best ways they thought the U.S. Government could assist them.
The plans for privatization of most companies, which are based on joint ventures with foreign partners, include assigning responsibility for marketing (at least overseas marketing) to the foreign partner.

### 2.3 PRODUCTION

A primary objective of the 1991/92 USAID Emergency Energy Program is to achieve immediate and lasting energy savings at low cost. The best way to accomplish this goal is through improvements to plant and equipment operations and maintenance. The program in Estonia has had substantial success, mainly due to the willingness of management to make such changes and the catalytic role afforded the USAID-sponsored consultants, who in most cases are the first Westerners to advise the plant's production staff. Some brief observations on energy utilization and production in Estonian companies follow across the key dimensions of production (staff, technology, operations, maintenance, organization, and energy management).

**Staff** - The production function, from inputs of raw materials (including energy) to outputs of finished products, is generally well understood by the technical managers and supervisory staff in the plants surveyed. It is clear that in Estonia, the production function has been able to attract the keenest minds available in the industrial sector. This is in clear contrast to the United States, where R&D or consulting is a bigger attraction to the best engineers, and where keen analytical minds often find their way into legal or financial professions, instead of engineering, in the first place. In general, capable technical engineering talent can be found in most Estonian companies. Further, the general director is typically promoted from production (unless he is appointed by political fiat), whereas in American companies, the path to the top usually passes through the finance department. Energy managers are generally well-informed about energy conservation, but are at a lower level of authority than the production managers. Thus the energy managers are not in as good a position to receive funding for annual budgets for new equipment or maintenance.

**Technology** - Equipment which would be deemed obsolete in western plants is still in place in most medium-sized Estonian factories. Instrumentation and controls are the most evident need for improvement. In the case of some joint venture plants, such as in textiles and wood processing, new, modern equipment has been installed. In the case of other plants, most notably the chemicals sector, plants which have excessive pollution and very dated technology are still operating.

**Operations & maintenance** - Because of the generally high level of staff education, the level of production operations is fairly good, except in plants which are run at less than full capacity. New, market-driven situations are requiring equipment "turndown". Reduction of production
rate below the plant capacity requires optimizing machine operations at less than full load, and this is uncharted territory in most plants, which were run according to plans. Operation of energy equipment (such as boilers) is at a lower level because of the continued use of outdated manual control systems. The level of maintenance is generally lower than that found in Western plants. Preventive maintenance seems to be the exception rather than the rule, and inadequate attention is given to routine maintenance (such as repair of steam, water, and compressed air leaks). The reasons for this are complex, and are related to the limited funding available, the weakness of management in the organization, and a general lack of care for equipment. Estonia is now refurbishing, and recovering from years of neglected maintenance. The mindset of refurbishing, or repair (breakdown maintenance) instead of preventive maintenance may be difficult to change. Managers are not accustomed to enforcing good housekeeping.

Organization - In some cases, energy has been elevated to the position of a department, at the level of a production unit (producing steam, hot water, electricity, etc). This was been done based on a government mandate related to energy conservation (circa 1980), which includes the assignment of energy managers and energy reporting systems.

Giving energy a high level of importance has proven to be both an advantage and a disadvantage. On the positive side, this structure has created an awareness of energy and a full-time position for a manager of energy. But at the same time, the structure may have made energy too independent from the production process. This separation seems to have relieved the production department from the responsibility to manage energy and seems to have elevated the energy department to a position of no longer having to serve the production department. In the worst cases, this dichotomy of functions has resulted in the staff of the energy department practically not being allowed to enter the production areas. The separate energy department serves to supply energy, and in the worst cases has lost touch with reality (the plant exists to make a given product), and at the same time the production department does not regard energy supply as being reliable enough. At best, energy efficiency is the hobby of the energy manager.

2.4 FINANCE AND INVESTMENT

In Estonian industrial companies, the finance department has been primarily concerned with developing an annual budget and with managing expenditures. Financing, whether through government budget, sales, debt or equity inflows, has been handled by the trusts, which are akin to holding companies. Because of the long history of government ownership, there has been little attention paid to investment financing. The assumption has always been that the necessary capital will be there when needed.
The current financial climate in Estonia is one of severe restrictions on credit and high interest rates. There is a dire shortage of investment capital and the preferred method of privatization, which nearly all companies are seeking, is to initiate a joint venture with a Western partner, thus injecting new capital into the system. There does not seem to be a clear system of evaluating joint venture proposals.

Investment decisions are made based on proposals submitted to the Directors by the operating divisions. The Directors generally have established priorities, and they set up an annual capital budget, with the help of the Finance department.

In the transition period, and the current economic hardship, investments which relate to the survival of the plant are given top priority. These include product quality improvement (at most plants audited), diversification to products acceptable to Western markets (chemical plant), and increased production capacity. Large investments are generally being postponed or cancelled now. Decisions are often biased and not optimal.

The recent rises in energy prices has stimulated interest in energy efficiency investment, but capital is not available. It appears to be easier to get money to rebuild an old boiler than to replace it with a modern new one. The attention is being paid to capital cost, instead of life cycle cost. Further, boilers are a priority in investment decisions because without steam there can be no production. Turbogenerators are not a priority, because steam pressure can be reduced through a valve and electricity can be purchased from the grid (production can continue, although the cost of production will be higher).

There also appears to be an unfortunate tendency to repeat decisions or to consider sunk costs. For example, because a large sum of money was spent to rebuild one boiler, a similar project should be carried out on the other boilers, instead of considering alternative investments. Or, because a large sum was spent overhauling a boiler, it should be kept in operation even if it is inefficient, even if analysis indicates a good payback on a new boiler.

Estonia's chief investment problem today is the severe shortage of available capital. In the short-run, the government assumes (no doubt correctly) that the domestic economy will be essentially unable to generate any significant amount of capital. Therefore, foreign investment capital inflows are being actively sought.

2.5 MANAGEMENT AND ADMINISTRATION

Management is the area with perhaps the greatest need for improvement in Estonia today.
In American companies, there is generally a clear distinction between workers and management. Decades of socialism have left no true management class in Estonian industry. There may be trappings, such as separate cafeteria meals, or even executive dining rooms, company automobiles, and different forms of dress (the Western-style business suit), but there does not seem to be a separate mentality.

In the past, workers could get production incentives but foremen and managers could not. As a result, workers were often able to earn much more than their supervisors - a situation which left them unable to manage the workers. The poor housekeeping in the plants is evidence of this.

This lack of a management consciousness is still clearly evidenced in decision-making. Relatively small decisions become weighty problems, particularly if they involve relationships with workers. The toughest decisions, and the most critical in Estonia's present transition period, relate to shutting down all, or even just a small part of, an operation, in response to the reduced demand from the market. It is difficult for management to forget the doctrine upon which they were raised, that their factory is a "national treasure," a tool of production. Their job is to utilize this tool to its fullest.

Management's role was always to achieve production - to meet the plan. The task was not to achieve production at a given cost (this would be a fundamental first step toward maximizing profit), so efficiency is basically a new concept.

Given the lack of sophistication of their former COMECON market, changes are required to produce the right product at the right quality, the right price and in the right package. These all-important values of the Western market are the keys to the future survival of each Estonian manufacturer, and all of these fundamental guiding principles of industrial production are new. As Estonian industries come up the learning curve, they will be very vulnerable to ill-advised management decisions.

Worker productivity seems to be a major problem in most companies. The basis of the problem seems to be the fact that the factories were built as production tools, but once in place, were used by the political directorate as employment generators. Specific hiring targets were set in each year's plan. With this mission in mind, management in most, if not all, plants has hired to the point that plants are grossly overstaffed, with at least twice as many workers as would be needed in a Western plant\(^1\). It is human nature to take advantage of

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\(^1\) Overstaffing is the rule, resulting from several factors. A technical factor is the use of manual control systems on process and energy equipment, instead of automatic controls. An organizational factor is that social enterprises included as part of the organization, so employees work in company stores, canteens, or housing. The company
loopholes in the system, so some workers do little more than collect their pay, and laugh at the system that makes it possible and scorning those who do bother to give a few hours of honest work. Again, this is a reflection mainly of the management problem - there is a good bank of skills available who can probably perform well if managed properly.

A derivative of the same employment generation theme is that salaries are very uniform throughout a given company and across the industrial sector. There may be only 25% difference in salary between a new shop-floor worker and his co-worker with 20 years experience. In the traditional European system, this would have been a craftsman-apprentice relationship, a concept that has been diminished if not destroyed in the socialist system. Further, the manager of an entire production department probably earns less than double the salary that the inexperienced new-hire is given. This lack of recognition of value-added saps the motivation of the experienced workers, particularly those responsible for decisions which might optimize operations.

Because salaries are low in absolute terms ($20-50 per month, probably from the bottom to the top of a typical state-owned company), Estonian products may be price-competitive on world markets, even with the over-staffing. Companies wish to reduce payrolls, but the government has ordered that stability be maintained. Many companies seem to be trimming staff (now by attrition rather than layoffs), and using the additional funds to upgrade the salaries of their most valued workers.

At the same time, new ventures with foreign joint venture partners are using injected capital to buy equipment and using the new company name to reset staff levels, giving a quantum upgrade to salaries. These joint ventures are thus able to attract staff from other concerns, who jump at the chance to double or triple their income. By doing so, these workers may be able to quit their "second" job. Holding two or more jobs is a practice that is becoming more and more prevalent, especially among the educated or professional staff. This is sapping workers' energy from their primary task.

In general, the plants that are undertaking investments in process modernization and energy efficient technology seemed to have "new style" managers. These managers are extremely well-motivated, feel that they are part of the reconstruction effort of the country, are ready to move ahead, do not want to waste time looking backward, and have turned a page of history. Some other plants are still controlled by "old style" managers, who adopt a low profile and a wait-and-see attitude. These old-style managers are unable to make decisions for one reason or the other, whether a lack of confidence, authority or guidance.

may have its own trucking company. A personnel factor is the legacy of hiring "political appointees" and the inability to reduce staff now.

RCG/Hagler, Bailly, Inc. August 1992
As noted above, plant operations (especially when running at less than full capacity) and maintenance (losses) does not appear to be adequate in many plants. Based on the experience during the audits, in the near term, the best opportunity for energy efficiency improvement in large plants may be process optimization. In these projects, operations and maintenance of process equipment are optimized to reduce energy and raw material requirements for a given level of production. These projects may involve loss reduction, productivity improvement, partial shutdowns of the least-efficient parts of the production process, preventive maintenance, rehabilitation, or low-cost improvements.

The ability to make basic day-to-day management decisions seems to be a clear problem. Good decisions are needed regarding hiring and firing, which equipment to operate and at what loads, retiring obsolete equipment, the allocation of costs across production units, scheduling of production runs, transportation optimization, cost control, preventive maintenance, overtime and employee benefits.

The primary reason why day-to-day decision-making is weak is the lack of a modern management information and control system. The systems in place offer very little information to management, and certainly do not provide sufficient information on performance ratio or the cost of production. The systems are operated "open-loop", and there is a tendency to perpetuate old practices inherited from the past, even under the new economic environment. This lack of information serves as one barrier to changing the attitude of "old style" managers. In cases in which we have been able to clearly present information related to the cost and benefit of operational decisions to Estonian managers, they have agreed to make changes which improve efficiency.

2.6 RESEARCH & DEVELOPMENT

In a few industries, particularly those producing a diverse slate of products (such as pharmaceuticals or household chemicals), an organized research and development department is in place. The R&D departments that exist are busy developing new products or testing existing ones, and seem to be in touch with the Western world. In other large industries, an investment department or construction department exists instead. The investment departments are looking forward to expanding operations or modernizing equipment.

The fundamental question that does not seem to have been addressed by these R&D departments is the transition to the market economy. Market surveys, consumer surveys, analysis of competitor's products, or industrial engineering production cost analysis do not seem to be a priority.
3.1 BACKGROUND

Over the past ten years, industrial energy efficiency\(^1\) in the United States and other OECD countries has improved by about 30%, on average. This improvement can be directly attributed to several actions:

- Market energy prices which reflected the cost of supply, without subsidies, administered prices or price controls;
- Structural adjustment in the industrial sector, away from energy-intensive industry and toward services and high value-added manufacturing;
- Increased awareness of energy efficiency techniques in industry to improve operations and maintenance;
- Investment in improvements to modernize industrial processes.

Experience in many countries has shown that the rationalization of energy prices is necessary to achieve energy efficiency. Without the right pricing signals, energy consumers and equipment designers make decisions which do not take the value of energy into proper account. When energy prices are set artificially low, decisions are taken that result in energy consumption at a higher level than the economic optimum. Establishment of competitive energy markets, with pricing based on production costs, is a crucial first step to energy efficiency.

However, it has been widely recognized that while the right energy pricing policy is necessary to achieve energy efficiency, it is usually not sufficient, in itself, to realize the needed improvements, especially in a reasonable period of time. This situation arises because of various market distortions which prevent the energy pricing signals from being taken quickly into account. Many of these distortions are related to information and decision-making, and can be overcome by establishing energy efficiency policy and by developing institutions that can carry out actions to effect this policy.

\(^1\) As measured by the ratio of industrial energy consumption to industrial share of GDP
Since 1990, RCG/Hagler, Bailly, Inc. has made energy efficiency inspections of more than 50 industrial facilities in Central and Eastern Europe and the former Soviet Union (for convenience, we will use the abbreviation former COMECON, in recognition of the fact that these countries were all members of the now-defunct Council for Mutual Economic Assistance), led teams of experts who carried out detailed energy management programs to improve energy efficiency in 21 industrial enterprises\(^2\) in the region, conducted energy pricing studies and related training in four countries in the region, and held numerous interviews regarding energy efficiency with professionals who are active in energy efficiency in the region. This experience in the region, together with RCG/Hagler, Bailly's extensive experience in industrial energy efficiency in the United States, western Europe, and many other countries, has been used to develop the conclusions reached in this report.

\(^2\) Similar studies were also undertaken in six district heating enterprises in the region.
3.2 INDUSTRIAL MANAGEMENT - IMPROVING PRODUCTIVITY, QUALITY AND EFFICIENCY

3.2.1 Measuring industrial energy efficiency

A definition may be a useful way to determine an objective function. In the case of the countries of Central and Eastern Europe and the former Soviet Union, this is especially important, since these are economies in transition.

Usually, for energy audits or engineering studies of an individual enterprise, a measure of specific energy consumption can be determined (such as Gcal/ton product). A similar alternate financial definition (such as dollars of sales per dollar of energy cost) could be developed. This definition would relate output (either revenues or earnings) to energy cost.

At the enterprise level, it is important that the distinction between two definitions be clearly made. The fact that the ratio of GDP to energy consumption in former COMECON countries is far higher than in the West has attracted considerable attention. Economic policy planners seek changes in the ratio, and actions on either side of the ratio can achieve improvements to energy efficiency.

The distinction is important because of the transition in the economies in the region. Many economists in the region believe that the transition to an economy which is less energy-intensive means a metamorphosis, with the result being an economy like that of a western European country, say, Sweden, Belgium, or Italy. This would call for investment exclusively in services and low-energy industries, with most energy-intensive industries being phased out.

3.2.2 Energy efficiency as an integral part of industrial management

Energy efficiency in the industrial enterprise is generally regarded as one important technique of cost reduction. Cost reduction is not the only objective of industrial management, and sometimes higher priority is given to investment in marketing, quality improvement, or production expansion. Cost reduction programs must take their rightful place in the priority structure in competition for capital investment and scarce human resources (management, engineering and maintenance attention).

The appropriate place for investment in cost reduction is determined based on the conditions of the market, and the relationship of the individual enterprise to its competitors.
Improvements to energy efficiency (defined as an output/input ratio) can be achieved as part of projects designed to improve quality or productivity. A holistic approach, which takes this into account, is best used in designing energy efficiency policy.

Production expansion projects, including market development, also are vital to improve energy efficiency. In any production process, there is a certain amount of fixed energy consumption required to bring the process up to operating conditions, and a variable consumption which is related to the volume of production. This fixed consumption goes for rotating equipment friction and inertia, and for bringing heating and cooling processes to the required temperature. The fixed consumption can be quite substantial, especially for the so-called energy-intensive industries. As production is reduced below the capacity of the plant, which is the case now in the majority of industrial plants in all former COMECON countries, this fixed energy consumption is spread over fewer and fewer units of production. Thus both the physical ratio of Gcal/ton, and financial ratio of sales/energy cost, will deteriorate as production is reduced.

The scatter diagrams on the following page, taken from RCG/Hagler, Bailly’s detailed studies of an energy-intensive factory in Hungary, illustrate:

1. daily energy consumption vs. daily production rate, showing fixed energy consumption (29,000 m³/day) plus variable energy consumption (110 m³/ton);
2. energy cost per unit of production (a good measure of energy efficiency) vs. daily production rate.

From these data, which are typical of many factories in the region, it is clear that energy efficiency is a function of production rate. Further, at any given production rate, there is significant scatter in the data, 10-20% variability in energy consumption. This indicates that management has the opportunity to improve control of operations, and thereby influence efficiency.

Industrial energy efficiency can best be achieved when industrial enterprises are market-driven. If there is no market for the product of the enterprise, the enterprise must either change its product or close its doors. The decision to close or consolidate operations is most critical for energy-intensive industries with high fixed energy consumption. In 1991, as part of the AID Emergency Energy Project, a glass container plant in Hungary consolidated operations from four melting furnaces to three. This measure alone saved the factory $2 million per year in natural gas cost.
ENERGY-INTENSIVE FACTORY IN HUNGARY

NATURAL GAS CONSUMPTION, Jan-Apr '81

Daily Gross Production, tons

ENERGY-INTENSIVE FACTORY IN HUNGARY

ENERGY COST OF PRODUCTION, Jan-Apr '81

Daily Net Production, tons
3.2.3 Defining industrial energy efficiency at the enterprise level

Earnings (profits) are very important to the owners of industrial enterprises. Retained earnings are used for investment in expansion, modernization, and rehabilitation of capital stock. Dividends to shareholders find their way into other the sale of consumer products, and investments, such as building construction and shares of other companies. Even in former COMECON countries, industrial enterprises have sought profits. These profits have been used to develop social infrastructure for the benefit of the workers, including housing, kindergartens, and recreational facilities.

A financial definition of industrial energy efficiency can be made. Performance indicators, in the form of financial ratios, are the common way of evaluating industrial firms in a market economy. In a monopolistic situation, however, these indicators may not give an accurate view. A financial definition might be:

$$\text{Energy efficiency} = \frac{\text{output ($)}}{\text{energy costs ($)}}$$

Under this definition, there would be several general types of projects which could improve the ratio:

- Energy efficiency projects, which act mainly on the denominator of the ratio:
  - Energy conservation projects which reduce fixed energy consumption, such as operating most efficient equipment in priority, repair of leaks, upgrading of insulation, improved lighting, or load management;
  - Energy conservation projects which reduce variable energy consumption, such as installing low-energy process equipment, the use of catalysts, improved metalworking tools, and radiant heat transfer equipment;
  - Fuel substitution projects which reduce the cost per Gcal, or which reduce the level of fines for environmental emissions (increasing profits).

- Other projects, which assist by acting on the numerator of the ratio:
  - Production enhancement projects, which would spread fixed costs and fixed energy consumption over a greater number of units of production, thereby
increasing profit per unit and reducing the specific energy consumption ratio (Gcal/unit);

- Quality improvements, which could reduce scrap (wasted energy) or would enable the product to be more marketable, while maintaining about the same specific energy consumption ratio (Gcal/unit);

- Marketing improvements, which would improve output (sales volume or selling price and profit margin) without affecting energy consumption;

A financial definition points out that improvements to energy efficiency is not merely a task for energy efficiency experts. The work of industrial process technologists, management experts, quality experts, and productivity experts are all needed to maximize energy efficiency.
3.3 TECHNIQUES FOR IMPROVING INDUSTRIAL ENERGY EFFICIENCY AT THE ENTERPRISE LEVEL

Any improvements in industrial energy efficiency, as measured at the sector or sub-sector level, can only be achieved by taking specific, detailed actions at the enterprise level. These actions involve changes to operations, maintenance, or equipment. An energy efficiency program at the enterprise level typically involves 10-20 actions, each of which improve efficiency by 1-2%.

Achieving and maintaining industrial energy efficiency in an enterprise is a never-ending process, and so must be fully integrated into the normal course of business operations. The standard of efficiency is always increasing, as dictated by the competition in any given market.

There are a myriad of techniques for improving industrial energy efficiency, but these are often simplified by categorization in four groups, on the basis of the investment required:

A. Management and organizational improvements, which generally require little or no investment;

B. Low-cost measures to improve operations and maintenance, projects which provide a payback of one year or less;

C. Minor investments to upgrade existing equipment, projects which provide a payback of three years or less, based on energy savings;

D. Major investments to acquire new, modern equipment, which may have multiple benefits in productivity, quality, and energy efficiency.

In the sections that follow, RCG/Hagler, Bailly has used experience gathered in industrial energy efficiency programs in the former COMECON region over the past two years to develop generic examples of actions which are suitable for the region. These actions may or may not be applicable in all industrial plants, depending on the specific circumstances and existing conditions in the enterprise.

3.3.1 Examples of "Type A" actions, management and organizational improvements

- Change ownership so that a new "owner's mentality" and sense of purpose for the future is created. This new mentality must establish a management
commitment to quality, productivity and efficiency. The owner may take an active approach to seek out foreign joint venture partners.

- Change organizational structure to establish energy department as a profit center, "selling" energy to production department, and thereby place responsibility for energy efficiency (including identification and implementation of energy saving ideas and projects) at the production level, where most energy is consumed.

- Establish energy accounting systems and management information systems to allow management to monitor efficiency in time to take control actions.

- Create working conditions that motivate all employees (especially those in the production departments) to improve efficiency, productivity and quality, including financial incentives and feedback of results.

- Provide information and training appropriate to employees at management and engineering levels in energy efficiency technology and techniques.

- Establish a "total quality management" program in the plant, based on employee participation in a process of continuous improvement based on planning, testing, action, feedback of results, and refinement.

- Organize a market-driven decision-making process for difficult, but essential, management decisions which are urgently required, but are being delayed, such as:

  -- Which markets to be in
  -- Which products to produce
  -- Level of quality needed by the market
  -- Type of packaging needed by the market
  -- Transportation needed to get to the market in time
  -- Which parts of the plant to close down

- Establish a marketing department with sufficient staffing and funding\(^3\) to increase sales, so that the plant can operate at higher capacity factor, and thereby spread fixed energy consumption over more units of production.

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\(^3\) Many western companies spend 20% of revenues, or more, on marketing.
Establish a production process R&D department to learn the state-of-the-art in the selected markets/products, and plan the future modernization of the plant. Provide a budget for experts to carry out market research and feasibility studies.

Optimize operations, so that production is carried out using the most efficient equipment in the factory in the most efficient way (least-cost production).

3.3.2 Examples of "Type B" actions, low-cost improvements to operations and maintenance

- Upgrade the general standard of maintenance throughout the plant, and provide maintenance personnel with tools, training, status, and management reinforcement to carry out the job.

- Establish teams dedicated to specific efficiency-related tasks (such as for steam/heating, electric motors/drives, compressed air, and combustion) and provide them with the necessary diagnostic instruments, repair tools, and budgets (for assistance from professional consultants or incidental expenses). These teams will have several tasks:
  -- To identify obvious energy waste, such as steam leaks, idling equipment or underloaded operations, and carry out necessary repairs.
  -- To identify low-cost improvements to operations and maintenance, and to establish new procedures.
  -- To identify minor retrofit improvements needed, and to develop cost and benefit estimates.
  -- To develop specifications for future procurement, and thereby upgrade the standard of efficiency over time.

- Upgrade the level of instrumentation in the plant, especially for energy flows and efficiency-related parameters, and establish procedures based on instrument readings.

- Establish a preventive maintenance system in the plant, with necessary monitoring instruments, procedures, and dedicated staff, to improve equipment reliability (reduce downtime) and thereby increase efficiency.

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4 Many Western companies allocate 10% of revenues to R&D and new product development.

RCG/Hagler, Bailly, Inc. August 1992
Provide information and training in energy efficiency technology and techniques, appropriate to employees at various production, operations and maintenance levels.

### 3.3.3 Examples of "Type C" projects, minor investments in equipment upgrading

- Improvement of control systems, including automation and regulation, such as boiler air-fuel control.
- Installation of heat exchangers to recover waste heat in production processes.
- Improvement in quality control equipment to reduce scrap generated by production process.
- Install recycling equipment to convert scrap generated at intermediate stages of the process.
- Rehabilitation of boilers, ovens, dryers, kilns, and heat exchangers to clean radiant and convective heat transfer surfaces and repair internal leaks.
- Rehabilitation of process equipment to improve reliability and reduce start/stops and downtime.
- Installation of efficient lighting systems, variable speed drives and other cost-effective retrofits where feasible.

### 3.3.4 Examples of "Type D" projects, capital investments in modernization

- Conversion of a plant to produce a different, but related, product that offers a higher value-added for a given level of energy consumption.
- Installation of new process technology for the same product to improve productivity, increase reliability, improve quality, and reduce specific energy consumption.
- Conversion to alternative fuel that offers benefits in lower cost, improved product quality, or reduced pollution.
- Installation of new boilers, turbines, and prime movers that offer higher efficiency.

- Installation of cogeneration - combined heat and power systems, possibly including sale of power to grid or sale of heat to the neighboring district.
3.4 POLICY AND PROGRAMS TO ACCELERATE IMPROVEMENTS IN INDUSTRIAL ENERGY EFFICIENCY AT THE ENTERPRISE LEVEL

Since the mid-1970’s, Governments in countries around the world have instituted policies and programs designed to improve industrial energy efficiency. Since its founding in 1980, RCG/Hagler, Bailly has assisted the US Federal and State Governments and Governments in many other countries to develop energy efficiency policy and has been actively involved in the design and execution of such programs. Before instituting any policy or designing any program, it is important to first establish the objective of the effort. RCG/Hagler, Bailly suggests the following objective statement:

It is the Government of Estonia’s objective to establish a policy framework that provides incentives for energy efficiency, to the extent appropriate to a modern market economy. Furthermore, in recognition of the period of transition to a market economy, it is the Government of Estonia’s objective to use limited resources to institute programs to overcome market distortions, and thereby accelerate improvements to energy efficiency.

Many different policies and programs have been adopted by market economies, designed to overcome specific market distortions. Examples which seem relevant to Estonia are provided in the sections that follow. These are listed by RCG/Hagler, Bailly as options for consideration, not absolute recommendations.

3.4.1 Industrial energy efficiency policy options

Policy options which RCG/Hagler, Bailly suggests as appropriate for Estonia are listed in the following section.

3.4.1.1 Establish an energy supply policy designed to promote industrial investment

Industry today competes in a world marketplace, and there is tremendous competition for new investment, both within the region and in other locations. Many countries provide strong incentives for industrial development. Over the long run, investment in industrial technology is the key to improving energy efficiency.

5 With additional references to district heating
At a minimum, a stable and secure supply of reasonably-priced energy is necessary to industrial development. Without development and investment, industry will become less and less efficient over time.

Government policy must be directed toward establishing the trading links necessary to secure energy supplies. For Estonia and many countries in the former COMECON region, historical oil and gas supply was from a single source, Russia, and this dependency continues today. To the extent that this supply is not secure, the risk to developers is increased, and investment will tend to locate elsewhere. Thus the establishment of infrastructure, including parallel sources of supply, should be regarded as a part of industrial energy efficiency policy.

3.4.1.2 Establish energy pricing policy based on costs

Obviously, a higher level of energy prices will promote improvements in industrial energy efficiency. Thus it is important that industrial energy prices reflect market prices, or economic border prices, at a minimum.

Beyond that, Government faces strong temptation to introduce taxes, or to raise prices on industrial consumers so that residential consumers can benefit from cross-subsidies. In fact, most countries in the former COMECON region are doing just that. Government should be warned that this policy may "kill the goose that laid the golden egg". Cross-subsidies to maintain low household energy prices are politically popular, but they may scare away potential new industrial developers. If the existing industry is not competitive, the factory may be forced to close, leaving the workers (who support the households that were being subsidized) with no income.

Beyond considerations of the level of prices, there are various structural considerations in energy prices that can encourage industrial energy efficiency, especially in relation to the investment in and utilization of energy infrastructure required to serve the industrial sector. These structural pricing policies include:

- Establishing energy prices on the basis of long-run marginal costs (LRMC). LRMC are typically lower for larger (bulk) consumers, or electric consumers at high voltage.

- Introducing two-part energy prices for electricity and gas, based on capacity and consumption, the relationship of which is established by LRMC.

- Making capacity charges on the basis of meter readings, rather than allocative subscription charges.
3.15 INDUSTRIAL ENERGY EFFICIENCY POLICY OPTIONS FOR ESTONIA

- Introducing fine-tuned LRMC prices, such as time-of-use rates for both capacity and consumption, and adjustments for distribution losses, such as for power factor (cosine phi).

3.4.1.3 Establish a stimulative industrial investment policy

This is because the design of industrial process equipment is continuously evolving, and new designs are more energy efficient than older designs, especially since the late 1970's. For example, a typical ammonia plant built today is designed to use 30% less energy per ton than one built in 1980. Further, even new equipment of the same design efficiency as the old equipment it replaces will provide better energy efficiency, because efficiency deteriorates over time, as equipment wears out with use.

Investors in industry have many alternative investments from which to choose, including productivity, quality, and efficiency. If energy prices are appropriate, efficiency will take its proper place in the decision-making trade-off decisions.

Investors also have many locations from which to choose, even if they have already decided to invest in the former COMECON region. Estonia is attractive in some ways, but now Russia itself is opening up to foreign investment. This market is now very competitive, and many countries have begun adopting the same investment promotion strategies used by developing countries, such as long-term tax holidays and other concessions.

In the 1970's, many industrialized countries (including U.S., U.K., and Japan) offered investment incentives to promote energy efficiency. Investments which qualified as energy saving projects were eligible for tax credits. This policy was judged by many to have been instrumental in stimulating investment. However, since that time, general industrial investment incentives (without the energy project restriction) have been almost equally effective in stimulating efficiency improvement. The difference has been that projects of marginal financial viability (such as some renewable energy projects) have not been implemented.

3.4.1.4 Establish an import regulation policy which fosters competition

A policy to open Estonia's markets to competition will promote industrial energy efficiency. Over the years, western industrial process technologies have evolved which are more efficient than the technologies of the former USSR. The shortest course to improvement in energy efficiency will be to introduce and adapt these proven technologies.
Further, the monopolistic situation that exists in many industries in Estonia and other former COMECON countries enables costs to be passed on to the consumer, providing no incentive for efficiency.

The temptation to levy duties on imports is strong. However, high import duties will reduce the rate of improvement of industrial energy efficiency in two ways:

- by preventing access to modern, energy-efficient technology, and
- by reducing competition, and hence the need for existing industry to improve its energy efficiency and competitiveness.

The need to develop and maintain local industry is great. However the greatest need is to earn hard currency. If local industry is to compete in hard currency markets, the best place to begin to do so is at home. If the local market is a fair one, then industry can feel confident to export.

3.4.1.5 Maintain control over fiscal and monetary policy

A lack of discipline in fiscal and monetary policy will lead to high inflation, which will reduce industrial energy efficiency. In periods of high inflation, nominal interest rates also become very high, and decision-making is made with fear under great uncertainty. In such times, the best decision is often no decision, so investment is delayed, even investment in low-cost, quick-payback projects like maintenance and rehabilitation.

RCG/Hagler, Bailly has observed a lack of interest among industry in the former COMECON region in any energy efficiency project (unless a payback period of one year or less seems guaranteed) or other investment which requires financing. This view reflects a combination of a lack of trust for the newly formed banks, the inflation climate which makes nominal interest rates seem very high, the lack of capital available (which drives up real interest rates), and the relative priority that energy efficiency has in today’s survival/shake-out period.

3.4.1.6 Privatize, or at least rationalize, industry in a competitive environment

Privatization of industrial enterprises will quickly improve industrial energy efficiency. The ownership question is central to decision-making in Estonia. The rules must change. An owner’s mentality is needed to make the tough decisions.
As long as the Government is the owner, two things will happen:

- Decisions regarding the closing of inefficient plants will be delayed because of social considerations.
- Factory workers will continue to have insufficient respect for management, property, or energy and will continue wasteful behavior.

If an industrial enterprise is to run efficiently, the boss must boss. Under the old rules, the all workers were equal. In the Japanese model, there is an appearance of equality, but in reality there is a strong respect for superiors and orders are followed gladly. The situation in many former COMECON factories was that management received little or no respect, and some workers regularly sabotaged a co-worker who rocked the boat by showing any initiative or being more productive than the bare minimum. Thus, state ownership of industry in a competitive market may not work as well in former COMECON countries as it does in western Europe.

3.4.1.7 Require energy supply enterprises to consider demand-side opportunities as an integral part of expansion planning

Electric, gas, district heat and water utilities historically are faced with growing demand for their services, due to population growth and industrial development. This growth leads to requirements for expansion and capital investment. However, energy audits in Estonia and most other former COMECON countries by RCG/Hagler, Bailly and other contractors under the USAID Emergency Energy Program have shown that there are economic opportunities to improve efficiency on the demand side, on the order of 10-30%. These opportunities offer an economic return on investment which is higher than investment in traditional supply-side expansion.

Experience in the U.S. has shown that electric utilities need regulatory guidance in order to stimulate them to pursue demand-side opportunities nearly as aggressively as supply-side investment. The concept of integrated resource planning, in which demand-side and supply-side projects are considered on an equal footing, has since arisen as a new discipline, which enlightened electric utilities have accepted as being in not only the country’s interest but also their own.
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3.4.1.8 Reduce the standard of district heating services

The temperature of district heating supply water is based on ambient temperature conditions, according to the standard "grafik". Under the new market conditions, the economy may no longer be able to afford to supply heat energy in the same quantities as in the past.

In a market economy, the level of heating services provided by the Government should represent a minimum level, rather than a comfortable level. If consumers want more services, they should pay for them directly. This could be accomplished over the long run by installing electric or gas-fired augmentation heaters.

The temperatures specified in the grafik are design conditions, and are not adjusted for actual installed conditions. The result is overshooting/undershooting of the necessary temperature. Reducing the supply temperature slightly will save energy (as much as 20% over a heating season), while still maintaining adequate comfort levels (at least 15° in flats).

The Government should require each district heating utility to carry out an optimization program to update the grafik for the new market energy pricing conditions and the physical characteristics of its heating system, based on a trial and error procedure.

3.4.1.9 Institute equipment efficiency standards

Another possible government policy option is to introduce minimum standards for equipment efficiency. This policy has been effective in the U.S. in stimulating energy efficiency improvements in the automobile industry. Similar programs have been used in other countries to require improvements in the efficiency of electric appliances and air conditioners.

Such a policy has limited applicability in the industrial sector. The characteristics of an industrial plant are based on many considerations, primarily the process itself.

One ubiquitous piece of equipment is the electric motor. In smaller sizes, western motor manufacturers offer two product lines, standard and high efficiency (for a higher price, up to 50% more). The high efficiency models save from 1% (50 kW size) up to 10% (0.5 kW size). A policy could be developed that requires the use of electric motors of a minimum efficiency, however caution must be applied. If a motor has a low duty factor (used only occasionally), the incremental cost of the high efficiency motor may not offer an attractive return on investment.

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6 The US opted for a consumer information program to require that manufacturers display labels on the appliances which list expected annual energy costs, so that consumers can compare alternatives.
The same tradeoff is true of most other standards, which makes a consumer education policy a better alternative. Energy users should not be required to make decisions based on energy considerations alone - other issues may be more important.

### 3.4.2 Industrial energy efficiency program options

Program initiatives generally require government expenditure, or access to precious donor financing. Most Western economists agree that the primary role of government is the provision of specialized services that cannot be provided by the private sector, such as police, defense, justice, and social safety nets. Many believe that government should provide other social services, such as education, water, sanitation, and health care. Fewer agree that government should be the owner of industry or assist industry directly, other than ensuring that the right policy framework is established. Program initiatives for industrial energy efficiency are controversial, and should be carefully targeted, if used at all.

Program initiatives should be designed to overcome market distortions. Market distortions are usually limited to temporary inadequacies, so the programs should be terminated when the market matures. The government must be particularly careful that its programs do not become subsidies, or represent conflicts with the development of the private sector. For example, what chance does a private Estonian engineering consulting firm have to sell energy audits if western consultants are doing free energy audits under a donor-financed program?

Examples of market distortions which reduce the opportunity for industrial energy efficiency include:

- Incomplete information or education, which impedes rational decision-making leading to action;
- Lack of available technology for implementation due to regulated markets or monopolistic position of suppliers;
- Lack of services available for implementation;
- Lack of available financing for necessary investment.
3.4.2.1 Information and education programs

It is widely accepted that information and education programs offer the best return on investment for government expenditure in energy conservation programs\(^7\). Energy conservation awareness or public relations campaigns can be effective at an early stage, but they must then quickly proceed to educational campaigns, in which real facts are provided, giving information about ways to save energy. Educational programs need to be targeted to specific audiences, and to provide technical information in a suitable level of detail.

Government sponsorship does not necessarily mean the program is implemented by government employees. Government can provide contracts or grants to private or non-governmental organizations to carry out the programs.

Examples of options for industrial sector information and educational programs under government sponsorship are listed below. Many of these programs are provided without government support in some countries, when an ability and willingness to pay develop.

- Public relations and awareness campaigns\(^8\)
- Energy management training courses for plant managers and plant engineers
- Specific energy efficiency training courses for energy using technologies or techniques, such as for:
  - energy accounting,
  - boiler operations and maintenance,
  - dryers, ovens and kilns,
  - electrical systems operations,
  - energy monitoring instrumentation
  - energy control systems
  - vehicle fleet management
  - refrigeration and air conditioning
  - waste heat utilization
  - institutional building energy management

\(^7\) Research by Georgia Institute of Technology on their industrial energy efficiency programs in the southeastern US during the late 1970's discovered this, and it was confirmed by an audit of all industrial energy efficiency programs sponsored by US Department of Energy by Price Waterhouse in 1981.

\(^8\) RCG/Hagler, Bailly warns that these may not be appropriate in former COMECON countries because of previous Governments' longstanding reputation for issuing false propaganda.
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-- electric motors, pumps, compressors, and drives
-- steam systems operations and maintenance
-- compressed air systems operations and maintenance
-- preventive maintenance programs
-- project management
-- industrial process-specific energy

- Publication of handbooks or training manuals for above short courses
- Energy auditor training programs, to develop skills among private sector consulting engineers
- University degree curriculum in energy management
- Publication of case studies of successful energy efficiency projects
- Conferences designed to disseminate successful experiences to peer groups and allow networking
- Exhibitions and trade fairs designed to match suppliers of energy efficiency products and services with energy consumers

3.4.2.2 Demonstration activities in individual plants

There are very good reasons why the Government should avoid carrying out energy efficiency activities in industrial plants. First, there are limited resources available and so those few plants that receive the assistance (especially the early ones) will obtain an unfair advantage. Secondly, by providing these services at low or subsidized cost, the Government deprives the private sector energy management consultants of a business opportunity. Finally, good energy efficiency projects are cost-effective, and so Government subsidies are very questionable.

Having said this, there are important reasons to consider a well-designed program, particularly since any improvement to industrial energy efficiency can only begin from micro changes at the plant level. It must be recognized that each plant is different, and so a given plant will benefit most from a program of expert advice tailored to their needs. Further, case studies in individual plants will provide concrete examples of potential savings and actual results of energy efficiency improvements, that can lend credence to the information and training programs. Finally, these programs can be used at an early stage as a training ground for

9 Such as "energy efficiency in the pulp and paper industry"
private sector energy management consultants. One program which was used to good effect was the US Department of Energy "Schools and Hospitals Energy Conservation Program", which provided grant funding for 50% of the cost of investments in energy conservation in public school and hospital buildings during the late 1970’s to early 1980’s. All design, procurement and construction work under this program was carried out by consultants and contractors from the private sector.

Programs to consider include:

- Plant visits to explain energy efficiency techniques one-on-one, inspect facilities, and offer limited advice
- Brief energy audits
- Provision of limited packages of generic, low-cost energy efficiency equipment
- Installation of specific energy efficiency technologies which have wider application within the industry

### 3.4.2.3 Technology research and development (R&D) programs

In the US, significant government programs are funded toward energy efficiency technology research and development. Principal examples of agencies carrying out such programs are the national R&D laboratories of the Department of Energy. These programs identify a specific need, such as energy losses through windows in buildings, then carry out R&D with the objective of developing technologies to improve efficiency. After developing a technology, it is released to the private sector for commercialization. The technical success of this approach in the US has been proven in a few cases, such as the pulse furnace and heat barrier windows. The cost-effectiveness of the approach is marginal, at best, compared to energy efficiency technologies developed and patented by the private sector.

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10 Under the early government-sponsored energy conservation programs in the US, limited energy audits were carried out. For example, in the programs designed and implemented by Georgia Institute of Technology, assistance to any one plant was limited to one engineering man-week, which included one day in the plant and four days of follow-up research and analysis. These audits referred the plant to a list of professional consulting engineers (offering services for a fee) for further assistance to implement projects or conduct feasibility studies.

11 Most notably Oak Ridge National Laboratory, Brookhaven National Laboratory, Battelle Pacific Northwest Laboratory, Argonne National Laboratory, and Lawrence Berkeley Laboratory.
There are significant energy R&D facilities and personnel in Estonia in the various research institutes. There are opportunities to continue to apply these resources to apply modern technology and perhaps develop new technology. However, these projects require significant funding, without any assurance of success. Estonia has limited resources at this time.

RCG/Hagler, Bailly suggests that the economy may be well served by applying the tremendously innovative human resources now available in these institutes to private sector enterprises seeking to commercialize energy efficiency.

3.4.2.4 Service development programs

The service sector was noticeably absent from the economy of the USSR. This lack of available services leads to an implementation gap in project execution. RCG/Hagler, Bailly observed in Latvia that a simple project, 25 ton steam/hour boiler rehabilitation, required six months, which is almost 10 times longer than a similar task takes to accomplish in market economies.

There are many services that now need to be developed to improve energy efficiency, including:

-- Energy management consulting
-- Energy auditing
-- Sales and service of energy efficiency equipment
-- Maintenance services for energy-intensive equipment

The Government can assist the development of a services sector mainly by providing training and information. Beyond that, the possibility of certification should be examined. Finally, if the Government intends to carry out any in-plant energy audits or demonstration programs, these must be contracted to the private sector, so as to create a market and a base of experience for these emerging industries. If bilateral donor agencies carry out in-plant programs, these must be done with local private sector senior experts as an integral part of the team, so that they benefit from the experience and exposure to a Western consulting approach.  

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12 This program design was used successfully by RCG/Hagler, Bailly in the US Emergency Energy Program for Central and Eastern Europe.
3.4.2.5 Financing programs

There is a very serious shortage of capital available in Estonia. Energy efficiency is far below western standards. Many plant managers cite this capital shortage as the greatest obstacle to improving energy efficiency.

Governments have the opportunity to make funds available for energy efficiency from several sources. Governments of many developing countries borrow funds from the World Bank and other multilateral developing banks to be applied to energy efficiency. In addition, private sector sources, such as foreign investors and commercial banks, will make financing available.

Industrial sector loans can be very useful in stimulating energy efficiency improvements, and the borrowing country Government should assure that the loans can be used for such investments. These funds allow projects with multiple benefits (productivity, quality, efficiency) to be packaged and funded. The World Bank has provided many sector loans for such purposes in other countries. Usually the World Bank requires a preliminary study of rationalization of the industry, which leads to conditions precedent to the loan approval or disbursement (such as restructuring of the industry).

3.4.2.6 Convert district heating to a market commodity

As developed in the USSR, district heating is the classic example of the triumph of theory over practice. High thermodynamic efficiency was achieved at the supply side, particularly when the heat is derived from combined heat and power stations. Even when the heat is provided by boilerhouses, there are economies of scale which make this the least-cost form of generation.

From the heat source, heat transfer losses and leaks in the distribution system rob the district heating technology of part of its efficiency. Because of a low standard of maintenance, these losses have increased as the system has deteriorated over the years. But even after these losses, the system is an efficient way to deliver heat to the building.

At the building level, the realities of the system illustrate the failure. According to schematics included in textbooks published in the west describing Soviet district heating systems, meters and temperature controllers (including thermostatic radiator valves) are installed. Experts also claim that systems were built to these standards. However, upon inspection of these systems, and having discussions in four countries, RCG/Hagler, Bailly has found that meters and controls are simply not there.
Only in Budapest, Hungary are heat (Gcal) meters commonly found in substations or building inlets, and that is because an aggressive program of installing meters has been carried out by Budapest District Heating Works over the past three years.

Manual valves have been installed in some cases to regulate the flow of hot water through radiators, but we have learned that these have not been used or maintained for 20-30 years. In some modern construction, so-called one-pipe systems are installed, in which radiators on different floors are connected in series. In these systems, valves cannot be installed unless bypass loops are also installed.

Energy consumption in district heating systems in the former USSR is not metered, and is not controllable. In a way, increasing prices for district heat hardly seems fair when the energy consumers cannot change their consumption.

Projects to make district heating systems meterable and controllable, and to institute heat tariffs based on consumption, represent infrastructure improvements that are good projects for Government intervention. Government attention is needed to attract the large amount of financing required, and because the consumers on their own probably will not be able to make the investment, for physical as well as financial reasons.
4.1 INTRODUCTION

There are many institutions that can work to accelerate improvements industrial energy efficiency. Generally these can be grouped into six types of organizations, each with important roles to play:

1) **Government** - which has the responsibility to establish the energy policy framework conducive to improved industrial energy efficiency;

2) **Energy supply companies** - which have the responsibility to supply energy carriers (oil, gas, electricity, etc.) reliably, and at least economic cost;

3) **Industrial enterprises** - which must supply industrial products (chemicals, metals, food products, etc.) that are competitive in terms of quality and price;

4) **Financial institutions** - which must attract savings and may make loans to viable industrial enterprises for working capital or attractive investments;

5) **Non-profit, non-government organizations (NGOs)** - which may assume responsibility for energy efficiency awareness-building, networking, and policy advocacy;

6) **Academic institutions** - which may assume responsibility for energy efficiency training, information, and research;

7) **Private sector energy efficiency industry firms** - which must provide products (energy efficient equipment) and commercial services (such as energy audits and implementation of energy efficiency measures) that are competitive in terms of quality and price.

The general distinctions listed above sometimes blur, and this can lead to conflicts. Such conflicts are very undesirable, as they can lead to a reduced rate of implementation of energy efficiency improvements. Sometimes energy efficiency projects fail simply because the wrong organization took responsibility for project execution. Too often, many institutions seem to be vying for the same role. This is unfortunate, since it will require the efforts of many agencies and individuals to succeed.
One typical source of conflicts arises when Government extends its mandate outside of the policy realm, and into energy efficiency training, research, energy audits, or implementation. In such instances, the rate of implementation of energy efficiency is slowed considerably.

4.2 ROLE OF GOVERNMENT

In a market economy, Government has a stimulative role in industrial energy efficiency, but should not be involved in implementation. Government has the responsibility to establish policy conducive to improved industrial energy efficiency. The first step is to establish the right energy pricing policy. The next steps are investment policy, industrial development and restructuring policy.

Agencies of Government which influence industrial energy efficiency include:

- **Ministry of Industry and Energy**
  - Industry - must establish privatization and restructuring policy
  - Energy - must establish market-based energy pricing policy

- **Local government** - must determine regional development and district heating system policy

- **Ministry of Environment** - must set policy to regulate airborne environmental emissions which are related to energy consumption, such as SO₂ and NOₓ

- **Ministry of Finance** - must establish fiscal, monetary, taxation, and foreign investment policy to control inflation and promote investment in industry

4.3 ROLE OF ENERGY SUPPLY COMPANIES

Energy supply companies have the responsibility to supply energy carriers reliably and at least economic cost. Reliability is important because outages or shortages result in economic losses, and a waste of energy in starts/stops of industrial equipment. Least economic cost development requires consideration of not only traditional supply-side investments but also possible investments in demand-side efficiency improvements at the same time.

It has been demonstrated in many countries that some demand-side management (DSM) investments reduce requirements for power (kW) and energy (kWh) at lower cost than
equivalent power and energy supply-side investments. To the extent that this is shown to be true in the industrial sector, the energy supply company should develop DSM programs to increase the market penetration of these technologies. DSM programs in the industrial sector can consist of financial incentives (or partial payments) for training, information, energy audits, and investments.

Monopolistic energy supply companies assume their 100% market share will last forever, but changes are definitely coming. Good customer relations develop consumer confidence and lasting relationships that help build market share. The best customer is a well-informed customer. Innovative energy supply companies in the US now know that in the long term they will also benefit from customer efficiency improvements. But in the short term, they will suffer a loss of revenues, and so financial mechanisms have been designed to compensate the energy supply company for investments in DSM.

DSM programs are particularly well-suited to the electric and gas energy systems. In addition, petroleum supply companies can also provide information and training to help their customers use energy more efficiently.

Finally, energy supply companies have an obligation to maintain high standards of energy efficiency in their own operations (power generation heat rate, distribution losses, refinery conversion efficiency, pipeline losses, etc.). Financial profits of electric companies in the US are usually directly determined by efficiency and management of the enterprise.

4.4 ROLE OF INDUSTRIAL ENTERPRISES

The primary function of industrial enterprises is to supply industrial products (chemicals, metals, food products, etc.) that are competitive in terms of quality and price. In Estonia today, this has become a matter of survival for each and every industrial concern. Energy efficiency improvement is one way to increase the probability of survival, and in some industries it may be the key to survival. But in most industries, efficiency is just one part of the problem, and solutions must be integrated with productivity and quality improvement programs.

The first step to energy efficiency improvement (and productivity and quality as well) is management commitment. If the boss doesn’t care, nobody cares. In RCG/Hagler, Bailly’s 1991 surveys of COMECON industries, we found that only about half of factory directors could be described as committed to change.

Given top management commitment, the next step is to establish a team dedicated to the task of energy efficiency. The efficiency team will include factory managers, engineers,
accountants, and outside contractors. The outside contractors may be energy management consultants, maintenance technicians, design engineers, and installation contractors.

The efficiency team must develop a tailor-made energy management program. An energy audit is usually a good first step in such a program. The energy audit identifies energy usage in the factory, identifies ideas for efficiency improvement, and develops estimates of cost and benefit for each idea. The energy audit develops an energy management action plan, and sets goals for efficiency gains.

However, the energy audit is just the starting point. Actual energy savings will only result from the efforts of the energy efficiency team to make changes over time. The efficiency team will act on the plan. Over time, the objective of the team will be to identify other ideas for improvements and carry out works to see that they are implemented.

As time goes by, the program must be monitored and feedback of results must be passed to the team. Recognition of the efforts of the team, particularly with financial incentives, is important to long-term success. Industrial energy efficiency is just part of operations and maintenance, and is a never-ending task.

4.5 ROLE OF FINANCIAL INSTITUTIONS

Banks and other financial institutions must attract investment capital and make loans to viable industrial enterprises for working capital or attractive investments. Energy efficiency is one such investment alternative.

It is the responsibility of financial institutions to develop an awareness of the need for financing of energy efficiency investments, so that they may receive proper consideration in the loan approval process.

Financial institutions must offer terms on loans that can sustain operations, but are not onerous. Industrial managers in Estonia are not accustomed to debt. In today’s unprecedented inflationary spiral, it may be difficult for industrial managers to understand the banks’ need to maintain positive real interest rates, and thus high nominal rates. Bankers must work to educate their borrowers, so that the whole system does not shut down, out of fear.

4.6 ROLE OF NON-PROFIT, NON-GOVERNMENTAL ORGANIZATIONS

Non-profit, non-government organizations (NGOs) are usually created for a single purpose, and have a responsibility to their constituents to carry out activities related to that purpose.
Examples of NGOs include industry associations, professional associations, and advocacy groups.

Most NGOs are formed by people who feel a moral obligation to do good. There is an important role for altruistic, hard-working individuals in stimulating energy efficiency.

The best ways to apply the NGOs in energy efficiency are in the areas that are generally regarded by the private sector as having little or no potential for profit, for example:

- **Public relations** - to build awareness of the need for energy efficiency through appearances, public service advertising

- **Information dissemination** - to prepare publications regarding energy efficiency technologies and techniques

- **Policy advocacy** - to speak out, within a democratic framework, urging Government to adopt policy and legislation which can accelerate energy efficiency improvements

- **Commercial trade associations (clearinghouse)** - to serve as a meeting ground and referral service for buyers and sellers of energy efficiency technology and services, to provide information about available suppliers

- **Industry associations** - to inform member companies from a specific industry about process-related opportunities for energy efficiency, productivity and quality improvement, and to put together managers of industry in conferences to share experiences and case studies.

- **Professional associations** - to inform member professionals (such as engineers, lawyers, managers) about opportunities in energy efficiency in their profession, and to put together peers in conferences to share experiences and case studies.

NGOs will not be as efficient as the private sector in the potentially profitable activities, such as energy audits, energy management consulting, and implementation. The competitive power of the marketplace will work best in these areas, so that implementation will spread as quickly as possible.

### 4.7 ROLE OF ACADEMIC INSTITUTIONS

Academic Institutions in Estonia include universities and other training institutions, research institutes, engineering design institutes, and the various laboratories of the academy of
science. As with NGOs, most members of the technical staff of these institutions are well-motivated. The best ways to apply the academic institutions in energy efficiency are also in areas that are generally regarded by the private sector as having little or no potential for profit, for example:

- **Information dissemination** - to prepare publications regarding energy efficiency technologies and techniques

- **Training and education** - to introduce energy efficiency concepts as an integral part of the science and engineering curriculum at all levels of schooling, to hold specific short courses, certificate programs, and advanced degree programs in energy efficiency topics

- **Research and development** - to carry out programs designed to investigate the effect of policy, programs and technology on energy efficiency, to perform general scientific and engineering studies toward designing improvements in energy efficiency

As with NGOs, academic institutions will not be as efficient as the private sector in the potentially profitable activities, such as energy audits, energy management consulting, and implementation. The competitive power of the marketplace will work best in these areas, so that implementation will spread as quickly as possible.

### 4.8 ROLE OF PRIVATE SECTOR ENERGY EFFICIENCY INDUSTRY

Private individuals go into business for two reasons: because they have an idea or are interested in providing a specific product or service, and/or to make money.

The energy efficiency business is like any other business. To survive, firms in the energy efficiency business must provide products and commercial services that are needed by the market and are competitive in terms of quality and price.

The private sector is now starting to grow rapidly in Estonia. Entrepreneurial spirit exists, and many professionals who have dedicated their careers to energy efficiency in the past are interested in going into business in this area. They have a real challenge to first develop a market, and then to develop products and services to serve that market. There are substantial risks in going into this business in Estonia today.

There are many business opportunities that exist, that can contribute to improved energy efficiency. These include:
consulting firms to offer energy audits, management consulting, and feasibility studies

manufacturing of equipment which can improve efficiency, including diagnostic instruments, repair tools, control equipment, and high efficiency energy-using equipment

sales centers to distribute high efficiency equipment, or to represent manufacturers from other countries

maintenance service firms to upgrade the standards of maintenance and carry out repairs, such as boiler tune-ups, boiler rehabilitation, steam line insulation.

financial service firms to lease equipment or provide loan funding for project implementation

construction and installation contractors to carry out projects to put energy efficiency equipment into operation

energy efficiency service companies ("ESCOs") to offer implementation services, including performance contracting or shared savings contracts
CHAPTER 5: PRELIMINARY RECOMMENDATIONS FOR AN INDUSTRIAL ENERGY EFFICIENCY PROGRAM IN ESTONIA

by RCG/Hagler, Bailly, Inc.

5.1 GENERAL RECOMMENDATIONS FOR INDUSTRIAL ENERGY EFFICIENCY PROGRAM DESIGN

RCG/Hagler, Bailly recommends that the following considerations be included in the design of programs to accelerate industrial energy efficiency. These recommendations are directed at the industrial enterprise level, which is where actions to improve efficiency will be taken. Therefore, a national program should be designed with activities which will stimulate the enactment of these recommendations.

- Create a policy framework that stimulates industrial energy efficiency improvements. Government policy must be directed toward improving energy efficiency. As described in this report, this will require policy initiatives which can adopt cost-based energy prices, assure reliable energy supplies, stimulate investment, promote competition and private sector development, and rationalize district heating systems.

- Adopt an integrated industrial management approach to achieve improvements to industrial energy efficiency. There is a need to emphasize that industrial energy efficiency is process-related, and will be best served in Estonia by projects that address the transition to a market economy. The private sector will hold the key to efficiency in two ways - through privatization industries will have the incentive to become more efficient, and the development of private sector energy efficiency service industry will assist in implementing improvements.

Energy efficiency programs should emphasize projects that have multiple benefits toward process refinement and cost optimization, such as product changes (modernizing uncompetitive energy-intensive products), quality control (thereby reducing energy waste through scrap generation), productivity improvement (thereby minimizing fixed energy losses), and process upgrading.

Large projects focused on achieving only energy savings benefits, such as heat recovery, cogeneration and alternate fuels projects, may have payout times of 5 years or more. In making these investments, extreme care must be taken to first ensure the survival of a given industry.
Companies need to focus on daily energy management and efficiency. Vast amounts of energy consumption data are collected which are used for administrative purposes, but not energy management. Plants need to relate energy consumption to production on a near-continuous basis (as part of the daily report, at a minimum) in order to exercise management control. In the near-term, personal computers can help management begin to address this task in a manual information and control system. In the long-term, modern computer-based industrial process control systems should be installed to achieve true closed-loop control systems.

Task forces should be established to plug leaks. Management should set up teams with specific missions to cut energy losses. Dedicated teams should be established to attack problems in production (quality, productivity, reliability) and energy systems (steam, electrical, hot water, compressed air, heat gain/loss). Management must provide these teams with the tools and budgets necessary to do the job (very low cost, compared with the benefits). Specialists with appropriate incentives, such as private sector energy efficiency companies, should lead these teams.

Production operations must be optimized. Existing production equipment and processes can be 10-40% more energy efficient through optimization, particularly during the shrinking market of the transition period. Management must make sure the most efficient equipment is operated and maximize the load on machinery in operation, running the minimum number needed and shutting down others.

Marketing demands urgent attention. Optimization of operations, and hence energy efficiency, must be based on the demands of the market. In the near term, the best optimization opportunity for many companies will be the creation of a market. Some companies are just producing at reduced (inefficient) levels for inventory, in the hopes that the market will return.

Upgrade efficiency monitoring instruments. In many plants, there is a need to modernize and expand instrumentation to meter energy and production more frequently and more accurately. In particular, submetering for gas, electricity and steam is needed at each production line. Final product quality monitoring is inadequate - more frequent testing is needed and laboratories need modern testing equipment. Raw material and intermediate product testing needs to be improved greatly, and these improvements could offer great benefits in reducing the generation of scrap.
Modernize production accounting systems, particularly production costing. Based on the upgraded instrumentation, production costing can be improved. In a market economy, knowing production cost is all-important. The allocation of costs across a company’s product slate needs to be improved to better reflect true costs, instead of design guides or formulae. The penalty of inaccurate costing could be that a company misjudges its competitiveness, makes the wrong decision to enter or leave a market, and ends up making a loss instead of a profit.

Stimulate awareness and motivation. Management needs to involve production workers in energy conservation, as one of the keys to the survival of their jobs.

Modernize production shop-floor control systems. There is a clear need for assistance in addressing the complete spectrum of industrial engineering topics, such as production scheduling, inventory control, reliability, work-in-process management, preventive maintenance, tool management, product line change-over, and automation.

Restructure natural gas and fuel oil prices. Estonia has raised energy prices to levels on a par with those of most Western European countries. However, the structure of energy prices still includes substantial cross-subsidies, especially for two of the primary industrial energy sources, gas and electricity. In today’s design, industry pays higher gas prices than residential customers (by a factor of three). Electric prices may not reflect the true cost of service at the various voltage levels.

Industrial pollution control problems need to be solved. The needs in this area has been well-documented, and projects are being prepared by many donors to address them. At the plant manager level, there is an awareness of the need for attention in this area. In some cases, pollution abatement programs can use waste-to-energy systems.

Plant environmental quality and safety needs urgent attention. Less media and donor attention has been focused on the conditions inside the plants, which is poor in many cases (particularly the metallurgy industry). It is ironic that a system built on glorifying the worker requires them to toil in such unsafe conditions. This environment has adverse affects on motivation and worker productivity, ultimately being reflected in product quality, cost, and even energy waste through excessive scrap.
5.2 RECOMMENDATIONS FOR A LONG-TERM INDUSTRIAL ENERGY EFFICIENCY PROGRAM IN ESTONIA

5.2.1 Objective

1. Demonstrate market-oriented approaches to industrial management, problem solving, energy efficiency, and decision-making, and serve as catalysts for action by Estonian counterparts.

2. Demonstrate technologies and services which are well-suited to addressing the needs of Estonian industry and thereby stimulate joint ventures in these areas.

3. Provide training and introduce Estonian managers to their counterparts in industry in western countries.

4. Foster development of self-sustaining delivery and implementation systems for energy efficiency, such as utility-sponsored demand-side management programs, private sector engineering companies, maintenance specialists, and energy service companies, and lending organizations.

5.2.2 Focus

1. Focus on projects in energy efficiency, especially improving energy management. Concentrate on short-term, low-cost actions to optimize operations and maintenance.

2. Use the energy management principles and tools as examples to catalyze management action in other areas of the organization, such as:

   - Product cost optimization
     ▶ Waste minimization
     ▶ Raw material utilization

   - Process refinement
     ▶ Quality control
     ▶ Productivity improvement
     ▶ Production scheduling and flow

   - Management strategy and restructuring
     ▶ Product slate
     ▶ Production lines
RECOMMENDATIONS FOR AN ENERGY EFFICIENCY PROGRAM

- Marketing
- Packaging
- Production cost accounting

5.2.3 Program elements

For the Focus shown above, provide elements of assistance that can have a measurable positive impact in the short term (within six months in each plant assisted).

1. Carry out studies and provide support to develop government policy which will stimulate industrial energy efficiency. Key areas in which to be involved include energy supply reliability, energy pricing, industrial investment policy, and industrial restructuring.

2. Establish energy efficiency program implementation systems in the energy supply companies (electric, district heat, gas, oil), based on U.S. demand-side management (DSM) programs and efficiency-related services offered by U.S. oil companies.

3. Provide consulting advice to advise and catalyze industry management in the Focus areas. Provide assistance to 30 companies per year, with a phased program leading to a self-sustaining financing structure, paid by the client plants. Develop local industrial management consulting firms to provide these services. Consultants must provide expertise in energy management, and other areas such as management consulting, process optimization, process technology refinements, for example:

   - energy management - efficient technologies, information & control systems
   - management consulting - marketing, production costing, joint ventures
   - production optimization - operations, maintenance, shutdowns
   - process technology refinements - quality, packaging, productivity

4. Provide hardware and software to demonstrate state-of-the-art U.S. technologies and services that address current needs and offer an opportunity for Estonian private enterprise development through joint ventures, for example:

   - process measurement & control equipment - quality control, quantity monitoring
   - production scheduling software - shop floor control and decisions

RCG/Hagler, Bailly, Inc. August 1992
energy management information and control systems, efficiency monitoring
instruments for leak detection/plugging teams (heat, steam, water, electricity)
computer software for scenario analysis and decision-making
production cost accounting systems

5. Finance feasibility studies for investment projects in energy efficiency that can be implemented by multilateral development banks.

6. Provide training for Estonian industrial managers and energy efficiency engineers, particularly internships and study tours, conferences & exhibitions.

7. Procure products and services in the Estonian market, so as to stimulate a demand and encourage joint ventures with U.S. firms.

5.2.4 Duration

A duration of three (3) years is recommended, 1993-95.

5.2.5 Budget

A budget of $13 million is recommended for the project. The method of funding recommended is a grant basis ($10 million), with at least 25% matching funds from the plants for project elements that give them immediate benefits (except feasibility studies and training), achieved on a phased basis over the life of the program. No matching funds from the Government of Estonia are anticipated.

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<tr>
<th>Project Contribution</th>
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TOTAL $10 million $3 million
ABOUT INDUSTRY IN THE ESTONIAN REPUBLIC

The present structure of Estonian industry is very singular. The aim of the industry was to supply Russian market with goods. The trade with Western Europe was very limited. Since the industry has few experience in exporting to the West, and is used to operate within a planned economy with a quarantined market, it is difficult to meet the demands for quality and function of the Western world. The Gross National Output in 1990 included 60.2% of industry production and 33% of engaged labour force. In 1990 was involved in the industry.

The concentration of industry in the northern part of Estonia has been encouraged by the location of mineral resources in North Estonia (includng all the resources of oil shale and phosphorite, the bulk of the prospectes limestone and dolomite deposits and approximately a third of the peat resources), likewise by the coastal situation of North Estonia.

The fuel industry comprises oil-shale mining and the production of oil-shale gas and fuel oil. In the pattern of fuel resource consumption in the Estonian Republic the first place belongs to oil-shale (about 55% of available fuel resource). The bulk of the oil-shale is consumed as a fuel by power plants or as raw material by the chemical industry. The oil-shale deposits suitable for industrial exploitations with an area of about 6,000 sq.km. are located in northeastern Estonia. There are seven mines (Ahime, Estonia, Kivioli, Kohtla, Sampu, Tammiku and Viiniku) and four open-cast pits (Narva, Viitna, Sigala and Viiokonna). In 1980 the production of oil shale was about 31 million tons, now it is about 19 million tons for environmental reasons.

The peat industry produces mainly peat brickettes, peat ammoniacs, litter and near-urninating boards. The major enterprises are the Ore Peat Combine near Kohtla-Järve and Tootsi Production and peat-brickettes plant at Sangla near Parnawa.

Power Engineering is the industry with the highest growth rate in the Republic. It is based on the fuel industry. More than 90% of electric power is generated from oil shale. Estonia is one of the main energy producers in the North-Western European Region. The Baltic Thermoelectric Power Plant put into service in 1959 (capacity 1.435 MW), the plant was completed in 1966. The Estonian Electric Power Plant achieved its total capacity of 1.610 MW at the end of 1973.

Both of the plants need to undergo modernization, because their environmental condition is not safe.

The chemical industry originally used primarily local raw materials: - oil shale and phosphorites. The most important branch of the chemical industry is nowadays naphtha and oil-shale chemistry.

Its main enterprises, Kivioli Oil-Shale Chemical Plant and Kohtla-Järve Oil-Shale Chemical Production Association, manufacture carbamide, fuel oil, impregnants, electrode coke, ammonia liquor, sulphur, aromatic hydrocarbons, phenols, salieves, formalin, resin adhesives, detergents etc.

The Kivioli Oil-Shale Chemical Plant (employee 1500) and the Kohtla-Järve Oil-Shale Chemical Production Association (employee 3700) were built about 30-40 years ago and now all these installations of these firms need reconstructions.

The Ministry of industry and Energencs is ready to discuss cooperation in this field of the chemical industry.

Phosphatic fertilizers are produced at the Estonian Phosphate (situated in Maardu, near Tallinn) - local raw materials as well as those from other Union republics are being used.

The manufacture of nitrogenous fertilizer was initiated 1968 at the nitrogenous fertilizers plant of the Kohtla-Järve Oil-Shale Chemical Production Association. Natural gas, obtained from the Kami ASSR, is used as the basic material.

The Chemical - Metallurgical Plant of Sillamäe is processing phosphorite from Kohtla Peninsula. The final products of this plant are rare earth elements and rare metals.

Applied chemical products such as paints, varnishes, detergents, cosmetics, etc. are manufactured. The most important enterprises in applied chemistry are the Flora Production Association (paint detergents perfumery, pharmaones, candles, employee 1000) and the Orto Chemical Combine. Plastics are produced by the Põltsamaa Production Association (producer of sporting goods, wallpaper, employee 1200) and the Salva Plant (slalom boats, ice hockey boots, employee 1200) and various drugs at the Tallinn Chemical and Pharmaceutical Plant. These all firms are situated in Tallinn. Eriko (employee 300) in Tartu is the biggest producer of combs in the Baltic Republics. These plants and combines belong to the voluntary Association of Estonian local industria enterprises "Estonian Industry".

Most of the raw materials for chemical industry are imported from USSR and from Western countries. Estoplast is the biggest producer of lamps and switches (employee 1000), situated in Tallinn too.

The Estonian local industry enterprises founded in August 1989 an Association for Foreign Trade Cooperation UNIST for:

- finding BUSINESS PARTNERS;
- organizing COOPERATION and JOINT VENTURES with foreign firms;

- making EXPORT and IMPORT agreements.

The statute of UNI-EST permits it to admit new members (also from abroad). The founding members of UNI-EST are engaged in different fields of production, that can be roughly grouped as follows:

- household chemistry (paints, washing powder, candles);
- sport goods (hockey and mountain skiing boots,
various helmets and balls;
- rays (plastic, rubber, wood);
- glassware;
- lamp shades (plastic, glass);
- wall and floor covering materials (polypropen on paper bases for walls and artiste coating for floors);
- metal works;
- pianos;
- japan.
- paint moss for industrial use;
- paper rolls for fuel;
- Kaknita (marking, knitwear, embroidered pleated terms, cements of metal and leather, wooden souvenir aids, etc.;

In the event that this production or its aims are of any interest to you, the Ministry of Industry and
Emergencies would appreciate it very much if you would inform

The machine-building and metal-working industry is
characterized by branches consuming a narrow range of metals.
The manufacturing of metal products and structures, as well as
machine bodies are represented.

The main products are electronic motors, code, transformers, high-voltage equipment, automatic devices, measuring and
control devices, equipment for the petroleum industry, excavators,
and advances for trade establishments and for the food processing industry.

The key enterprises are the Tallinn Engineering Plant
(former Railway Works, main production is transformers and
converters, employee 3400), the Tallaks Production Association
(founded in 1944, a producer of excavators, employee 1500),
the Tallinn Machine-Building Plant (former Krull Machine-Building
Works, main production is equipment for the oil industry,
employee 700), the Vana Works (main production is electric
engines, employee 800), the Radio-Electronic Production
Association (former REA, main production is radio and military
equipment, employee 2000), H. Põdegeimnn Plant (main
production is radio and military equipment, employee 3000),
Eesti Kaibel (code production, employee 500), Tõlluskaseharj
(main production is measuring instruments, employee 1300),
Suvane (production was military equipment, employee 4000),
Kummne (main production is boiler equipment, employee 1000),
Baltic Ship Repair Plant (employee 2100) and Tallinn Ship Repair
Plant (employee 300). Vasar (employee 1700) is a main
producer of locks in Estonia. Norma's (employee 3100)
production consists of safety belts for cars, flash lamps for
camera, toys. All these companies are situated in Tallinn.

Factories situated outside the capital are the Võru Gas Analyst
Plant (founded in 1959, main production is gas analysers,
employee 800) in Võru, Tartu Aparateński ((main production is
regular equipment, employee 1400) and Väst (main production
is agricultural machinery, employee 500), both in Tartu, Põlme
Masinetehas (stereo equipment and machinery for the fish
processing industry) is situated in Põlme. Large electronic
enterprise Baltiers (main production is control equipment and
computer, military equipments) is in Harjumaa.

The development of this field is oriented to small metal
voluminous products, being supplied for the local market too.

The timber, woodworking, pulp and paper industry are
amongst the oldest industries of Estonia. The production of
furniture, wood boards and matches has made rapid progress.
Wood and charcoal, charcoaldust and paste, etc. are also produced.
The main enterprieses are Standard and the Tallinn Plywood and
Furniture Combine (former Luhama Plywood Factory), situated in
Tallinn. Outside the capital are Tarsme in Tartu, Verno in Võru,
Vere in Pärnu, Narva in Narva. Some big furniture plants are in
Kunda area and in Vaasa too. In Estonia alone the furniture
industry is comprise of twelve companies with over 10 000
employees. Most of these enterprises are exporting their production
to the Western countries.

The Estonian pulp and paper industry is represented by
two state pulp and paper companies in Kehra (50 000 tons/year, employee 700) and in Tallinn (60 000 tons/year, employee 900). There is also a smaller independent paper mill in
city (employee 300).

The Pissi Wood Boards Combine (founded in 1974,
employee 1000) is a big plant, producing wood chip and fibre
board, which are used in furniture factories and in construction.
In 1990 firms associated with concern "Estonian Forest". There are 22 enterprises in "Estonian Forest" with
19 000 workers. Enterprises are as follows: timber felling,
furniture factories, particleboard and fibreboard plants, research
design bureau, and trading centre.

The amount invested is 280 million roubles. Capacity of
production:
- timber felling — 1.0 million m³;
- sawn materials — 0.24 million m³;
- plywood — 35.0 moulana m³;
- particleboard — 140.0 thousand m³;
- fibre boards (hard) — 14.0 million m³;
- fibre boards (soft) — 5.6 million m³;
- furniture — 190.0 million roubles (export);
- saw — 80.0 thousand pairs;
- matches — 790.0 thousand special boxes;
- racons for table tennis — 1500.0 thousand pairs;
- pul — 93.0 thousand tons;
- paper — 96.5 thousand tons;
- paper bags — 100 million pieces;
- cardboard — 5.0 thousand tons.

In my estimation of the Estonian Forestry Office the
amount of the paper wood to be felled in 1996 — 2000 will
be about 900 000 cubic metres, although the potential is higher.

In developed countries of the world the chemical
treatment of wood is necessary. The construction of a new
modern cellulose and paper industrial combine for giving
production of international quality is required. The best location
for it is Kehra.
At present there are several proposals for constructing Kehra Cellulose and Paper Industrial Combine.

The main trends of development are:
- timber felling to the year 2000 of 2.0 million m³ will mainly be thick-sided hardwood. For increased timber felling modern machinery is needed;
- a new particleboard plant or MDF (medium density fiberoard) with the capacity of 100,000 m³ per year is intended to be established;
- the plant for the processing of E1 products with the capacity of 75,000 tons per year is under planning

- lacquers, special glues, gartening materials and parts for furniture, melamine etc. are imported for 3.5 million per year.

Light industry is the largest and oldest branch of industry in Estonia. At present most of the Estonian enterprises in the field of industry have joined into one big organization named "ESTAR" — The Estonian Concern of Light Industry and Commerce. The concern has been established on the basis of the former Ministry of light industry of the Estonian SSR. About 30,000 people are employed in the concern and associated enterprises.

Today the concern incorporates 25 of the largest firms in light industry in Estonia. Among them are the Sadu Textile Factory (founded in 1833, woven fabrics, employee 800), Kreenholm Manufacturing in Narva (founded in 1957, main production is cotton fabrics, employee 3,000), Baltic Manufacturing in Tallinn (founded in 1983, main production is cotton fabric, employee 700), the Plant for Linen Products in Parnawa (main production of linen fabrics, employee 400), Sindi in the east of Parnawa (woolen fabrics, employee 300) and Keilo (woollen fabrics, employee 600). The cotton is coming mainly from Uzbekistan, and wood from Georgia and Kazakhstan. Felt is produced in Estonian agriculture.

The largest clothing companies in Estonia are: Klemter — mainly production is suits and coats for women, employee 1,300, Baltic — suits for men, employee 1,600). Punane Kinni — main production is socks, employee 1,000). Kanimund is the biggest producer of shoes (employee 2,300). All these companies are situated in Tallinn. Factories outside the capital are: Sangar — producer of shirts, employee 800) and Eklar (main production of shoes, employee 1,300). All these companies are situated in Narva, Toomla — bath robes, employee 600) in Haapsalu, Wola (producer of clothing, employee 700) in Vaasa. Necsis (main production is clothing, employee 700) in Kose, Ravik — and other firms with long-lasting working traditions are worth mentioning. Several wholesale and retail organizations, a commercial bank, a construction firm, scientific and training centres, etc. also belong to the concern.

Besides the concern ESTAR the other large companies are: Marat (main production is knitted fabrics and tricot goods, employee 2,500) and Umia (producer of different leather goods, employee 1,100).

In 1990 firms associated with the concern "ESTAR" produce a large variety of cotton, woolen and silk textiles (yarns, fabrics and finished products), nonwoven materials, darning amities and kninwear, leather goods, amities of fur, footwear, hosiery products, fancy textile goods, carpets and floor coverings, etc.

Considerable quantities of this production are exported to many different countries all over the world.

"ESTAR"'s associated companies are capable of exporting 100 million metres of cotton fabrics, 10 million square metres of upholstery materials for cars and aircraft and tufting (needle-punched) floor coverings, 5 million square metres of heatliner fabrics for bedlinen per year. In addition to that they can export ready-made clothes and footwear. More than 5% of the total output of the light industry branch goes for export. Estonia exports its light industry production to such countries as: Finland, Sweden, Germany, France, Switzerland, Portugal, USA, Canada, Japan, Denmark, Austria, Hungary, Poland, Bulgaria and others.

The scope of export increases constantly. Technological restructuring of cotton weaving enterprises including "Baltic Manufacturing" and also the Tallin P/C "Mistra" producing non-woven materials tufting floor coverings and upholstery materials for cars and aircraft is going on at present on the basis of hard currency payback. In 1990 the above mentioned textile companies purchased new weaving looms "Sulzer-Ruti", spinning machines of "Krieter" (Switzerland) and other equipment.

In order to speed up the restructuring process in the above mentioned companies they need a long term hard currency bank loan (credit) in the amount of USD 35 million with the term of repayment 5 years.

Technological reconstruction projects for "Kreenholm Manufacturing", "Baltic Manufacturing" and P/C "Mistra" have been developed by Leading West-European firms.

The companies have obtained guarantees from foreign banks who are going to buy such quantities of their production that will enable them to repay 4 million SUR per year for their equipment purchases.

Necessary calculations on credit payback have been made and will be presented on demand.

The Ministry of Industry and Commerce fully supports the development program of the above mentioned plants.

The light industry of Estonia has a possibility of large cooperation for the joint production of various types of clothes with the partners markets and with the use of his highly skilled labour and techniques for sewing. The price is about 0.8-0.9 Swedish krona by the standard minute of sewing. That is the same level as in Spain or Portugal.

* Association of the Estonian Food Industry (ASTO) is a voluntary union of enterprises, organizations and their unions.

ASTO acts on the basis of common interests mainly in the sphere of elaboration, production and marketing of food products. The association includes 19 enterprises, a society and a private firm at the present time. These enterprises produce most of the bakery goods. The Association of the Estonian Food Industry (ASTO) is a voluntary union of enterprises, organizations and their unions.
and confectionery goods, soft drinks, beer, mineral water, starch and named fruits and vegetables.

It is the sole producer of bakery yeast, cigarettes, food concentrates, macaroni, starch syrup, alcohol, margarine and mannanase in Estonia. It also produces named meat, cosmetics and somea grape wine imported from other republics.

Most of the production is sold in Estonia, a certain amount of confectionary goods, cigarettes, cosmetics, soft drinks, alcohol, named food and beer is exported to the other countries. The private firm or the association deals with the extension of the potato products industry in Estonia.

In this field of activity we need to build a cocoa processing factory with a capacity of 16,000 tons of raw cocoa beans per year (provided to roast and further to grind and produce both cocoa powder and cocoa butter).

The entire equipment will be produced by the German firm "Bauermester & Co." with the total amount of money DM 14 million. There are also competing offers from several other firms. On the technical and once scores "Bauermester" is the best. For placing of this equipment exists an agreement: it will be the replacement for repairs of range tractors of the Estonian EPT. The required 500 m² of production surface, the whole engineering network system and infrastructure exist.

The calculation shows that by realization of such a programme it will be possible to guarantee the payment of the equipment in 3 years.

Diary industry is developed mainly in towns, largest are in Tallinn and in Tartu. Confectionary Kalle (employee 1,600), TK Teiur (bakery, employee 800), Tallinn Soft Drinks Factory employee 300) in Tallinn, Soke Brewery (employee 300) in Soke, Tartu Brewery (employee 400) in Tartu.

The private sector covers joint stock companies, joint ventures, cooperatives, farms and other private enterprises. As a result of entrepreneurship and privatization in Estonia the economic structure of enterprises has been totally changed during last 2 - 3 years. At the beginning of 1991, there were more than 3 thousand cooperatives in Estonia. Services, consumer goods, and constructing are the main products of cooperatives. The first joint venture was established in January 1987. At the beginning of 1991, there were 226 joint ventures in Estonia. Joint venture have a remarkable share in Estonian export and in 1990 their contribution was more than 30%. More than half of joint venture are founded with Finnish or Swedish partner. The successful joint venture have been the ones having chosen the right partner; the ones, being able to keep the trading rights, and having a good production management.

The other popular way of international enterprises is joint stock company, where individuals from the other side can participate too. At the beginning of 1991, there were 187 international joint stock companies in Estonia. For a foreign partner, the form of joint stock company is more suitable and understandable than joint venture, because of the clear ownership relations and familiar structure and management relation.

In order to facilitate cooperation with Western companies, the Estonian Government has enabled made possible for foreign companies to open representative offices. It was legalized in August 1990. Permits are issued by the Estonian State Department of Foreign Economic Relations. The permit is issued after an application and endorsed by the Estonian Ministry of Foreign Affairs. Copies of the company's registration documents remain in homeand, and a document confirming the payment of USD 150 into the account of the Monetary Fund of the Estonian Republic. After the permit has been issued, the representative office will have to apply to a local authority to be included to the register of companies. At the beginning of 1991, 50 representative offices have been registered.

Now, in the quest for economic independence, the Government of Estonia is facing with the problems of changing the structure of economy (mainly of industry) according to the requirements of Republic of Estonia. Government of Estonia has elaborate directions for developing each branch of economy. The following branches in industry are preferred:

- building materials industry (especially cement industry);
- wood industry (especially pulp, paper and furniture industries);
- engineering-machinery for food and light industries, and for agriculture;
- electronics;
- microchemical industry.

The extensive use of technology is being promoted in all branches.

Katio Aamer
Councillor of Ministry of Industry and Energetics of Estonian Republic.
Consulting firm SIAR-Bossard work "ESTONIA", Guidelines for Foreign Investors (June. 1991, Tallinn) is used.