CDIE
Impact Evaluation
United States Agency for International Development

SAVING ENERGY IN THE CZECH REPUBLIC

After 40 years of communist political repression and a straitjacket of economic controls, the Czech Republic has broken free. USAID has played a key role in two major problems facing the country: inefficient energy use and high levels of pollution.

USAID projects demonstrated that energy conservation can

- Reduce wasteful and inefficient industrial energy use at relatively low cost
- Generate high rates of return for individual factories and the country
- Reduce pollution at relatively low cost
- Be effectively promoted by a nongovernmental organization

The projects also pointed up some areas of difficulty:

- An uncertain investment or business climate deters investments in energy conservation
- Price distortions harm energy efficiency
- A technical solution of better equipment is rarely enough; improved business planning, marketing, and finance are needed
- There is a need for a more effective strategy for test-marketing and disseminating new approaches to energy conservation

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SUMMARY

The Czech "velvet revolution" of 1989 ended 40 years of communist rule and set the stage for major democratic reforms. Along with dramatic political change came economic reforms heading the country away from central planning and toward a relatively open and free market.

Under communism, central planners decided what would be produced and how. For a new factory, for example, planners would choose a site, pick a production process, select equipment, and determine the type of workers needed. Planners and factory managers made technical decisions only—they did not worry about prices and markets. Market demand was not a concern; nor was the price of labor, machinery, energy, and raw materials. Planners believed society's problems were best solved by cheap energy, cheap capital, and subsidized prices for major industrial inputs and essential consumer goods. The environment was seen as a free input, with almost no attention to pollution and health-related effects.

With the end of communism the economy shifted to international prices, and many Czech firms now faced international competition. The move to a market-based economy was traumatic, particularly for industries with old and inefficient equipment. Czech industry had some advantages—industrial quality was good and workers were highly skilled and relatively low-cost. However, industrial energy requirements were extremely high, and industrial pollution was poisoning the population.

The Czech Republic is situated in the "black triangle," one of the world's environmental hot spots. Severe environmental degradation results from economic policies that promoted highly polluting heavy industry, discouraged energy conservation, encouraged the use of dirty fuels, and had few controls on industrial pollution. In fact, while the Czech people harbored a wide range of complaints against the communist government, a universal rallying cry was the environment. They may not have understood how economic theory relates energy efficiency to energy pricing and pollution, but they did understand how poor environmental conditions affect their health and living conditions.

The overall USAID assistance program dealt with a number of problems in the transition from a centrally planned economy to a free market economy.* One of the biggest problems in the transition was cheap energy. USAID confronted that problem with two projects. The Emergency Energy project began in 1990 and was followed six months later by the Regional Energy Efficiency project. The rationale for Agency assistance was economic: if the Czech economy could use energy more efficiently, it could maintain economic momentum, advance economic restructuring, and deal with pollution problems. The projects provided consultants, training, energy audits, and energy conservation equipment. They also provided support for a nongovernmental energy conservation organization known by the acronym "SEVEn." All together, the projects invested approximately $500,000 in support of energy conservation at five industrial plants.

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*Detailed technical analysis and background information on environmental, energy, and economic issues of USAID energy assistance in the Czech Republic are available in USAID Evaluation Working Paper No. 218, PN ABS–547, *How USAID Energy-Saving Programs Are Faring in the Czech Republic .*

The projects demonstrated that energy conservation works. Companies that made energy investments saw very high financial rates of return, averaging 122 percent. This represents financial costs and benefits directly related to the company and the energy it saves. It excludes benefits flowing to the economy as a whole (reduced pollution, increased taxes) and costs to the economy and USAID for project management. Including these costs and benefits yields an economic rate of return for the economy as a whole of 50 percent—still a very good rate. SEVEn has played a major role in energy conservation. Being separate from the government and special interests, it has been able to press the government for policy reforms while serving as a matchmaker, bringing together industry and energy service providers. In most other countries USAID has had only fair to poor results working with government energy organizations. Working with a nongovernmental organization might provide a model worth following elsewhere.

Energy conservation is more than a technical or engineering issue of making energy-efficient equipment available. Business decision-making is influenced by prices, markets, and incentives. Under communism, Czech industry directed all attention at meeting production targets, not reducing costs. Prices and incentives did not encourage energy efficiency or controls on pollution. Even now, with communism gone and with nearly free markets, the old business culture survives in many firms. Moreover, it has taken the government several years to shift most energy prices to international levels.

The government has stressed pollution control rather than energy conservation. Stiff regulations and fines have forced factories to switch to cleaner fuels and improved burner combustion. Pollution control has done more than just cut down on pollution—it has discouraged wasteful and inefficient energy consumption.

A factor impeding widespread success of the USAID project was limited dissemination. The project succeeded at the five demonstration factories and with SEVEn, but the energy conservation message has been slow to spread throughout the country. The technology clearly works, but more needs to be done to spread the word.

CDIE STUDY

In September 1995, a four-person team assessed two USAID energy conservation projects: the November 1990 Emergency Energy project and the May 1991 Regional Energy Efficiency project. The team consisted of Joseph M. Lieberson, team leader and economist with the Agency's Center for Development Information and Evaluation (CDIE); Matthew Addison, energy economist with Development Alternatives, Inc.; Frank Hahn, energy engineer with Development Alternatives, Inc.; and Alberto Sabadell, environmental engineer with USAID's Global Bureau.

This was one of six impact assessments on energy conservation carried out by CDIE. The other countries in the series are Guatemala, Hungary, Jamaica, Pakistan, and the Philippines. All of the country evaluations examined the economic and environmental impact of USAID projects by exploring the same four questions:

1. *Policy reform.* What has been the impact of government energy policy, energy pricing decisions, environmental policy, and privatization?

2. *Technology transfer.* Was the right technology selected, was it adopted, and is it still being used?

3. *Education and awareness.* How successful was the project at spreading the energy conservation message?

4. *Institution building.* Were government and private sector institutions strengthened to the point where they could promote energy conservation after USAID funding ended?

BACKGROUND

The Czech Republic is shifting to a free market system and opening its economy to trade with Western Europe. However the economy has a major problem: it is excessively dependent on energy. Compared with Western European countries, the Czech Republic requires nearly six times more energy to produce a unit of gross domestic product (GDP) (see figure 1). This is due to inefficient energy production and transmission, use of antiquated and energy-wasteful capital equipment, and artificially low energy prices that discourage conservation. In addition, high energy use and dirty fuels generate air pollution four to eight time higher than in Western Europe (see figure 2).

Project Rationale: Why Energy Conservation?

After the fall of communism, Czechoslovakia launched major economic reforms. But in late 1990, just as reforms were starting, the economy faced a serious economic crisis because of dramatic changes in international energy markets. Almost all oil and gas had been imported from the Soviet Union, and the Soviets were now

Figure 1
Energy Needed to Produce a Dollar of Output
1993

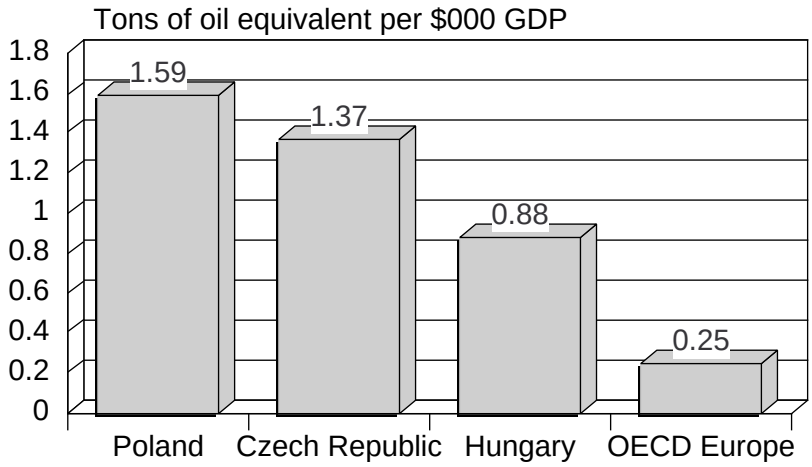
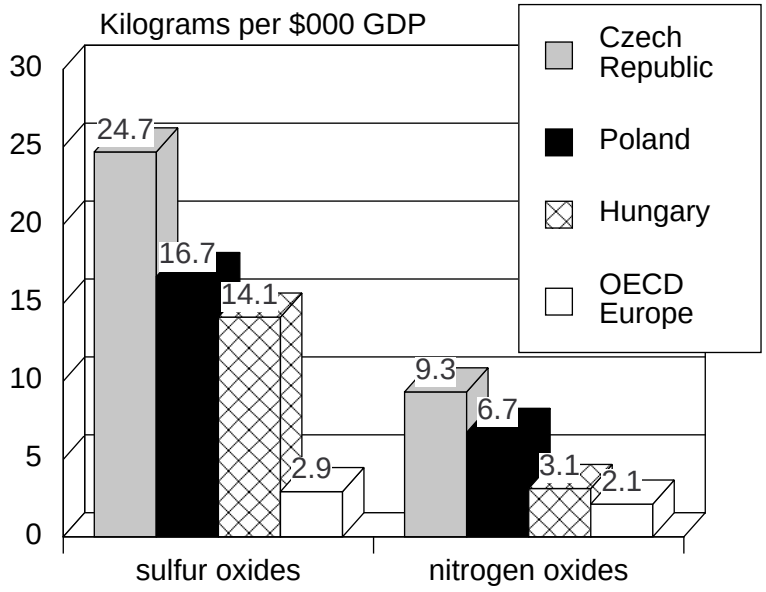


Figure 2
Pollution Levels in Selected Countries
1992



cutting back on deliveries and shifting to hard-currency payments. With Iraq's invasion of Kuwait and the cutoff of Iraqi and Kuwaiti oil, international prices soared. Experts assumed oil prices would remain at $31 a barrel (from a 1990 preinvasion low of $13) and possibly move higher.

The new, democratically elected Czech government was starting to reform and modernize the economy, but higher oil prices and energy shortages could derail those efforts. Faced with mounting financial and industrial problems, pressure might arise to return to the old system of state controls and allocations. USAID assistance could help cushion the shock and even use the energy crisis as a way to reform Czech industry and encourage a market-based approach toward development.

The rationale for USAID assistance was economic: a Czech economy using energy more efficiently would save foreign exchange, maintain economic momentum, and then move forward on economic restructuring. Energy conservation was a *means* to help the economy—not an end in itself.

USAID projects provided energy consultants, energy audits, funds for energy conservation investments, and training for Czech energy auditors who then helped factories improve their energy efficiency. The project also provided start-up funding for an energy / environmental group known by the acronym "SEVEn." A nongovernmental organization (NGO), SEVEn is now highly successful and operating independent of donor funding. SEVEn helped spawn two private energy service companies that work as energy conservation consultants. USAID projects supported energy conservation demonstration investments in five factories. The investments generally went to low-cost, quick-payback measures such as steam traps, steam valves, thermostats, and energy-monitoring equipment.

PROGRAM ELEMENTS

Policy Reform

The era of cheap energy is coming to an end, but the politics of ending it is difficult. Previously, the government set energy prices low to encourage industrial production and to provide cheap energy to households. Major reforms started in 1989 with the end of communism, and from 1989 to 1991 energy prices were raised dramatically, moving close to world market levels.

Since 1991, however, as the economy has slipped into recession and political resolve has softened, energy prices have lagged behind inflation. Energy price increases were outweighed by massive inflation. As a result, from 1989 through 1994 real energy prices (adjusted for inflation) declined for most industrial fuels (see figure 3). It was difficult to encourage energy conservation and energy efficiency in industry when energy prices were falling. Moreover, during 1989–93, energy intensity increased—that is, it now took more energy to

Czech Republic
A Thumbnail History

The Republic of Czechoslovakia emerged in 1918 from the ruins of the Austro–Hungarian Empire as a newly formed state embracing the provinces of Bohemia, Moravia, and Slovakia. For the next 20 years, a liberal, democratic constitution and able leadership allowed the republic to thrive. Czechoslovakia became the most industrially advanced country in eastern Europe.

But the prosperity would end abruptly. In 1938, appeasement in mind, Britain and France signed the Munich Agreement ceding the German-populated Bohemian borderlands to Hitler's Germany. The next year, Nazi troops occupied large parts of the country. Czechoslovakia ceased to exist.

At the end of World War II, Czechoslovakia was restored to its prewar borders, but it swiftly came under Soviet domination. It took on all the trappings of a Stalinist state: Industry was nationalized. Virtually all agricultural land came under the control of state collectives. Manifestations of dissidence, whether artistic, political, or religious, were repressed. Cultural and intellectual life became pedestrian.

Under such conditions, the economy stagnated. In response, leaders in 1963 launched a period of economic reform. By early 1968 it had coalesced into a mass movement (supported by the Communist Party itself) for social and political liberalization. In July, however, the movement was summarily crushed as Soviet, Polish, East German, Hungarian, and Bulgarian armies rolled into Czechoslovakia. Not until 1989, with the fall of the Soviet Union imminent, would Czechoslovakia be restored to its democratic traditions.

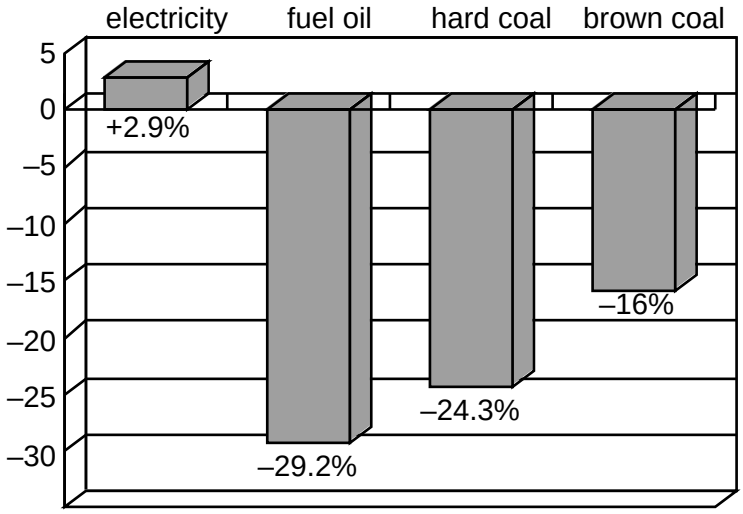
The end of Soviet domination saw the emergence of a strong Slovak nationalist movement. In 1992, Czech and Slovak political leaders agreed to split the republic into two fully sovereign states. That agreement was realized peacefully on January 1, 1993. The Slovak Republic (with roughly a third of the land and people) came into being as a separate, independent nation. At its western border lies the country now called the Czech Republic.

produce a given level of output. Energy efficiency was slipping because of two factors: 1) The economy was in recession and factories were operating well below capacity. This meant it was hard to maintain energy efficiency. 2) With fuel prices becoming relatively cheaper, there was no incentive to conserve energy use. Even with these problems, for industry most energy prices are now moving close to costs of production. Only the residential sector still receives highly subsidized energy. The government is hesitant to raise energy prices to households, fearing political backlash.

Czech environmental policy has reduced pollution through regulation. New laws require major reductions in pollution by 1998 with reductions being phased in over several years. When factories exceed emission limits they must pay fines, and if they fail to meet the 1998 standards they will be forced to shut down.

Factory managers are taking the regulations seriously. The fines, and in particular the prospect of having to close down production in 1998, have provided them with a strong incentive to clean up their smokestacks. The pollution policy already is having an impact, with significant declines in sulfur dioxide and nitrogen oxides emissions (see figure 4). Factories and the national electricity-generating company are switching from coal to cleaner fuels, installing stack scrubbers, changing production processes, and improving burners and boilers to reduce pollution. In addition to reducing pollution, this approach discourages wasteful energy consumption.

Figure 3
Czech Republic
Change in Industrial Energy Prices, Adjusted for Inflation, 1989–94



Technology

Probably as important as the equipment were the introduction of energy planning techniques and training in ways to develop business and financial plans for energy conservation. The projects demonstrated how a good financial and business plan incorporates and ranks investments in a manner understandable to company managers. This approach enabled engineers and management to agree on investments that generated energy savings.

Long known for its industrial excellence, the Czech Republic is a country comfortable with technology and innovation, and manufacturing standards are high compared with those of other ex–Soviet bloc countries. Under communism, however, industry concentrated on production and output, with less concern for costs, including energy costs. There was little initiative to bring innovative technologies to management. It was in this environment that the USAID projects were begun in 1991.

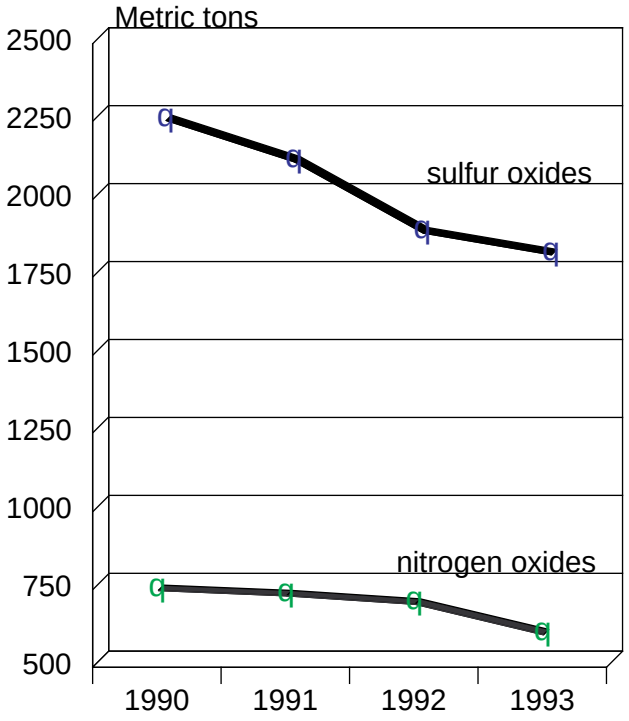
In many projects in other countries, USAID introduces new technologies. That was not the case in the Czech Republic. Most of the energy conservation hardware was known to Czech engineers. Changes initiated by the projects were mainly in the use of existing technologies to solve problems new to the Republic.

The USAID projects took low-cost hardware and software technologies and applied them to Czech industries. Under communism, management had little incentive to apply its knowledge to solving energy efficiency or pollution problems. The USAID projects demonstrated low-cost, quick-fix, off-the-shelf solutions that could meet the needs of energy conservation. Principal hardware consisted of valves, thermostats, steam traps, insulation, and lighting. Principal software introduced was automatic controls, energy policies, planning techniques, and business plans and know-how.

Engineers were trained to prepare financial feasibility studies management could understand. Management was quick to realize that simple, low-cost investments could save energy and reduce operating costs while having a positive environmental impact. The projects demonstrated how a good financial and business plan incorporates and ranks investments in a manner that can be understood by a company's managers. This knowledge caused both engineers and management to seek out and propose investments that generated energy savings. Industrial managers and lenders have been shown by demonstration the benefits of energy conservation investments.

Now that Czech energy prices are moving closer to international prices and environmental pollution costs are being assessed, engineers are able to propose technological solutions that address energy / pollution problems. It has been

Figure 4
Czech Republic
Air Pollution Levels



the *acceptability of technological and policy change*, rather than the *knowledge of technology*, that the USAID program has helped.

Education and Awareness

The USAID projects supported training, education, and promotional efforts, but a firm's ownership (whether it was privatized or still state owned) and market incentives had a much greater impact on energy conservation. Education in and promotion of energy conservation are both well and good, but without proper prices and incentives, results will be minimal.

Each country has its own business culture, and the culture in the Czech Republic is heavily influenced by 40 years of socialist state planning. The old socialist mentality of meeting production targets and channeling all efforts toward output (and letting costs take care of themselves) is sadly still alive and well in many firms. Factory managers who still emphasize production, not costs, make it difficult to promote cost- and energy-saving investments. Success with energy conservation often depends on where a plant is in the privatization process. Plants still owned by the state or by local management tend to take a limited view of the future and are reluctant to make any investments.

The best hope for energy conservation is with privatized companies with foreign partners, since foreign firms bring technology, management, finance, and marketing skills. They also are concerned with cost controls, take a strong interest in energy conservation, and are willing to make energy conservation investments with a longer payback period. USAID training, workshops, equipment, and energy audits helped change these old attitudes, but a change in a factory's ownership and management usually was more important.

Institution Building

SEVEn is a highly effective energy NGO. Its performance stands in sharp contrast to the weak performance of government energy agencies in many other countries. USAID institutional development efforts put great stock in SEVEn. USAID funded SEVEn for three years, but now it is self-sustaining, able to fund operations by selling services to the commercial market. SEVEn has done it all—combining the missionary zeal of an NGO with technical savvy. It has actively gone after business contracts and has shown good business sense.

SEVEn has organized annual technical interchanges (such as the Energy Efficiency Business Week) and many meetings, newsletters, demonstrations, and other forms of information dissemination. It has promoted energy policy reform with the government and served as a matchmaker, linking energy users with engineering and equipment firms. It helped create two private companies that provide energy consulting services to industry. Probably

as important as the technical side of energy conservation, SEVEn learned how to package and market energy conservation proposals. It is now highly skilled at training others in preparing business plans, feasibility studies, and loan applications.

USAID has supported energy conservation organizations in a number of countries, but none like SEVEn. In most countries, the Agency supported government organizations or parastatals; in this case it supported an NGO that is independent of government and private special interests. In most other countries, concessional assistance continued for many years; in this case, after three years of start-up funding, SEVEn operating on its own. By any measure, SEVEn has been highly sustainable and has seen its services and influence continue to expand.

RESULTS

USAID assistance addressed both the immediate emergency need to reduce energy consumption and longer term efforts to restructure the economy and move toward a modern, efficient energy system. The November 1990 Emergency Energy project included some longer range efforts but concentrated mainly on short-term energy conservation.

In the next year, the May 1991 Regional Energy Efficiency project grappled with longer range problems of improving industrial energy efficiency through energy audits. An energy audit is a technical analysis by an engineer of how a company uses energy. It identifies ways to eliminate waste and increase efficiency. Key energy-using companies were identified, energy audits conducted, and then low-cost energy-saving equipment and training provided to those companies. The project helped achieve energy savings of 5 to 15 percent.

USAID funded five energy audits of industrial companies: the Pragolaktos dairy plant, Branik brewery, TOFA–DETOA wood products plant, Mileta Cerny Dul fabric plant, and Autobrzdy Jablonec auto parts plant. Energy conservation investments, funded mostly by USAID, were then completed at each plant. They were generally low-cost, quick-payback measures such as valves, thermostats, steam traps, and monitoring equipment. The dairy plant investment was $35,500, and the average investment at the other plants was $10,725. The payback period on the energy conservation investments (the point at which cost savings equal investment costs) was less than a year for all plants except the dairy plant. There it will take 13 years of energy savings to recover costs. The investment is not likely to be cost-effective.

USAID supported creation of SEVEn. A direct spin-off from SEVEn was a firm—Energy Performance Services Co., a Czech–U.S. joint venture—that has introduced energy performance service contracts in the Czech Republic. Intesco is another energy service company. Its local operation was spawned from one of the SEVEn-sponsored energy efficiency seminars.

The final area of project efforts (consultants, studies, and training) was in energy-pricing reform. USAID worked successfully with the World Bank to bring most industrial energy prices in line with real economic costs. However, energy prices for households are still well below economic cost levels.

IMPACT

Financial and Economic Impact

The USAID projects have strong rates of return—a financial rate of return of 122 percent for the companies and a 50 percent economic rate of return for the country. It can be said that all USAID projects generate benefits, but it is important to look at benefits in comparison with costs: what is the bang for the buck? If benefits merely exceed costs, that is not enough; they should be equal to or greater than the return that could be earned on alternative investments. In the Czech Republic, business expects to earn 30 to 40 percent financial return on investments. An investment in energy conservation has to be at least in that range.
One can look at costs and benefits in two ways:

first, from the perspective of the individual firm, and second, from the perspective of the entire country. Economic analysis examines costs and benefits to the country, including externalities such as benefits from reducing pollution and the cost of foreign aid to support the investment. The firm has a quite different perspective; it is interested only in its own financial rate of return. The firm looks at the cash it takes in and pays out. It receives no cash benefit from less pollution and has to turn part of its profits from energy savings over to the government in the form of taxes. Table 1 provides details on financial and economic rates of return.

Financial and economic rates of return are calculated by first taking all program investments, next valuing the flow of benefits, and finally comparing costs with benefits to calculate a rate of return—the net economic benefits. The flow of benefits occurs for a number of years, and that flow, less all costs incurred in their generation, yields the net annual benefit. For example, in a simplified case, if a $100 investment generates net annual benefits of $20, the project has a 20 percent rate of return.

The first step in calculating an economic rate of return is identifying USAID's initial investment—the resources used to plan, design, and implement the project, along with the costs incurred in procuring equipment and technical assistance. Excluding equipment costs, a total of $425,000 was spent by USAID on salaries, travel, reports, and other implementing activities. The factories spent $15,000 of their own money plus $78,400 of USAID money on equipment for a total of $93,400. Total costs are then $518,400 ($425,000 plus $93,400). The next step is to estimate project benefits.

Total annual energy savings at the five plants were 401 metric tons of oil and 16,987 metric tons of steam. Valued at international energy prices, these savings amount to $189,030 per year. To this are added the benefits of reduced pollution of $103,608 to yield total annual benefits of $292,638. The economic rate of return is 50 percent. To calculate financial rates of return adjustments are required. Adding in taxes, excluding pollution benefits, and excluding USAID assistance (not directly related to the five demonstration factories) yields a financial rate of return of 122 percent. Energy conservation investments are clearly profitable for firms.

Environmental Impact

The USAID projects have demonstrated how to reduce pollution at relatively low cost. The Czech capital of Prague has the distinction of

Table 1
Czech Republic
USAID Energy Conservation Project
Financial and Economic Rates of Return

Description	Financial analysis	Economic analysis
Annual energy benefits	$113,418	$189,030
Annual environmental benefits		103,608
Total annual benefits		292,638
Costs	(93,400)	(518,400)
Payback period (months)	9.8	21.3
Financial rate of return	122.0%	—
Economic rate of return	—	49.8%

being the most polluted capital city in all of Europe. Outlying factories and electrical power plants burn low-quality brown coal, making the air thick with pollutants such as sulfur dioxide at levels four times greater than in Western Europe. Over the last three years, however, air pollution countrywide has been reduced by 14 to 20 percent (see figure 4). Pollution is now less of a problem. That is due in large part to the decline in economic activity, but also to energy price increases, a switch to cleaner fuels, shutting down highly polluting heavy industry, modernizing industry by replacing old and energy-inefficient equipment, and USAID's energy conservation projects.

Energy efficiency and positive environmental effects go hand in hand. Less oil or coal (or electricity) used in factories means less fuel burned, which means less air pollution. The Agency's energy conservation projects helped reduce energy consumption, which in turn reduced air pollution.

Pollution is harmful, but it is difficult to place a dollar value on cleaner air. Since long-term health costs and aesthetic values are hard to determine, environmentalists often use alternative ways of valuing cleaner air.

In one way, they look at *abatement costs*—how much it costs to reduce pollution by installing pollution-control devices at the factory. If new burners and stack scrubbers remove a ton of sulfur dioxide pollution from the air, and the burners and scrubbers cost $800, then that is a good proxy for the value of reducing air pollution.

Another way to place a value on cleaner air is to count the abatement cost *avoided*. If a manufacturer reduces pollution by burning fuel more efficiently, he avoids the cost of the burners and scrubbers. The value of reduced pollution is counted as the money saved by *not* having to invest in pollution-control devices—in this case, the same $800.

Abatement cost avoided in the Czech Republic is estimated at half of abatement costs in the United States. This lower amount reflects two factors: the difference in income levels and the technical stage of pollution control. U.S. incomes are higher than Czech levels, and reduced pollution has a higher value for higher income citizens. With lower income levels, Czechs are not willing to pay as much to reduce pollution. On the technical side the Czech Republic has high pollution levels, and measures to reduce pollution are much cheaper than in the United States, where easy and low-cost early measures have already been completed.

Table 2 shows pollution reductions resulting from USAID energy audits and equipment installed at five factories. It is useful to link these pollution benefits to energy savings and equipment costs. The value of reducing annual emissions ($103,608) is greater than the one-time equipment costs of $93,400; pollution benefits cover costs in less than a year—which is a very fast payback. But equipment costs are not really an environmental cost. *The pollution benefits are almost a gift***,** since energy conservation equipment was installed by factory managers as a way to save on their fuel bill; the financial rate of return on the energy saving investments is 122 percent. *From the manager's perspective the equipment pays for itself in fuel savings, and the country receives the bonus of reduced pollution.*

PERFORMANCE

Program effectiveness

Program effectiveness answers the question, Who received the benefits, and were the right groups targeted—those who could generate the greatest energy savings? Effectiveness also relates to improved institutions and markets. In this case we want to know how effective the project was at developing institutions and improving market functions.
Since the objective of the project is to generate

the maximum reduction in energy use through energy efficiency investments, then it seems likely industries that use the most energy should have been targeted. The project action memorandum states: "A large percentage of total energy use is probably concentrated in a relatively small number of large plants. It should be possible to identify in a relatively short time the plants that are the largest energy users."

USAID project documents targeted the critical groups, but project implementation did not follow through on that approach. In fact, as it turned out, energy consumption at the participating companies was a smaller percentage of total costs than for other industries such as chemicals and heavy manufacturing. Moreover, conservation measures tended to address minor uses of energy (lighting, steam distribution and regulation) rather than significant improvements in manufacturing processes (smelting, refining).

The question is one of tactics. It is obviously easier to deal with several dozen firms that are large energy users than with several hundred firms that are small energy users, but during implementation the project opted for the latter. If targeting small energy users is to be successful, the technology must be adopted by large numbers of industrial energy users. The project sponsored energy audits and energy saving investments at only five factories. In a country with several hundred industrial plants, this approach required major dissemination efforts. But these were not undertaken.

The investments demonstrated that relatively low cost measures could have short payback periods and generate good rates of return. While these rates were good, rates on alternative investments such as increasing output were often even higher. Czech management is mainly interested in increasing sales and output rather than reducing costs. They are not convinced investments in energy efficient equipment yield the highest rate of return.

Another factor affecting the willingness of firms to invest is their form of ownership. The nonprivatized, state-owned firms are carrying on much as before. With a secure market and government subsidies or price controls, they emphasize production rather than efficiency or costs. Many so-called privatized companies are still majority owned by the national government or by a municipality. Energy conservation is of minor interest.

For enterprises awaiting privatization or those that have been privatized by turning the factory over to managers and workers, things are only slightly different. Although these firms worry about markets and costs, they lack needed capital resources to invest in equipment

Table 2
Estimated Annual Reduction in Air Pollution
As a Result of USAID Projects

	Metric tons	Cost of control $ per ton	Total value if in the U.S.	Total value if in the Czech Republic
Carbon monoxide	21.0	56	$ 1,176	$ 588
Carbon dioxide	5,464.6	25	136,614	68,307
Sulfur dioxide	58.8	865	50,833	25,417
Nitrous oxides	9.3	1,980	18,365	9,183
Particulates	15.1	15	227	113
Total	5,568.7		207,215	103,608

modernization and energy efficiency. They can make a few no-cost and low-cost energy investments but cannot afford major expenditures. The best hope lies with privatized firms that have a foreign partner or owner, since foreign companies bring technology, management, finance, and marketing skills. They also are concerned with cost controls and take a strong interest in energy conservation. They have funds and are willing to make energy conservation investments with a longer payback. Most Czech firms lack capital, and given current uncertainties, they are reluctant to make investments with a payback period of more than a year.

Sustainability and Replicability

Energy conservation investments were sustained at the demonstration plants, but spread and replicability to other plants was limited. A foreign aid project transfers resources and provides benefits, which is fine. However, of equal interest is what happens after the project ends. Will new technology and practices introduced by the project continue? The next question deals with replicability. USAID projects could not cover all industries and all factories, so they were designed to create a few successful examples that would be picked up and replicated by other plants. The ultimate test is whether practices promoted by the projects spread beyond the five demonstration companies to other companies.

The evaluation found that all five plants that received energy conservation equipment were using the equipment effectively. When, for example, a few project-provided steam valves failed at the wood-products factory, plant managers immediately used their own money to buy replacements. To improve efficiency, managers have installed additional steam pipe insulation. In the future plant managers intend to convert from steam heating to hot water, make better use of wood scraps as fuel, and improve ventilation and capture exhaust heat and recycle it to save energy.

The factory received consulting support from the firm Energy Performance Services Co., a spinoff from SEVEn. However, plant engineers appeared unaware of what was happening at other plants in the Czech Republic. Nor did they know what equipment and services were available, or how to find solutions to energy problems that were beyond their own technical knowledge.

The brewery, which now has a foreign partner, has used its own funds to replace two boilers with new energy-efficient boilers that include preheaters. It has also installed improved burner combustion controls and better insulation. While the USAID preheaters have been scrapped, the fact that management would purchase new high-efficiency boilers is one of the best indications energy conservation has taken hold. Brewery management is planning to increase computer networking of the production and energy process and recently completed a follow-on energy audit. It has switched from heavy fuel oil to gas (for pollution control and energy conservation) and is working to bring its consumption of heat and electricity per unit of output up to Western European standards. Management is clearly concerned about energy.

The manager of the auto parts plant also seemed very energy conscious. USAID-installed valves, thermostats, and other equipment were still operating. The company now has a foreign partner who has injected capital for major upgrading, including energy conservation. The heating system had been upgraded and new, more efficient production equipment had been installed.

For the brewery, wood products plant, and auto parts plant, managers recognize the importance of energy conservation. They are maintaining equipment and benefiting from energy savings. Sustainability is less clear at the dairy plant. Management is awaiting privatization, and maintenance and investment are almost nil.

In addition to USAID-supplied equipment, the district heating plant was installing additional valves, thermostats, meters, and subdistribu-

tion controls. (The plant provides heat for several thousand apartments in the city of Pilsen.) The USAID project created awareness and interest in energy conservation, and the manager was proud to report that one demonstration housing block was able to save 25 percent on energy costs.

But it appeared little information was exchanged between Pilsen and other city heating systems, and Pilsen officials had received no information from private sector equipment suppliers. Managers appeared cut off from information needed for future planning and felt vulnerable. They faced competition from private power suppliers, cooperative heating systems, and gas and electricity distribution companies, but were not sure what to do.

The wood products plant, brewery and auto parts plant had been privatized. They clearly were concerned with costs and energy conservation. The Pilsen heating system had also been "privatized" and was now owned by the city. Although not private in the true sense, Pilsen government officials did appear to be acting like cost-conscious entrepreneurs. Awaiting privatization, the dairy plant was treading water, doing almost nothing about energy conservation. Its engineers gave the impression that once its status is settled, they would take an interest in energy conservation.

On the question of replicability, except for the auto parts plant (part of a conglomerate) the demonstration effect or spread of information between plants and industries is very limited. SEVEn is doing a good job, but it is but one small organization. Government-supported efforts, including energy consulting and information service companies, are promising but cannot service the whole country. It appears little information is flowing between plants or between city heating systems; the plants are isolated, and managers are unfamiliar with their competition and what others are doing on energy conservation. The Czech Republic lacks the institutions that, in the West, disseminate information: trade associations, technical societies, industry newsletters, industry seminars, and in particular, private sector equipment salesmen. Replicability within an industry or even within a geographic region is limited.

LESSONS LEARNED

1. **When, because of particular market conditions, firms are not oriented toward cost reduction, energy conservation measures are difficult to promote.**

Each country has its own business culture. Many Czech factory managers still follow the old approach from communism of concentrating on output rather than costs. On the rebound from 40 years of socialist planning, Czech manufacturing firms have taken to the new religion of market capitalism—but only part of the religion: increasing output, not reducing costs. The old mentality from the days of central planning—of meeting production targets and directing all efforts toward output (and not necessarily costs)—remains. Some inefficient plants have closed, but many face limited competition, and with high rates of inflation, they have been able to raise prices. This accounts for the tendency to stress increasing production and sales, and not reducing costs.

2. **Good energy conservation technology is not enough; effective dissemination through multiple channels is critical.**

Another part of the socialist heritage is emphasis on engineering and technical solutions. Business planning, marketing, and finance were not needed before; now they are. In addition there is a need to learn how others deal with similar problems. Managers at several manufacturing companies told us they had pollution and energy conservation problems, but when asked

what they were going to do about them, the managers gave a puzzled expression. They seemed not to know how to package the problem and deal with related marketing and management issues. Under the socialist planned economy, these technical problems were taken care of by the central government; now they are not. In the West there are trade associations, technical magazines, newsletters, equipment salesmen, consultants, and other sources of technical interchange. In the Czech Republic such information sources barely exist. Companies don't know how to package and frame their question or where to go for help.

Successful replication of industrial energy conservation requires dissemination that allows management to keep abreast of solutions and technologies. If information exchange is weak, results will suffer. When USAID designs a project, it should also develop a dissemination plan.

3. **Although energy conservation efforts are important, stressing pollution control through regulation may be the most effective way to cut harmful emissions and improve energy efficiency.**

Pollution control, rather than energy conservation, is the driving force in the Czech Republic. The electricity-generating company and industry have been given tough deadlines to reduce emissions. Faced with fines for excessive emissions, and with a threatened shutdown of the worst polluters by 1998, they have reacted by putting in stack scrubbers, switching to cleaner fuels, improving burner combustion, and redesigning district heating projects. All of these measures reduce emissions and (except for scrubbers) are more energy efficient. Pollution regulation can do more than just cut down on pollution—it discourages wasteful and inefficient energy consumption.

4. **Compared with a government agency, an NGO can often be more responsive and more effective at meeting the needs of all energy players.**

A key factor in successful energy conservation is getting people to first realize that they have a problem. The next steps are dissemination of technical information, bringing suppliers and consultants in contact with energy users, and encouraging appropriate government policies and regulations. SEVEn has done it all. It has combined the missionary zeal of an NGO with technical savvy. It has actively gone after business contracts and shows good business sense. SEVEn offers a model that might usefully be considered in other countries.

5. **USAID needs to decide on a clear strategy for test-marketing and dissemination. The sample might be a small number of major energy users or a large number of firms that are not energy-intensive, but not a small number of low energy users.**

If energy is a major cost of production and fuel costs are high, major energy conservation measures will be adopted. Ore smelting, some heavy industries, and district heating plants are major energy users. It is possible to achieve major results by targeting a small number of energy-intensive firms. The firms that received USAID energy audits and conservation investments, however, were not energy-intensive; energy amounted to only 5 to 10 percent of total costs. The Agency decided to try to reach thousands of small energy users rather than a few large energy users, but did so by working with only five plants and without a dissemination plan to spread the technology to thousands of small users. This was probably not the best tactic. To have the largest impact on energy conservation, USAID should begin with careful analysis of the setting and then devise a responsive strategy.

6. **An uncertain economic climate will deter most investments, including those in energy conservation.**

This is mainly a problem for firms awaiting privatization. Faced with uncertainty concerning market, prices, and employment, they have postponed all but the most necessary investments as they await transformation from state to private ownership. Plants that have already

gone through a successful privatization showed a strong interest in energy conservation.

7. **Long-term energy conservation requires an independent regulatory body (a public utility commission) that supports economic prices, minimizes cross subsidization, has a framework for public participation, and develops rate structures that support conservation.**

Local distribution companies were broken off from the national electricity authority and national gas authority, but rules on prices, responsibilities, and benefits were never adequately defined. Uneconomical prices and subsidies continue to send unclear signals to energy users and providers. Energy "rules" for electricity and gas producers and distributors must be well defined.

8. **Price distortions harm energy efficiency.**

In the past, all energy users were heavily subsidized, but now industry is paying rates close to true costs. However, the household sector pays one third to one half the rate industry pays for electricity, coal, gas, and heat. This is a politically sensitive area, but the government has pledged to phase out the subsidies by the year 2000. In sectors where major energy subsidies exist, conservation is difficult. USAID-supported conservation programs will not be successful if the government fails to implement appropriate policies.

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