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A PROFILE OF ENERGY EFFICIENCY IN HUNGARIAN INDUSTRY

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BUREAU FOR EUROPE AND THE NEAR EAST
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Prepared by:

RCG/HAGLER, BAILLY, INC.
370 L'Enfant Promenade, S.W.
Suite 700
Washington, D.C. 20024
(202) 488-1500

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SUMMARY

The objective of this report is to describe the plant level environment in Hungary, and its impact on decision-making for energy efficiency. The report provides observations of plant organization and management and management responses to changes in government policy, such as restructuring, privatization, and competition. Also provided are recommendations for the future.

Energy efficiency has been improving in Hungary, assisted by programs funded by the World Bank and the efforts of the Government of Hungary. Industrial restructuring and increased industrial energy prices, now on par with Western Europe, have both helped improve efficiency. However, based on the findings of a series of case study energy audits carried out in eight representative industrial enterprises in 1991, Hungary still appears to have significant scope for further improvement. Low-cost investments identified during the case study audits would improve energy efficiency an average of 12%, with a payback period of less than one year.

In general, energy efficiency improvements can be achieved most effectively through the following recommendations:

1. Improve energy efficiency implementation and delivery mechanisms, such as by using Demand-Side Management techniques developed in the U.S., in which energy supply utilities partially finance implementation of efficiency improvements through competitive contracting with private sector energy service companies

2. Optimize production operations to meet the demands of the present market

3. Improve day-to-day management and cost control through expanded metering and computer-based information and control systems

4. Establish task forces to cut energy losses (steam, heat, compressed air, electrical), using specialists from private sector firms under performance contracts

5. Invest in industrial process modernization to improve quality and efficiency

6. Stimulate awareness and motivation, making quality and efficiency everybody's job

RCG/Hagler, Bailly, Inc.

SECTION 1 - INTRODUCTION

A.I.D. Emergency Energy Assistance Program for Hungary

On February 15, 1991, the U.S. Agency for International Development launched the 1991 U.S. Emergency Energy Assistance Program for Hungary. Component #1 of this program addresses industrial energy efficiency. The prime contractor for Component #1 is RCG/Hagler, Bailly, Inc. of Washington, D.C., and its subcontractor is EGI Engineering and Contracting of Budapest (through K&M Engineering of Washington DC). The program's other components are: 2) petroleum refinery efficiency, 3) petroleum procurement training, and 4) energy price reform.

In 1991, five RCG/Hagler, Bailly senior industrial engineers worked in Hungary at various times to carry out the following tasks:

1) Screen the industrial sector to identify eight representative and appropriate plants for the energy management programs to be funded under Component #1.

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

3) Identify low-cost equipment packages for procurement for each of the eight plants under the program (such as energy monitoring instruments, averaging about $30,000 per plant).

4) Carry out an assessment of institutional and policy issues related to energy efficiency.

5) **Prepare a profile report on plant energy management, after completion of the initial audit work.**

6) Procure equipment and deliver it to the plants;

7) Return to each of the plants to monitor the results of the program and help make best us of the equipment.

8) Hold a one-day wrap-up seminar for the management and technical staff of the eight plants, followed by formal presentations by each of the eight plants at the annual meeting of the Hungarian Energy Managers Association.

Objective and basis of this report

The objective of this report is to describe the plant level environment in Hungary, and its impact on decision-making for energy efficiency. The report provides observations of plant organization and management and management responses to changes in government policy, such as restructuring, privatization, and competition. Also provided are recommendations for the future.

This report is in fulfillment of the Contract Section C. Description/Specifications/Work Statement, Part 1. Component #1, Subheading D. Deliverables, Item 3. Industry Profile Report (Contract Work Statement).

This report is based on observations made during energy audits at eight industrial enterprises in Hungary from February - May 1991 by the RCG/Hagler, Bailly team. The report is also based on interviews with representatives of the Government of Hungary, industrial trusts, and the private sector, and plant visits to seven other industrial sites that were not selected for audits. The eight plants audited were: (1) alcohol & yeast, (2) copper & brass, (3) alumina, (4) paper, (5) basic chemicals, (6) bakery, (7) district heating, and (8) glass containers.

The primary mission of the work in the industrial plants was to improve efficiency - by identifying projects, by training plant personnel, and by catalyzing the plant to make changes on the spot. Specific findings are included in separate audit reports for each plant. The RCG/Hagler, Bailly audit team found among Hungarian plant managers a tremendous willingness to change operations and implement the recommendations in order to improve efficiency.

This report serves as a debriefing for A.I.D. on general findings. In most instances, the members of the RCG/Hagler, Bailly team were the first Western engineers to provide consulting services to the industrial plants on energy efficiency or other subjects. This project was also among the first A.I.D. technical assistance programs to Eastern and Central Europe.

Organization of this report

The report is organized in several sections:

- Section 2 provides a background on recent trends in energy use in Hungarian

industry and the findings of the eight plant case studies

- Section 3 offers general observations on Hungarian industry.
- Section 4 offers specific observations on areas listed in the Contract Work Statement, and lists recommendations based on the findings of the 1991 work.

An Appendix is also provided with preliminary recommendations for possible medium term industrial energy efficiency programs in Hungary.

SECTION 2 - BACKGROUND

Since 1989, and in fact for several years before that, the industrial sector in Hungary has been evolving toward a market economy. Two key trends have been industrial restructuring and price reform, including energy prices. World Bank assistance has been provided for several projects since 1983, longer than most other economies in Eastern and Central Europe. Significant assistance from the World Bank has gone toward energy efficiency.

According to the Energy Policy Department of the Ministry of Industry and Trade, there are two objectives of the restructuring. First and foremost is to change the industrial sector so that appropriate market-oriented products are produced. A secondary objective is reduced physical energy intensity, as measured by specific energy consumption.

As indicated in Exhibit 1, the market-oriented programs had begun to have some effect by 1989, the latest year for which data are available. It is also notable that the industrial sector was moving away from coal to natural gas and fuel oil during the period. The eight plants audited in Hungary embodied these trends:

- three had switched from coal firing in their boilers to cleaner fuels (alumina, chemicals, alcohol and yeast).
- five had modern (circa 1980s) computer-based production control systems or other process upgrades (alcohol & yeast, copper & brass, paper, district heating, glass)
- one had been partially restructured, in which part of the plant was spun-off as a joint venture with a foreign (U.S.) partner (glass) and two had definite plans for restructuring, already having identified interested foreign joint venture partners (alcohol & yeast, paper)
- four had carried out projects that had significantly reduced specific energy consumption (alcohol & yeast, copper & brass, district heating, bakery)

Exhibit 1
Trends in Energy Use in Hungarian Industry

Compared to 1980, significant progress has been achieved by 1989:

- Reduced production in some traditional uncompetitive energy-intensive industries
  - pig iron reduced 13%
  - open hearth steel reduced 59%
  - coal mining reduced 22%

- Fuel substitution toward cleaner fuels, such as natural gas
  - industrial use of brown coal reduced 73%
  - industrial use of hard coal reduced 48%

- Total energy consumption in industry reduced by 14.5%

- Specific energy consumption (energy per ton of product) reduced significantly (by more than 10%) in 6 of the 27 most energy-intensive industries
  - pig iron reduced 19%
  - converter steel reduced 14%
  - alumina hydrate reduced 10%
  - sulfuric acid reduced 10%
  - refined sugar reduced 12%
  - distilled alcohol reduced 30%

- Specific energy consumption has increased significantly (more than 10%) in only 3 of the 27 energy-intensive industries[1]
  - open-hearth steel increased 38%
  - hot-rolled steel bar & section increased 16%
  - coal mining increased 45%

[1] Specific energy consumption is the ratio of energy consumption to production (such as GJ/ton). Increases in specific energy consumption could result from either reduced capacity utilization (reduced production) or increased energy losses. Because most of the industries that reduced production exhibit increased specific energy consumption, we believe that their production systems probably have not yet been optimized to the lower production rates.

The characteristics of the eight case study plants and the summary findings are illustrated in Exhibit 2. All plants are using oil or gas fuel, and are paying fuel and electricity prices which are, on average, higher than in the U.S. and approximately equal to those in Western Europe. Average energy prices for industrial plants in Hungary in 1991 were as follows:

	Hungary[2]	Typical U.S.[3]
Heavy fuel oil, US$ per ton		
Low sulfur (1% max)	$175	$106
High sulfur (2-3.5%)	$140	$91
Natural gas, US$ per GJ	$3.60	$2.36
Electricity, US$ per kWh		$0.047 (avg)
on-peak	$0.063	
off-peak	$0.031	
average	$0.047	

The plants are medium-to-large enterprises, with an average annual energy cost of over $7 million. Energy as a percentage of production cost is fairly high, averaging 16% for the seven industrial plants. This is higher than in Western plants for several reasons, including the fact that energy prices are at Western levels but raw materials and labor are not yet. Also, devaluation of the Hungarian Forint has left amortization/depreciation costs very low. Lower energy efficiency is also a contributing factor.

The general findings of the energy audits with respect to the efficiency of equipment found in the plants is shown in Exhibits 3 and 4. As shown in Exhibit 3, quite a number of the plants have installed modern (1980s) process technology, and would be considered at or near Western standards. In contrast, Exhibit 4 shows that the efficiency of basic equipment, such as boilers, turbines, and pumps, is not up to Western standards. In many cases, the equipment is old and obsolete, or in need of repair.

[2] Source: RCG/Hagler, Bailly findings at industrial plants in Hungary, May 1991

[3] Source: Energy User News, average prices for industrial users, May 1991, page 44.

Exhibit 2
Characteristics of Hungarian Industrial Plants
Assisted Under 1991 A.I.D. Program

	Energy used for Production		
	Annual Cost[4]	Form[5]	Pct.[6]
Alcohol & yeast	$3 million	GE	20%
Electrolysis Chemicals	$6 million	EG	11%
Alumina refractories	$12 million	O	22%
Copper & brass	$8 million	EG	7%
Paper	$4 million	GSE	20%
Glass containers	$17 million	GE	25%
Bakery	$700,000	GE	8%
District heating	$11 million	GE	70%
TOTAL - 8 PLANTS	**$61 million**		

[4] based on 1991 Hungarian energy prices, which approximate world market prices

[5] Forms of energy used, in order of total cost, where:
O = fuel oil and other petroleum products
G = natural gas
S = steam imported to the plant from another supplier
E = electricity purchased from the grid

[6] Energy cost as a percentage of total direct manufacturing cost

Exhibit 3
Findings on Efficiency of Industrial Process Equipment in Hungary

Process Technology

Up to Western standards:
- alcohol plant,
- glass plant,
- alumina plant,
- district heating boilerhouse,
- paper plant

Outdated, inefficient:
- chemicals (chlorine) plant,
- yeast plant,
- copper refining plant,
- heating systems in apartment buildings

Process instrumentation and control technology

Up to Western standards:
- glass plant,
- copper & brass plant energy management,
- chemical plant electricity management,
- district heating plant,
- alcohol plant,
- paper plant

Outdated:
- yeast plant,
- alumina plant

Exhibit 4
Findings on Efficiency of Basic Industrial Equipment in Hungary

Boilers

Up to Western standards (over 89% thermal efficiency[7]):
district heating plant (92%),
chemical plant (new package boiler, 89%)

Outdated, inefficient, or in need of repair:
paper plant (83%),
alcohol & yeast plant (converted from coal to gas, 82-85%),
chemical plant (converted from coal to gas, 75-82%),
alumina plant (converted from coal to heavy fuel oil, 82-85%).

Steam turbine generators

Up to Western standards (over 70% isentropic efficiency): none

Outdated, inefficient, or in need of repair:
alcohol & yeast (65%, 20%),
alumina plant (60%, 42%),
glass plant (not operable),
chemical plant (retired).

Boiler feedwater pumps

Up to western standards (over 65% mechanical efficiency):
alumina plant (65%)

Outdated, inefficient, or in need of repair:
alcohol & yeast plant (40%),
chemical plant (50%).

[7] Thermal efficiency is defined here by European standards, as used in Hungary, which are based on lower heating value of fuel. American standards use higher heating value of fuel. To convert the numbers to the American system, subtract about 8% for gas-burning boilers, or 5% for oil-burning boilers at the alumina plant.

Any project has a limited budget, and the case studies were no exception to this rule. Because of limitations on the time available, the energy audits in the plants were not able to be an exhaustive study of all areas of the plant. The studies usually focused on specific areas of the plant, such as the boilerhouse. The savings identified should therefore be taken as indicative, but are an incomplete representation of the short-term savings available. Exhibit 5 illustrates the type of projects which were identified as being typical to several of the case study plants. Exhibit 6 lists other principal recommendations, which are specific to the findings in a particular plant.

Exhibit 7 lists the type of equipment procured under the project. A total budget of $275,000 was expended for equipment for the eight plants, including a set of energy audit instruments which was donated to the Government of Hungary, to be used by consulting engineers to carry out similar energy audits in the future.

Exhibit 8 lists the results of the energy audits, in terms of savings identified. Short-term savings identified ranged from 3% (alumina plant) to 20% (glass plant). These results must be explained - they should not be interpreted to mean that the alumina plant was more efficient than the glass plant. In the case of the alumina plant, the agreement with the plant was that the study would focus on the boilerhouse, rather than the process, and so this limited the potential savings. In the glass plant, the largest savings were identified in optimization of the production process. Thus the results obtained were a function of the scope and limitations of the study. Nevertheless, we believe that the overall average result, 12% potential short-term savings, represents a useful estimate of overall potential in the industrial sector.

Exhibit 5
Typical Energy Efficiency Audit Recommendations
Applicable to Several of the Plants Studied

Improved metering of steam and fuel

Energy management information and control systems

Boiler instrumentation and controls for combustion efficiency

Task forces to reduce losses and improve management of electricity, steam and hot water, compressed air, and industrial water

Operation of process equipment for minimum cost

Exhibit 6
Plant-Specific Energy Efficiency Audit Recommendations

Alcohol & yeast
- cogeneration steam turbine efficiency improvement
- operation of most efficient equipment in priority

Basic chemicals
- steam condensate return and use

Alumina
- heavy fuel oil atomization control

Copper & brass
- use existing computer-based energy management system for manufacturing shop floor production control

Paper
- improve steam distribution system, especially steam traps

Glass containers
- optimize regenerator
- consolidation of production (shut down one melting furnace/line)

Bakery
- install low excess air burners on ovens

District heating
- convert apartments to meterable, controllable system
- convert hot water boilers to cogeneration based on gas turbines

Exhibit 7
A.I.D.-Funded Energy Efficiency Procurement in Hungary
For Short-Term Projects

Metering and energy management
- steam meters
- fuel meters
- computers for energy management

Instrumentation to measure efficiency
- portable combustion analyzers
- fixed combustion analyzers (O_2, CO, opacity)
- electric multimeters, including power factor
- electrical power demand analyzer/recorders
- ultrasonic testers
- energy audit instruments

Control equipment
- fuel atomization control valve
- energy management system terminals to interface to shop floor
- steam traps
- process control system archiving & reliability improvement
- thermostatic radiator control valves and heat allocation meters

Exhibit 8
Short-term Energy Savings Identified at Hungarian Industrial Plants
Case Studies Under 1991 A.I.D. Program

	Short-term savings Identified[8]	Pct[9]	Payback
Alcohol & yeast	$500,000	16%	< 1 yr
Electrolysis Chemicals	$290,000	5%	< 1 yr
Alumina refractories	$340,000	3%	< 1 yr
Copper & brass	$700,000	9%	< 1 yr
Paper	$280,000	7%	< 1 yr
Glass containers	$3.4 million	20%	< 1 yr
Bakery	$40,000	6%	< 1 yr
District heating	$2.2 million	20%	< 3 yrs

TOTAL - 8 PLANTS	**$7.7 million**	**12%**	**< 1 yr**

[8] Total annual energy cost savings for short-term projects identified by audit

[9] Expected energy cost savings as percentage of total annual energy costs

SECTION 3 - GENERAL OBSERVATIONS ON ORGANIZATION OF INDUSTRY

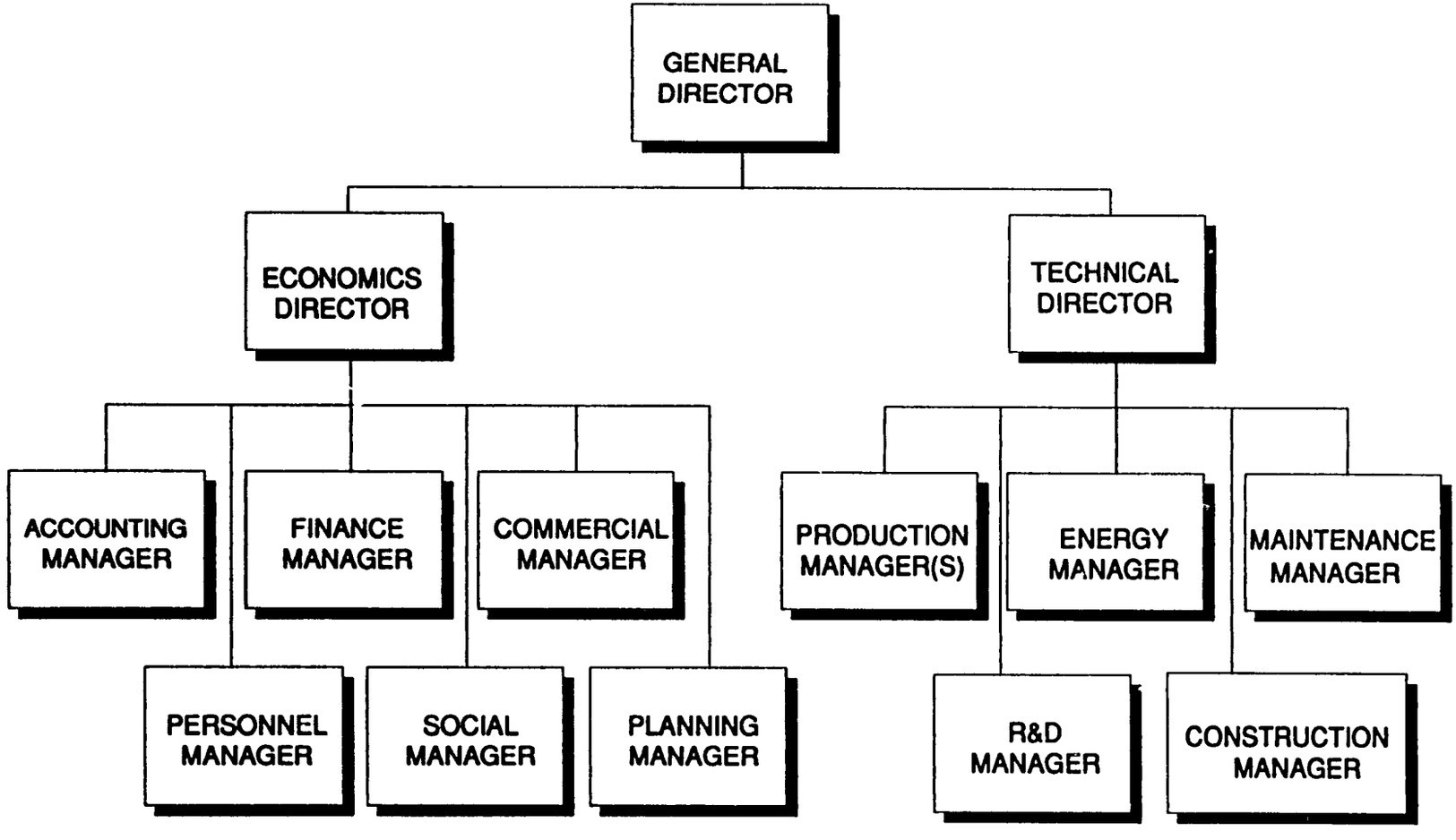
All industrial companies have certain generic functions - marketing, production, finance, management and administration, and research & development. Whereas each of these functions usually represents a division in an American company, in Hungary, organizations are structured differently. In most of the 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 typical organization diagram is shown in Exhibit 9.

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 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 Hungarian 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.

Exhibit 9
Typical Organization Chart -- Hungarian Industry



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 Hungary, for many years there has been flexibility in the system. Thus there have not been penalties if the plan was not strictly adhered to, except for fixed demand charges based on annually-negotiated contracts for electricity (monthly charge per kW) and gas (a capacity charge). In some cases, plants can save 1-3% of their electricity bill by negotiating new contract limits, but this would reduce their flexibility for additional production or plant expansion.

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 (in one plant audited by 40%). This situation caused great confusion (in fact, arguments) between the planning department (consisting of accountants who make the normative calculations) and the energy department (who read the meters which prove that energy consumption is 40% over target).

3.1 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 management 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.

3.2 Production

A primary objective of the 1991 A.I.D. 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 Hungary has had substantial success, mainly due to the willingness of management to make such changes and the catalytic role afforded the A.I.D.-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 Hungarian 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 Hungary, 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 Hungarian 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 - Some modern equipment is in place in most medium-sized Hungarian factories. The influence of the openness of the economy to Western vendors, and the various World Bank programs which have provided capital, is obvious. The level of technology has been brought up to mid-1980s Western standards in the best of the process lines for the glass, copper, alumina, alcohol, district heating, and paper plants that received energy management audits. The plant production people have been exposed to the latest advances in process technology through conferences, exhibitions, and salesmen from Western countries. West German and Austrian equipment is particularly evident, followed by Italian and Swiss. American technology can be found most often in control systems, such as computer-based process controllers. Further, some Hungarian products themselves are relatively modern, as Hungary had the leading position among COMECON countries for several engineering products. In particular, Hungarian-made heavy equipment such as boilers, turbines, and motors, and meters for electric, steam, and gas is quite good. Partnerships with foreign joint venture partners is expected to allow a further influx of modern technology.

Operations & maintenance - Because of the generally high level of staff education, the level of production operations is nearly on a par with that of developed countries. New, market-driven situations are the exception, such as instances 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. Hungary 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 - As shown in Exhibit 9, 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.

Energy management - In years past, energy audits were compulsory, and were used to develop an energy budget, which amounted to a bargain between the plant and the government on how much energy the plant was supposed to be able to use each year (the quotas were never strictly enforced, and this procedure no longer applies). These audits were done partly by the plants themselves, and partly by Government consultants (such as AEEF and EGI). In theory, the plants should have carried out the operations & maintenance recommendations made by the audits, but this was not necessarily the case, with lack of monitoring instruments being the usual excuse. The plant must send data to AEEF, which is responsible for monitoring energy consumption and production and for calculating and tracking specific energy consumption. AEEF is also responsible for the inspection of boilers and other energy systems for safety. The data appear to be as accurate as metering allows, since there was no implied penalty (in recent times, the data were not used to adjust "quotas", as in some other countries). Industry views AEEF as an inspectorate, primarily from the point of view of safety (such as burner controls), and as a Government statistics office, to which it must report.

Comments - 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 departments 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, such as observed in the alumina plant, 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 the extreme, plants that cogenerate and sell steam to neighboring industrial companies are losing their market for steam because of low reliability and steam prices, which do not reflect the advantage of the cogeneration system.

3.3 Finance

In Hungarian 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. Even within the trusts, 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.

In the 1980s, with the beginnings of a banking system in Hungary and the influence of the World Bank in the industrial sector, a system of investment evolved which approximates that used in Western countries. Investment proposals are generated in industrial plants, which are then evaluated by the trust for possible funding. These proposals are evaluated in the plant (and by the trust) on a financial basis, using specific criteria. The criteria used in most companies seem to simple, ignoring the time value of money. Investments that affect the basic production (quantity and quality) are favored over investments that reduce costs (such as energy efficiency). This is similar to the system used in most American companies for small investments, which are made on the basis of simple payback period.

The current financial climate in Hungary 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, and some Hungarians feel that the "national patrimony" is being sold out for too little (just as many Britons felt about the privatization of their electric utilities).

3.4 Management and Administration

Management is the area with perhaps the greatest need for improvement in Hungary today.

In American companies, there is generally a clear distinction between workers and management. Decades of socialism have left no true management class in Hungarian 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 Hungary'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 previous 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 Hungarian manufacturer, and all of these fundamental guiding principles of industrial production are new. As Hungarian 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[10]. It is human nature to take advantage of 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 green shop-floor worker and his co-worker with 20 years experience. In the traditional European system, this would have been a craftsman-

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

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 ($200-500 per month, probably from the bottom to the top of a typical state-owned company), Hungarian 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. In 1991 directives, stability seems to be loosely defined as $\pm 5\%$ of payroll from year-to-year, which means total cost, but also relates to staff complement. 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. Moonlighting 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.

3.5 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.

SECTION 4 - SPECIFIC OBSERVATIONS AND RECOMMENDATIONS

The 1991 U.S. Emergency Energy Program for Hungary includes Component #1 - Industrial Energy Efficiency, which has certain specific areas of interest, for which observations are to be provided. It is the purpose of this section to respond to these areas.

4.1 Observations on Industrial Energy Efficiency

As indicated in Chapter 1, Hungary has begun improving its industrial energy efficiency. The gains in the past, as well as those expected in the future, result from all of the following:

- Industrial restructuring - closing outdated heavy industries or obsolete production lines, privatization.

  Example - the glass plant audited had been partially restructured, with the sheet glass operation spun off as a joint venture with an American company. The container plant remained state-owned, but anxious for a similar opportunity. Meanwhile, many capable staff had left the container plant to join the joint venture, which offered 2-3 times higher salaries.

- Energy pricing - increasing prices to world market levels

  Example - industrial energy prices are at western European levels. This alone has created strong awareness in the need for improved energy efficiency in all plants visited. Attitudes toward energy have changed.

- Fuel substitution - replacing coal with gas

  Example - of the plants audited, none burned coal anymore. The alumina plant had converted to low-sulfur fuel oil and the chemical and alcohol & yeast plants converted to gas. However, efficiency improvements are not as high as they could have been if modern boilers were installed, instead of retrofitting old, manually-controlled boilers.

- Energy efficient technologies - installations of up-to-date Western equipment, and modernization of production systems

  Example - modern process lines had been installed at the alcohol plant and the paper plant. Energy saving technologies had been installed at the boilers of the district heating plant and the lighting and electrical demand control of the copper & brass plant.

In general, the plants that were 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.

As noted above, plant operations (turndown) and maintenance (losses) does not appear to be adequate in many plants. Based on the experience during the audit of the glass plant, 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.

4.2 Observations on Investment Decision-Making

As noted in Chapter 3, there is a fundamental weakness in management decision-making in Hungary. While this weakness is evident in investment decisions, it is perhaps even more apparent in day-to-day management decisions.

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 canceled now. Decisions are often biased and not optimal.

The recent rises in energy prices has stimulated interest in energy efficiency, 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 is also 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.

In Hungary, investments in energy efficiency appear to be receiving about the same priority as compared to investments in process technology as is found in many American companies - cost cutting is judged on relatively quick payback (say 2 years or less), whereas process modifications are allowed a longer payback (perhaps 5-7 years). Process improvements have inherent multiple benefits, by enabling a company to upgrade product quality or quantity, enter new markets, or remain competitive. The way companies treat such benefits, which are often not readily quantifiable beforehand, is to apply a higher rate of return criteria to cost-cutting (energy efficiency) projects.

Based on observations by RCG/Hagler, Bailly, the present policy with respect to energy efficiency investments does not seem to be inhibiting such investments. In fact, the elimination of energy price subsidies over the past 2-3 years has brought energy conservation into clear management focus. In many of the companies visited, investments have been made in energy efficiency during the past few years, most notably the lighting and energy management system at the copper & brass works.

Hungary'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.

4.3 Observations on management practices

The reader is referred to Section 2 for a general discussion of management practices. No further specific observations are offered, except to reiterate that 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 ratios 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 Hungarian managers, they have agreed to make changes which improve efficiency. The most dramatic example was the consolidation of production at the glass plant in three lines instead of four. This decision enabled the plant to save about $2 million per year in gas costs.

4.4 Recommendations

Based on observations in 1991 by RCG/Hagler, Bailly during site visits to 15 companies and one-week audits in 8 plants, a number of needs have been identified, for which recommendations are offered.

- **Adopt a holistic approach to industrial energy efficiency.** There is a need to emphasize that industrial energy efficiency is process-related, and will be best served in Hungary by projects that address the transition to a market economy. 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.** Hungary 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. Fuel oil prices appear excessive, which may be reflection not only of taxation but also refinery cost allocation By May 1991, fuel oil prices had not fallen, three months after the Gulf War.

- **Industrial pollution control problems have identified solutions.** 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 could be described as Dickensian in many cases (particularly the metallurgy industry). It is perhaps the ultimate irony 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.

APPENDIX 1 - RECOMMENDATIONS FOR A POSSIBLE MEDIUM-TERM INDUSTRIAL ENERGY EFFICIENCY PROGRAM IN HUNGARY

Objective

1. Demonstrate the American approach to industrial management, problem solving, energy efficiency, and decision-making, and serve as catalysts for action by Hungarian counterparts.

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

3. Provide training and introduce Hungarian managers to their counterparts in U.S. industry.

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

Focus

1. Focus on helping viable industries solve problems in the short term, to assist them during Hungary's transition to a market economy.

2. Dedicate limited funds available to projects that act as catalysts and assist Hungarian industrial managers to make the decisions required to cope with the diverse slate of transitional problems faced by industry, all of which affect energy efficiency:

   Business strategy and restructuring
   - Product slate
   - Production lines
   - Marketing
   - Packaging
   - Production cost accounting

   Product cost optimization
   - Energy efficiency

- Waste minimization
- Raw material utilization

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

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. 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.

2. Provide consulting advice to advise and catalyze industry management in the Focus areas. Provide assistance to 100 companies per year, with a phased program leading to a self-sustaining financing structure, paid by the client plants. Consultants must provide expertise in management consulting, process optimization, process technology refinements, and energy management, for example:

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

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

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

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

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

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

Duration

A duration of three (3) years is recommended, 1992-94.

Budget

A budget of $25 million is recommended for the project. The method of funding recommended is a grant basis, with at least 50% 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 Hungary are anticipated.

	Project Contribution	Plant Matching
1. Establish DSM implementation	$ 2 million	$10 million
2. Consulting services to plant management	$ 8 million	$10 million
3. Demonstrate technologies	$ 5 million	$ 5 million
4. Finance feasibility studies	$ 5 million	
5. Sponsor training, internships, study tours	$ 5 million	
TOTAL	$25 million	$25 million