Preliminary Business Plan

Plzeň District Heating System Upgrade

Prepared by
SEVEn
Pacific Northwest National Laboratory
Tecogen

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Pacific Northwest National Laboratory
Washington, DC 20024

Disclaimer

This business plan has been prepared on behalf of the City of Plzeň, Czech Republic, by the Pacific Northwest National Laboratory (PNNL) and its subcontractors, Tecogen and SEVEn (the Czech Center for Energy Efficiency) under funding providing by the U.S. Agency for International Development's Support for Eastern European Democracy (SEED) Program.

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Summary

The City of Plzeň, Czech Republic, is faced with two issues regarding the district heating system serving the municipality. The system needs to have physical upgrades to replace equipment nearing the end of its useful life and to comply with upcoming environmental regulations. At the same time, the ownership and management structure of the district system are being transformed as a result of the privatization process under way in the Czech Republic. As majority owner of the district heating system, the City has the primary goal of ensuring that the heating needs of its customers are met as reliably and cost-effectively as possible.

Detailed analysis has been conducted to assist the City in deciding these issues. This work is documented in five reports: 1) demand-side technical and economic analyses, 2) supply-side technical and economic analyses, 3) an integrated demand/supply report, 4) the *Final Plzeň Heating Supply Report* and its appendices, and 5) this preliminary business plan.

The preparation of this plan included investigation of ownership, management, and technology alternatives; estimation of the market value of existing assets and investment requirements; and forecasting of future cash flow. Cash flows required to operate the system and pay loan interest and principal were used to estimate the price that will have to be charged in order for the proposed heating plant company to be a viable operation. Given the uncertainties in the future inflation rate, all analyses were done based on real prices, using estimated real escalation rates for fuel, labor, and other production costs.

The district heating system consists of the Central Plzeň co-generation plant, two interconnected heating plants (one of which supplies both hot water and steam), three satellite heating plants (two of which are interconnected), and cooperative agreements with three industrial facilities that generate steam and hot water. The majority of the plants are coal-fired, with some peaking units fired by fuel oil.

The total capacity of the heating system under consideration for financing is 323 MW heat in hot water, 99 MW in steam, and 55 MW electrical capacity in the heating plant. These plants, together with additional boilers in the Plzeň brewery and railway maintenance facilities (ŽOS) (a total of 72 MW heat capacity in steam), cover the demand for hot water at a capacity of 287 MW and for steam at 92 MW. Under the highest growth scenario, the maximum annual growth in demand for hot water is expected to be less than 1% to the year 2010. Hot water supply in 1993 was 2833 TJ/year, and steam was 881 TJ/year.

The City has divided its investment activities into near-term (1994-1996), mid-term (1997-2003), and long-term (2004-2010). The following near- and mid-term activities are the subject of this plan:

- Near-Term - Based on the decision of the Plzeň Heating Co.'s Board of Directors, construct desulfurization units and install baghouses on the heating plant's boilers to remove particulates. Investment is also expected to extend the life of the Central and distributed plants, install baghouses on TEZA (Plzeň Heating Supply Co.) units, complete construction of the East I transmission line to connect the Letná and Doubravka satellite systems to the central system, and upgrade segments of the transmission and distribution system. In addition, the City is considering initiating an energy

efficiency investment program for consumers—demand-side management—in the residential sector. Capital requirements for the supply- and demand-side activities are currently 778 million Kč and 230 million Kč, respectively.

- Mid-Term - Install a new co-generation unit (75 MW thermal and 32 MW electrical capacity) on the grounds of the central plant to increase heat production and implement most of the demand-side management program. The demand-side program will acquire the equivalent of 21 MW thermal generating capacity by the year 2000. Capital requirements for the supply- and demand-side acquisition efforts are 1.184 billion Kč and 220 million Kč, respectively.

Anticipated long-term activities include installation of additional heating generation capacity, which will replace old units, and installation of efficiency measures to capture the rest of the efficiency potential.

The Central plant with its heat transmission lines (Plzeň Heating Co.) is in the process of being privatized. After the second wave of the coupon privatization process, the City will own 80.5% of this company's shares; the remainder will be sold to the public and restitution funds. The property of TEZA that is currently owned by the state —satellite heating plants and transmission lines—will be transferred to City ownership as of October 19, 1994. The property transfer would have Plzeň Heating Co. own the heating plants and the City (as successor to TEZA) all the district heating system transmission lines. The City is considering renting the Plzeň Heating Co. heat transmission lines and consolidating management of the entire heating supply system under a single company in order to eliminate duplication of administrative functions and to improve the operational efficiency of the system.

Preliminary projections indicate that in the scenarios considered the cost of supplied heat in Kč/GJ and, thus, of total annual residential heating will remain reasonable. Although the implementation of efficiency measures will increase the per unit price of heat by 9%, the typical annual household heating bill will decrease by 7-8%. These estimates are based on conservative assumptions, so appropriately implemented demand-side savings measures will apparently make it possible to achieve even more favorable economic results. Analysis showed that, in addition to reducing the economic burden on consumers, demand-side investment is expected to be the least-cost method for adding new capacity to the system. Energy efficiency programs also positively affect the environment by reducing emissions.

An effort was also made to document past cash flow to verify the validity of expected future cash flow. This task was difficult because in the past, the co-generation plant was operated under West Bohemian Energy Enterprises (formerly the Czech Energy Company [ČEZ], now West Bohemian Energy, a.s.) and the co-generation plant's accounting system was not set up to be separate from the rest of the enterprise.

This document is intended to provide potential lenders or investors with fundamental information for deciding whether they are interested in exploring this investment opportunity further. The City of Plzeň is also receptive to suggestions and recommendations for changing the organizational structure, as well as the financial terms and conditions for financing the investment program.

This work was funded by the U. S. Agency for International Development (US AID) under a cooperative agreement with the U. S. Department of Energy (US DOE). This part of the project was

managed by Pacific Northwest National Laboratory[a] with significant support by Tecogen; SEVEn, The Energy Efficiency Center; and SEVEn's Czech subcontractors. Employees of the City of Plzeň, Plzeň Holding, and the district heating system enterprises also contributed a great deal to this report. Upgrading the district heating system is a very high priority for the City, and the Mayor and his staff have been very helpful and given effective support.

(a) Pacific Northwest National Laboratory is operated for the U.S. Department of Energy by Battelle under Contract DE-AC06-76RLO 1830.

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1.0 Introduction

As part of the Czech Republic's transformation to a market economy, the City of Plzeň is faced with two major tasks related to the city's district heating system. The first task is to upgrade the heat generation resources that are near the end of their lives and to comply with environmental regulations. The second task is to manage the transfer of the existing district heating systems assets to a city and/or privately owned management structure. An overriding objective is to operate the district heating system in the most cost-effective manner to minimize the impact of the required capital investment and the elimination of heat price subsidies on consumers.

In support of this process, US AID funded assessments of the demand and supply sides for the City to examine options for upgrading the Plzeň district heating system. The results of these assessments are contained in the following reports:

An Evaluation of the Supply-Side Options for the Plzeň District Heating System (Gilbert/Commonwealth)

Assessment of the Buildings Sector Efficiency Resource for the City of Plzeň, Czech Republic (Pacific Northwest National Laboratory)

Efficiency and Supply Resource Options for the Upgrade of the Plzeň District Heating System (Pacific Northwest National Laboratory)

Heat Supply in Plzeň: Final Report (SEVEn, Pacific Northwest National Laboratory)

These reports assessed and compared life extension of the current coal-fired generating units, upgrade and early replacement with a coal-fired generating configuration, two upgrade scenarios for the gas-fired units, and energy efficiency in buildings. Based on these assessments, the option desired by the City is life extension to the existing equipment, with environmental compliance upgrades to current co-generation units, conversion to low-sulfur fuels, and the use of baghouse technologies for particulate removal in the heating plants. The City is also considering implementing a program to increase end-use efficiency, which would alleviate the current narrow capacity margins and defer the need for capacity additions.

To implement the necessary upgrades to and investment in the district heating system, the City of Plzeň needs to obtain financing for investment and operating capital, in the form of loans, municipal bonds, or a combination of both.

This business plan provides potential lenders or investors with basic information that allows them to decide whether they would like to learn more about this project. The City of Plzeň is open to suggestions, recommendations, and offers of financing terms and conditions, as well as to recommendations for upgrading the district heating system.

2.0 Description of the Current System

The existing district heating system serving the City consists of four segments (see Figure 1). The system provides steam for industrial customers and hot water for households and commercial customers.

The **Central System** consists of the Plzeň co-generation plant; the Košutka hot water peaking plant; the Bory heating plants, which provide steam for an industrial load and hot water; and the contractual cooperation of steam boilers from the brewery and the Railway (ŽOS) maintenance facilities. The total capacity for hot water is 245 MW and for steam 99 MW.

The primary customers served by the Central System are the residential areas of Košutka/Lochotín to the North of the City, the Bory area in the South, the City center, the train station and associated maintenance facilities, the brewery, and the Bory technological steam consumers (hospital and others) which use steam.

The Central and Košutka/Lochotín regions consume heat from the central co-generation plant. The Košutka heating plant serves as a supplement and peaking source. Conversion from fuel oil to natural gas is being considered for the Košutka heating plant. Formerly the Plzeň co-generation and Košutka

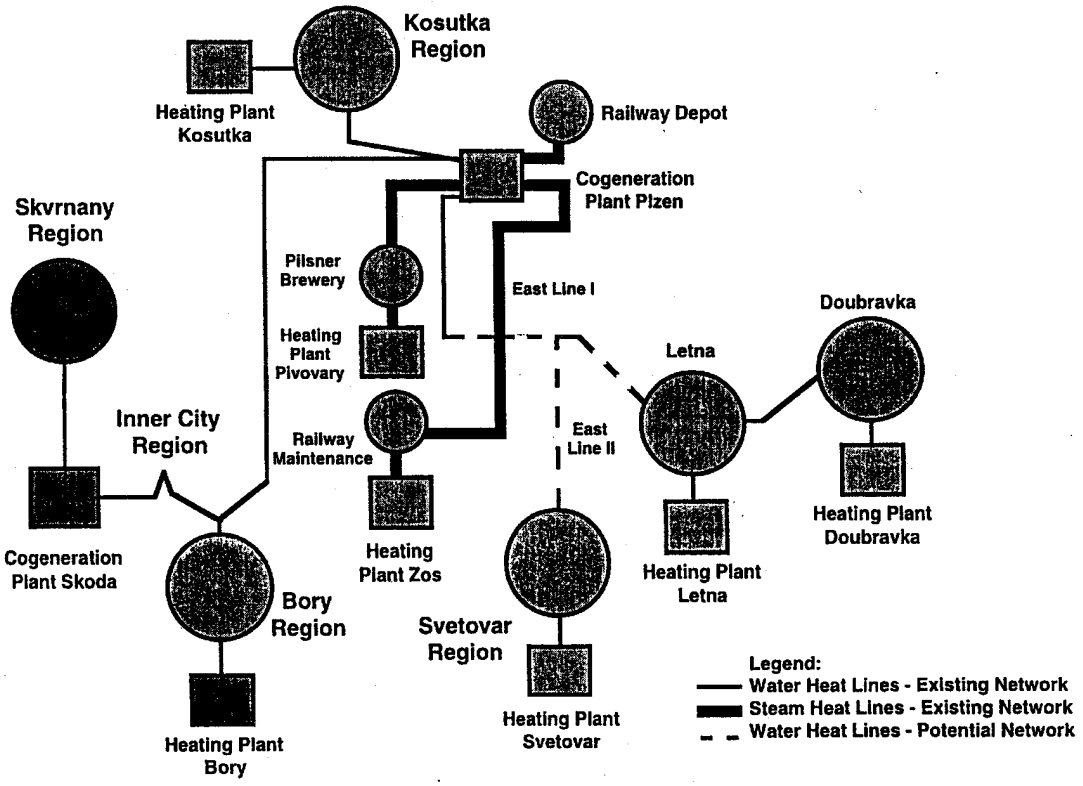


Figure 1. The Existing District Heating System in Plzeň

plants were owned by ZČE (West Bohemia Electric Utility) and, after the second round of coupon privatization, will transfer to majority ownership of the City (over 80%). In its co-generation portion, the central co-generation plant has two steam boilers with a capacity of 110 MW and a back-pressure turbine with an electrical output of 55 MW_e. In its heating portion, the total capacity of the three hot-water boilers is 105 MW_t. The Košutka peaking plant has an installed capacity of 35 MW_t.

The Bory region to the South consumes heat from the Bory heating plant and the Plzeň central co-generation plant. Partial modifications of the network will be necessary for greater cooperation between these two plants (providing peaking and sharing supplemental capacity). The Bory heating plant, which is owned and operated by the state enterprise TEZA, will be transferred to city ownership in the near future. The Bory heating plant has a hot water generating capacity of 23 MW_t and a steam generating capacity of 31 MW_t, including a supplemental steam boiler with a capacity of 9.8 MW_t.

Steam customers in the Bory area (hospitals, transfusion stations) get their steam from the Bory heating plant. Steam needs for the train station are met by the co-generation plant of the Plzeň Heating Co. Steam for the train maintenance facilities is provided by ŽOS' own heating plant and, in the winter months, is supplemented by the Plzeň co-generation plant. Steam needs for the brewery are met by the brewery's own gas-fired heating plant in the summer months and by the Plzeň co-generation plant in the winter months.

The **Letná/Doubravka segment** of the system is supplied by two interconnected heating plants that consist of eight grate coal-fired hot-water boilers and one light-oil-fired peaking and supplemental boiler. The units are owned and operated by TEZA. The heating plants have a total hot water generating capacity of 46 MW and a reserve capacity of 9.8 MW; they are located in the Letná and Doubravka areas. TEZA also owns and operates the associated heat transmission and distribution lines. Construction of the East I transmission line to connect the central co-generation plant to the Letná/Doubravka areas is under way and should be finished by 1997.

The **Světovar segment** of the system is supplied by a local heating plant, which consists of four grate brown-coal-fired boilers. The plant, including transmission and distribution lines, is owned and operated by TEZA and has a generating capacity of 23 MW. In the winter months, it supplies hot water for heating in the Světovar area. The Světovar heating plant has been upgraded so that it meets environmental requirements and can continue functioning as an independent plant. Proposals have been made to connect the Světovar region to the central co-generation plant by an East Line II, but the analyses do not show the cost-effectiveness of such a connection and so have not been developed further.

The **Škoda/Skvrňany segment** of the system is supplied by the Škoda co-generation plant, which has three coal-fired boilers and two oil-fired steam boilers. This co-generation plant is owned and operated by Škoda Plzeň, a.s. With a total capacity of 245 MW, it provides steam, hot water, and electricity for the factory's needs and hot water for the residential Skvrňany area. Škoda industries owns and operates the co-generation plant and transmission and distribution lines on its grounds. Plzeň Heating Co. owns and operates the transmission line to the Skvrňany area, which, together with the connection to the central co-generation plant, is not currently used. The distribution lines and exchanger stations are owned and operated by TEZA.

This business plan includes the Central system, Bory heating plants, Letná/Doubravka, and Světovar segments. It is assumed that the Škoda plant will provide heat to customers in the Skvrňany area at a price consistent with that charged customers in other parts of the system.

2.1 Energy Consumption Profile

This section describes the consumption of thermal energy in the city of Plzeň. Table 1 provides total primary fuel consumption in Plzeň for all technologies and types of heat production calculated in 1989. On-site consumption refers to the conversion of fuel to heat or hot water in individual dwellings, be it a single or multi-family dwelling. Distributed boiler consumption refers to the approximately 590 small industrial and distributed boilers, each serving a single building or a group of buildings. DHS consumption refers to all sources serving the district heating system.

This table and Figure 2 show that approximately 70% of the city's primary energy is consumed in the DHS system and that 80% of the energy comes from solid fuels, primarily coal.

End uses for the total consumption of 20.9 million GJ of primary energy are shown in Table 2.

Table 1. Total Primary Fuel Consumption in Plzeň in 1989 (GJ)

Place of Consumption	Solid Fuels	Liquid Fuels	Gaseous Fuels	Total	
				(GJ)	(%)
On-site	857,212	0	1,157,834	2,015,046	10
Distributed Boilers	1,450,050	585,247	2,323,767	4,359,064	21
DHS Sources	14,341,440	149,645	0	14,491,085	69
Total (GJ)	16,648,702	734,892	3,481,601	20,865,195	100
(%)	80	3	17	100	

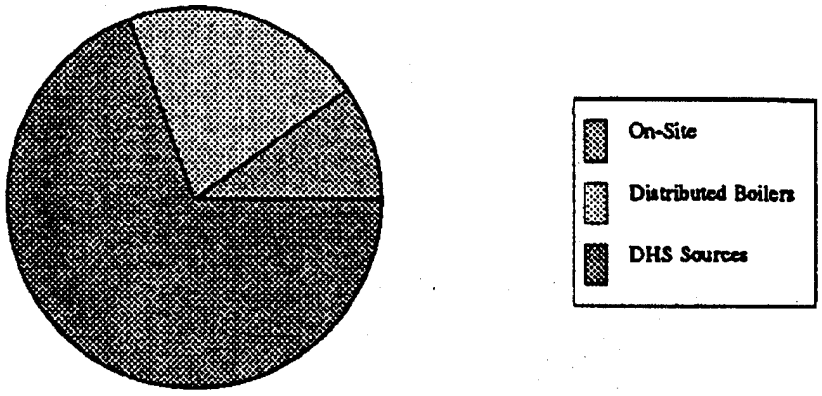


Figure 2. Heat Sources in Plzeň

Table 2. Primary Heat Consumption by Purpose in 1989 (thousand GJ)

Purpose	Consumption (GJ)
Total Heat & Hot Water for Heating and Household Water	**7,854**
Residential	3,047
Non-Residential	1,769
Industrial	3,038
Process Heat Total	**4,248**
Industrial	4,041
Other	207
Electricity Production	**675**
Electricity Consumption for Heating and Household Water	**-106**
Total Losses and Cooking	**8,194**
DHS Sources and Primary Distribution	6,417
Secondary Distribution, Other, and Cooking	1,777
Total	**20,865**

Of the total energy used to provide heat, about 38% provides space and water heating, 20% is used for process heat, 38% is lost in conversion and transmission/distribution losses, and about 3% is for electricity generation.

Losses in the production and transmission of district heat amount to 44% of heat from the fuel used in DHS sources. Conversion losses for on-site consumption and distributed boilers amount to 25% of their combined energy consumption.

Energy consumption for heating and hot water use by fuel type and heating equipment type is shown in Table 3. Nearly 40% of heat and hot water is used in the residential sector, over 20% in non-residential buildings, and almost 40% in the industrial sector. The district heating system is the major energy source for heat and hot water at 64% of the total, followed by distributed boilers at 18%, and on-site boilers at nearly 17%.

The district heating system provides 55% of the heat in residential buildings for space heating and hot water (see Figure 3). High-rise pre-fabricated panel apartment buildings account for 56% of residential sector heat consumption for space and hot water and 97% of the residential sector district heat consumption. Within the non-residential building sector, education, office and service buildings account for 65% of total heat consumption in this sector and 70% of the non-residential sector district heat consumption.

Table 3. Energy Consumption in 1989 for Space and Hot Water Heating by Fuel Type, Heating Equipment Type and Sector (GJ)

	On-Site		Distributed Boilers						
	Solid Fuels	Gas Fuels	Solid Fuels	Liquid Fuels	Gas Fuels	DHS	Electr. Energy	Total	
Group	(GJ)	(GJ)	(GJ)	(GJ)	(GJ)	(GJ)	(GJ)	(GJ)	(%)
Res.	318,169	633,912	233,275	0	108,690	1,673,465	79,884	3,047,395	39
Nonres.	92,987	184,831	238,944	2,653	236,679	994,823	17,739	1,768,655	23
Industry	46,493	25,538	176,989	129,475	290,239	2,359,975	8,870	3,037,579	39
Total	457,649	844,281	649,208	132,128	635,608	5,028,263	106,493	7,853,629	100
%	6%	11%	8%	2%	8%	64%	1%	100%	*

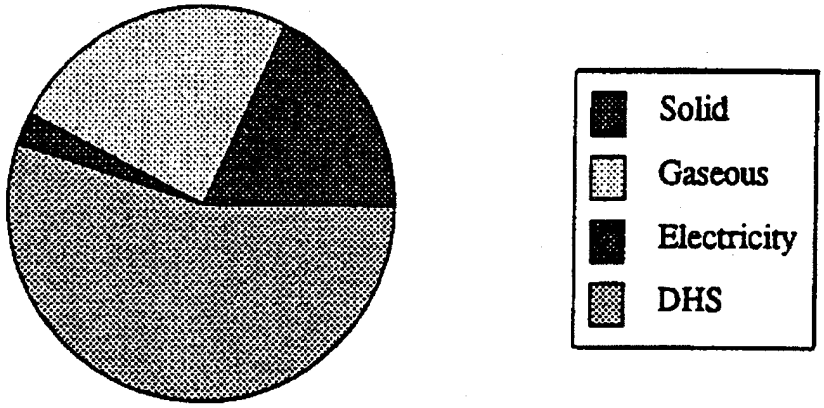


Figure 3. Structure of Fuel Use for Heating and Hot Water in Residential Sector

The five largest energy-consuming industrial sectors in Plzeň are machine tools and steel (Škoda); food processing (the Plzeň Brewery); the paper industry; construction materials (pre-fabricated blocks); and agriculture. Industrial heat and hot water needs are met almost entirely by the district heating system at 80% of total heating needs. This includes heat production in the Škoda plant and the brewery.

2.2 Fuel Base

Brown coal is the primary fuel used in DHS boilers and has the following characteristics:

	Central Co-Generation Plant	TEZA
Heat Value	12.6 MJ/kg	13.2 MJ/kg
Sulfur Content	0.88%	0.64%
Ash Content	14.9%	13. %
Moisture Content	35.8%	38.2%

Natural gas is supplied by the monopoly distribution company West Bohemian Gas Company, a.s.. Plzeň is gradually completing its conversion from town gas (a gas made from North Bohemian brown coal, a harmful process for the environment) to natural gas for all individual consumers.

2.3 System Load Forecast

On the basis of potential load growth analysis, two load growth scenarios were developed and further divided into an efficiency and non-efficiency version, resulting in four scenarios. The trends in the necessary thermal peak capacity for each of the growth scenarios to the year 2010 are shown in Table 4.

The scenarios differ in new customer expansion because this factor depends on the rate of new construction and the number of buildings served by distributed boilers that are connected to DHS. A potential 250 MW of load exists in the form of customers served by distributed boilers that can be connected to the district heating system.

Table 4. Load Forecast

Hot Water Load Scenarios	1993	2010	Annual Compound Growth Rate
High Growth Without Efficiency	280 MW	320 MW	0.8%
High Growth With Efficiency	280 MW	286 MW	0.1%
Low Growth Without Efficiency	280 MW	278 MW	0%
Low Growth With Efficiency	280 MW	254 MW	-0.6%
Steam Load Scenarios			
High Growth	92 MW	100 MW	0.5%
Low Growth	92 MW	89 MW	-0.2%

Owners of distributed boilers, however, must comply with the requirements established by the law on air pollution, No. 309/91 as amended by No. 218/1992. Their options are converting to a cleaner fuel (low-sulfur coal along with particulate removal), converting to natural gas, or connecting to the district heating system. Although it apparently will not be cost-effective to connect the entire potential of distributed boilers to the DHS, it is possible to consider this connection as a possible option in the further development of the system.

The scenarios without efficiency reflect the expected effects of Czech legislation that requires the installation of heat metering and control equipment. This step will improve the efficiency of heat production and distribution by the producers because metering at the base of buildings will motivate them to raise efficiency throughout the production process. The City was also informed that this measure prescribed by law will reduce energy consumption, but will not reduce demand for heat to any considerable extent. To reduce demand for heat, it is necessary to implement demand-side efficiency measures as well. The scenarios with efficiency measures reflect the benefits of additional cost-effective residential sector efficiency measures such as weatherization, heat recovery, and building insulation.

3.0 Proposed System Upgrade

3.1 Supply-Side Measures

By 1997 the City of Plzeň expects to complete the East Line I connection to connect the Letná/ Doubravka area to the central co-generation plant, at an expected cost of 75 million Kč. The project will include the installation of individual circulation pumps for servicing the Košutka/Lochotín area in the North and the City center and Bory area in the South, increasing the reliability of heat supply to these areas. The Světovár area will continue to operate as an independent system. The costs for this project will be covered by existing funding.

Near-term activities, 1994-1997, will include upgrades to extend the life of existing sources of the co-generation plant and TEZA heating plants and to limit their emissions to comply with legal emissions limits as of 1998. Beyond the year 2000, it is anticipated that a new coal-fired co-generation unit will be added to the system and that some of the older, coal-fired units will be retired. Measures for meeting emissions limits will consist of the following.

The co-generation unit of the central co-generation plant will undergo desulfurization by the wet limestone method. This method is proven and allows the co-generation plant to continue operating while construction is going on, so that the risk of blocking energy supply during construction is greatly reduced. Maximum investment costs for this technology are 450 million Kč.

To reduce ash emissions, baghouses will be installed on the hot water portion of the co-generation plant and all coal sources of TEZA in place of today's cyclone ash elimination system. In order to meet sulfur emissions limits in this capacity category, it is sufficient to transfer to cleaner, low-sulfur fuels. Investment costs for installing baghouses on the co-generation plant are approximately 10 million Kč per boiler (for a total of 30 million Kč).

Investment costs for TEZA's hot water and smaller steam boilers (16 boilers) will be approximately 2 million Kč per boiler, including boiler repairs and maintenance. Investment for upgrading the larger steam boiler at the Bory heating plant is assumed to be 3.5 million to 4 million Kč. The total amount necessary, therefore, to bring TEZA up to environmental standards is around 36 million Kč.

System improvements planned beyond the year 2000 will include upgrades and replacement of the distribution lines, possible retirement of the Letná or Doubravka heating plants, and construction of additional supply (co-generational) capacity to the central co-generation plant.

The total capital required for the upgrades and environmental improvements of the district heating system is estimated at 2.157 billion Kč. Operating parameters are estimated in Table 5.

Table 5. Operation Profile

Operating Parameters	Units	1994-96	1997-2003	2004-2010
Electricity Production	MWh/year	161,803	179,272	179,272
System Electricity Consumption	MWh/year	41,324	43,562	43,562
Energy Delivered				
Hot Water and Steam	GJ/year	3,282	3,815	3,756
Electricity	MWh/year	129,893	143,788	237,148
Resource Consumption				
Brown Coal	Tons/year	434,671	370,910	370,910
Black Coal	Tons/year	24,973	44,874	44,874
Natural Gas	10^6m^3/year	0	0	0
Oil	Tons/year	1,243	743	743
Limestone and Limestone Hydrate	Tons/year	0	7,954	7,954
Ash Disposal	10^3Kč/year	5,667	6,183	6,183

3.2 Demand-Side Measures (Efficiency Investments)

An energy efficiency investment program on the part of the consumer is the desired least-cost solution for increasing the current system capacity margin and deferring the construction of new, more costly supply capacity. A thorough analysis was made of measures to reduce heat consumption for space and hot water heating. These measures reduce the peak load of the system as well as the energy costs for heat customers. The considered potential will allow at least a 15% reduction in system load, which amounts to 425 GJ/year when fully implemented. In the residential sector, the savings potential in high-rise pre-fabricated panel buildings represents over 70% of the entire savings potential in the residential sector. In the non-production sector (education, services, and public sector) the greatest savings potential—about 65% of the sector's whole potential—lies in educational, office, and service buildings.

The efficiency acquisition program consists of installing combinations of the following measures in the City's residential and non-residential buildings serviced by the district heating system:

- insulate building exterior side walls
- weatherstrip elevator penthouse, stairway, doors and windows
- weatherstrip windows and doors

- install revolving or double door in vestibule
- install storm windows
- install zone valves on each radiator and installing central thermostats with "on time counter" in each apartment
- install heat recovery vent system in basements
- install heat reflectors behind each radiator or heater
- remove draperies from radiator
- install low-flow shower heads
- install flow restrictors on faucets
- insulate hot water pipes in unconditioned spaces
- install hot water flow meters
- install waste water heat recovery heat exchanger.

Full implementation of the effective measures is expected to take 8 to 10 years. The total investment required to acquire the efficiency resources on the part of the energy end-user in buildings is estimated to be 450 million Kč.

The cost-effective savings potential in the industrial sector is reported to be 15% to 20% of base consumption. This number is based upon the findings of other studies and discussions with facility managers. Total costs for acquiring this resource were not available.

The efficiency resource is depicted in a supply curve format as shown in Figure 4. As can be seen, virtually all of the efficiency resource is available even at the current subsidized price.

3.3 Investment Requirements and Schedules

A preliminary estimate of necessary investment requirements by time period is shown in Table 6.

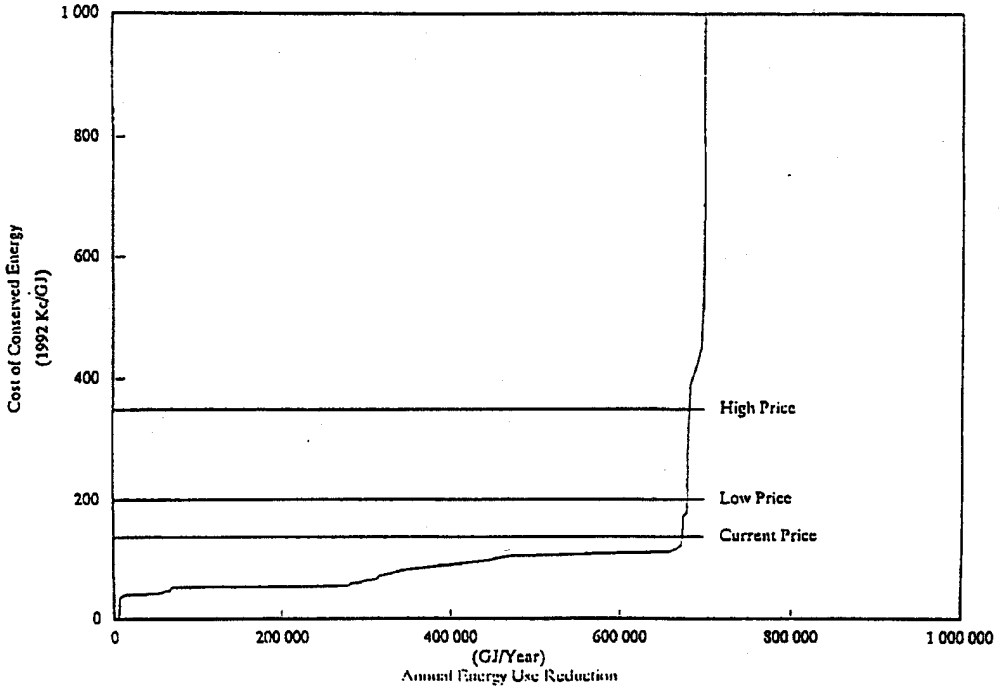


Figure 4. Plzeň Energy Efficiency Supply Curve

Table 6. Investment Requirements and Schedules (millions of Kč)

Investment	1994-1997	1998-2003	2003-2010	Total
Life Extension and Environmental Upgrades	521.6	0	98.5	620.1
New Central Plant	0	1,159.5	91.5	1,251
Heat Distribution and System Upgrades	255.9	24.3	5.3	285.5
Demand-Side Investments	230	220	0	450
Total	1,007.5	1,403.8	195.3	2,606.6

4.0 Organization and Management

4.1 Ownership

The National Property Fund will transfer ownership of today's state-owned enterprise Plzeň Heating Supply Co. (TEZA) to the direct ownership of the City as of October 19, 1994. The property of this company includes the heating plants of Bory, Letná, Doubravka, and Světovar, as well as their transmission lines, steam distribution lines in the Bory area, the central dispatch building, and most of the heat distribution lines for the district heating system.

Plzeň Heating Co. was established by separating the Plzeň-based district heating assets from the state-owned enterprise West Bohemian Energy Works. It owns the central co-generation plant, the Košutka peaking plant, the transmission lines connected to these plants, and the hot water transmission lines from Škoda Plzeň to the Skvrňany area. The second wave of coupon privatization will divide its stocks in the following manner: 80.5% of the shares will go to the City of Plzeň; 5% will go for restitution; and the remaining 14.5% will be divided between privatization funds and stock purchased by the public in the privatization process. The City of Plzeň formed a joint-stock company called Plzeň Holding a.s. to manage its shares. The City is the sole owner of Plzeň Holding a.s.

The Board of Directors and officials of Plzeň Heating Co. are elected by their stockholders at an annual general assembly. Given that the City owns the majority of shares, the election of the officials and Board of Directors is more or less dependent on its focus. Today's Board of Directors and officials include representatives of Plzeň Holding, the City administrative departments, and both district heating system companies.

4.2 Business Relations

Plzeň Heating Co. owns and operates the central co-generation plant, the Košutka peaking/ supplemental heating plant, and the hot water transmission lines to the Košutka and Skvrňany areas. Most heat from hot water is carried by transmission mains to exchanger stations, where the heat is sold to TEZA. TEZA then distributes the heat to its customers—enterprises or apartment cooperatives—through its own distribution lines. Steam is sold directly to end-users by both Plzeň Heating Co. and TEZA from the Bory Heating Plant. Heat for the Skvrňany area produced in the Škoda Plzeň factory is sold through the Plzeň Heating Co. to TEZA, who then supplies it to end-users.

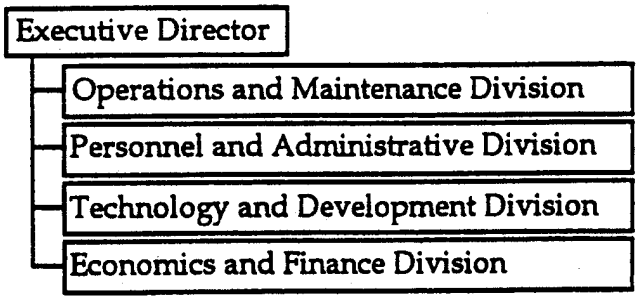
On the basis of a Plzeň City Council resolution, a property exchange is being prepared between Plzeň Heating Co. and the City (TEZA) that would place the heat plants under the ownership of Plzeň Heating Co. and all heat distribution lines under the ownership of the City. Negotiations on property balancing are also under way with Škoda Plzeň, who owns part of the Southern Heat Connection Line.

4.3 Current Management Structure

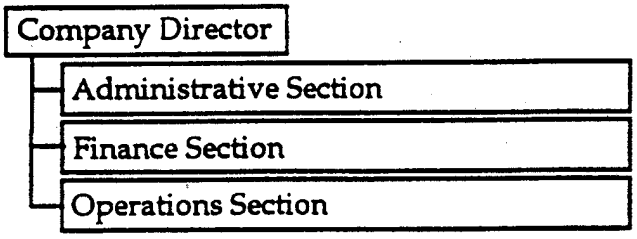
Currently the system is operated by two organizations who buy and sell heat to each other on a contractual basis. TEZA's central dispatch building is connected to the central co-generation plant, so operational cooperation is possible. According to a decision of the City Council, the City-owned heat distribution lines is expected to be rented to Plzeň Heating Co. This setup will allow the entire system

to be operated by one organization, further increasing effectiveness, especially thanks to better options for optimizing the operation of the entire district heating system.

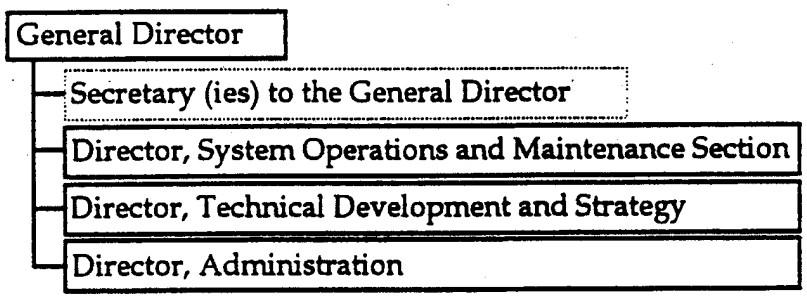
The current Plzeň Heating Co. Organization is as follows:



The current TEZA organization is as follows:



The organizational structure of the operating company was based on modification of Plzeň Heating Co.'s current organizational structure. The proposed optimal organizational structure is as follows:



4.4 External Relations

4.4.1 Coal, Gas, Water, and Ash Disposal Suppliers

Fuel for the central co-generation plant and satellite heating plants is purchased from brown-coal mines in northwestern Bohemia. The demonopolization of this industry has spurred good competition between mines, increasing the quality of the supplied coal while maintaining reasonable prices.

In contrast to the past when the sulfur content of fuels fluctuated a great deal, current brown-coal supplies for the Plzeň district heating system plants have a sulfur content guaranteed to comply with

prescribed emissions limits for burning coal in individual heating plants. Given the declining use of brown coal in the Czech Republic and the competitive position of individual mining companies, the price of brown coal is not expected to rise.

To convert the Košutka peaking and supplemental heating plant to gas, it is possible to contract for natural gas from the West Bohemian Gas distribution company.

Waste ash from the central co-generation plant is transported to the current ash dump in Plzeň-Božkov in liquid form through mains that are placed partially underground in areas where they would otherwise lie exposed. Plans to expand this dump include raising its sides, and dry ash transport by car is being considered. Ash from the rest of the TEZA heating plants is transported to the dump by car.

4.4.2 Labor Market

A city with a long tradition in the machine-tool industry, Plzeň has a sufficient number of qualified technical experts in the field of heat management. In addition to Plzeň Heating Co. and TEZA, Plzeň has several other industrial heating plants with experienced technicians in the field of heating and co-generation. The Škoda Factory plant, the largest of these plants, supplies heat to the Škoda Factory itself as well as to the adjacent suburb. Its co-generation unit is comparable in size to the central co-generation plant of Plzeň Heating Co.

4.4.3 District Heating Customers

Industrial enterprises are among the largest heat customers connected to the district heating system in Plzeň. These enterprises often meet at least part of their heat needs by production in their own heating plants. The largest single heat consumer in the City—Škoda Plzeň—meets all of its heating needs by its own heat production in a co-generation unit. It does not take any heat from the district heating system; in fact, it supplies heat to the Skvrňany suburb.

In the residential sector, approximately 40% of apartments are still owned by the City (formerly by the state). The remainder of apartments are owned either privately or by cooperatives. It is expected that of these roughly 24,000 municipal apartments, about 2/3 will be sold to private ownership. The City is expected to maintain ownership of only about 8,000 apartments.

New legislation (Regulation No. 186/1991 on heat management) requires that heat consumption from the district heating network be metered at the entry point to each building connected to the district heating system. Until cost-allocation meters are installed on the radiators in individual apartments, heating bills are paid according to the area of heated space in the apartment. After installation of cost-allocation meters (mandatory from September 1995), heating bills will be determined by a pre-set combination of heated area and a consumption reading from the cost-allocation meter. Under this regulation, hot water consumption must be individually metered in each apartment from September 1994. For heat supplied from the district heating system for heating space and hot water, the building owner or manager pays the bill to the district heating system companies. The owner or manager then divides the total energy bill among the individual building tenants.

Currently the Ministry of Finance sets a maximum price that can be billed for heat from the district heating system. Building owners/managers who divide the heat bill among their tenants can request a subsidy from the state budget to cover the difference between the lower capped heat price that can be

charged to end-users and the higher cost-based heat price they must pay to the heat supply companies. These subsidies for heat from the district heating system will be gradually limited according to a government decree, but currently there is no definitive future planned for these subsidies.

4.4.4 Central Co-generation Plant Electricity Sales

The distribution company West Bohemian Energy, a.s., was formerly operated the central co-generation plant. Now, it purchases electricity from this plant for the public electricity network at a price negotiated on a contractual basis. In the future, it should be possible to sell all electricity produced in the central co-generation plant to the public electricity network at a price based on the electricity sale prices of other electricity producers.

Plzeň Heating Co. submitted an application to the Ministry of Industry and Trade for authorization to sell electricity directly to end-users. This authorization would allow Plzeň Heating Co. to supply electricity to large industrial customers (e.g., Plzeň brewery) directly and at better terms than the current sales agreement with the West Bohemian Energy distribution company.

5.0 Regulatory, Legislative and Tax Considerations

5.1 Accounting Regulations, Price Regulation, and Subsidies

The price of heat supplied from the sources of central heating is regulated by the government of the Czech Republic under Law No. 526/1990 on prices. The price of heat is cost-based, which means that the ministry issues a binding regulation on how to calculate the price (Czech Republic Ministry of Finance [ČR MF] Ruling No. 015/93 of October 21, 1993).

For heat supply to the public, the maximum price set according to ČR MF Ruling No. 01/94 of November 17, 1993 is 139 Kč/GJ at the entry point into the heated facility. The difference between the cost-based price and the capped price of heat for the public can be subsidized from the state budget. Owners of heated facilities can obtain subsidies by applying according to the form given in Measure No. 3 of the Ministry of Finance of the Czech Republic of November 10, 1993 (also applies to owners of family homes connected to the district heating system). Apartments that are permanently uninhabited are not eligible for subsidies.

The capped price increases each year; however, it is expected that within several years it will be eliminated entirely (provided metering and controls are gradually installed in the residential sector according to the deadline set in Regulation No. 186/1991 on managing heat in the district heating system). Cost-based heat prices are expected to continue, and they may reflect only costs and commensurate profit as established by the government. Costs that can be included in the price of heat are listed in ČR MF Ruling No. 01/94 of November 17, 1993.

5.2 Environmental Protection

After 1989, Czech legislative bodies passed new laws meant to minimize damage to the environment. Among those laws that most closely relate to supplying heat in Plzeň are the law on atmospheric protection (No. 309/1991 amended according to Law 218/1992), and the law on waste (238/1991). These laws prescribe a responsibility to reduce the level of harmful emissions into the atmosphere and to uphold stricter conditions for waste disposal.

The construction of new units will fall under Law No. 244/92 on environmental impact assessment (EIA).

5.3 Taxes

Companies pay income tax according to Law No. 586/1992 on income tax as amended by later legislation (No. 35/1993, 96/1993, 157/1993, 323/1993), and theses taxes are revenue for the state budget. The companies pay no local or regional taxes. The company operating the Plzeň district heating grid is responsible for paying taxes just as any other legal entity in the Czech Republic. This involves primarily value-added tax, which for heat supply amounts to 5%, and income tax.

The income tax rate for legal entities is 42% of base income minus deductions. Examples of deductions are costs for operating environmental protection equipment (§24.g), rent (§24.h), or 10% of the

purchase price of certain new tangible assets (§34). With the expected development of the economy, it can be expected that this rate will go down by several percent in the next 4 to 5 years.

Law No. 331/1993 on the state budget for 1994[a] established that if a city is an income taxpayer, it pays this tax into its own budget and not into the state budget. This condition would allow the City, if it were the taxpayer for operating the district heating system network, to pay this income tax into its own budget. Reinvesting this money in the district heating system network would have a positive effect on the network's overall economic profile. This measure, however, is listed in the law on the state budget for 1994, but it is not certain that subsequent state budget laws will include it or if it will be transferred to a different, more stable legal form.

Calculations in Chapter 7 of the business plan are made on the assumption that income tax will be paid into the state budget and thus will not be reinvested in the district heating system network.

There are also smaller tax reliefs for municipal companies (exempt from property tax, inheritance tax, gift tax, and property transfer tax). Income from operating energy plants using renewable energy sources is tax free for 5 years after the initiation of operation.

Companies also pay part of the social and health tax for their employees, at a rate of 36% of the gross salary.

(a) Article 3, Paragraph 2: In 1994 the city budget will also receive as a revenue the income tax of legal entities who are taxpayers according to Article 17 of the Czech National Council Law No. 586/1992 on income tax, as amended by later regulations. This law applies if this entity is a municipality, with the exception of taxes applied at a special rate according to Article 36 of the same law and with the exception of pre-paid payroll tax according to Article 6 of the same law.

6.0 Major Steps of the Business Plan

The goal of this business plan is to acquire the necessary capital investment to meet near-term activity needs (up to 1997). These activities include upgrading some equipment, bringing all system boilers up to environmental standards, and constructing the hot water connection line East I. Investment activities also include initiating programs implementing demand-side efficiency measures. It is assumed that financial cooperation will also bring capital resources for continuing efficiency programs during the period 1998-2003. Another expected important investment activity is the construction of a new unit around the year 2000, although this does not have to be part of this financial cooperation.

6.1 Financing and Organization

In the near term, it is necessary to take steps in the areas of financing and organization to construct a heat connection and to upgrade boilers and some other equipment. Steps in the area of financing and organization include the following:

- Select and make initial contact with banks and private investors to gauge their interest in the project.
- Initiate discussions with potential investors who expressed interest in the project. Delineate acceptable organizational structures and financing methods.
- Select and develop the optimal organizational and financing alternative.
- Carry out the agreed changes in the organization and financing method. Possible methods of financing are
  - municipal bonds
  - debt financing by a bank
  - debt financing by a private investor
  - a combination of the above options.
- Negotiate optimal contracts for fuel purchase and electricity sales.

6.2 Investments

In the area of investments, the following steps are assumed:

- Complete project preparation for technical and environmental upgrades as well as the construction of the East I connection line.
- Solicit and evaluate bids for construction of the required equipment.
- Initiate, monitor, check and complete construction.
- Establish criteria for energy efficiency program bid solicitation.

- Solicit and evaluate bids for efficiency programs and sign agreements with contractors.
- Initiate and monitor energy efficiency programs.

7.0 Financial Analysis

Today's district heating system network is composed of two enterprises: Plzeň Heating Co. and the state enterprise, Plzeň Heating Supply Co. (TEZA). Plzeň Heating Co. was established on January 1, 1994, by separating from West Bohemian Energy Works (today West Bohemian Energy, a.s., a joint-stock company) during the privatization process. In West Bohemian Energy Works accounting, the co-generation plant was treated as one part of the whole, together with other activities of the distribution company. For this reason, it is very difficult to reconstruct the past flow of costs and revenues for operating the co-generation plant alone. Past bookkeeping data are thus somewhat incomplete (for example, electricity sales are missing). There was no similar separation in TEZA, so it was possible to use past bookkeeping data for this company directly.

7.1 Bookkeeping Results for 1993

7.1.1 The State Enterprise Plzeň Heating Supply Co. (TEZA)

Tables 7 and 8 show the primary economic data for 1993, taken from the results and balance sheet for TEZA.

Table 7. TEZA Balance Sheet as of December 31, 1993 (in thousands of Kč)

Assets		**Equity and Liabilities**	
Intangible Investment Property	0	Net Worth	330,290
Tangible Investment Property	325,371	Capital Reserves	1,694
Financial Fixed Assets	0	Reserves from Profit	7,750
Total Fixed Assets	**325,371**	Operational Bookkeeping Balance	11,065
		Total Equity	**350,728**
Stocks	32,286	Other Reserves	0
Long-Term Receivables	0	Long-Term Liabilities	0
Short-Term Receivables	-878	Short-Term Liabilities	13,325
Financial Property	20,590	Bank Loans	15,063
Total Current Assets	**51,998**	**Total Other Sources**	**28,855**
Other Assets	2,214	Other Liabilities	467
Total Assets	**379,583**	**Total Equity and Liabilities**	**379,583**

Table 8. Results for TEZA for 1993 (in thousands of Kč)

Total Earnings	347,256
Earnings from Commodity Sales (purchased heat)	187,998
Production	159,267
Costs for Sold Commodity (heat purchase)	158,980
Production Consumption	132,004
Share of Materials and Energy	90,901
Personal Costs	21,471
Taxes	1,005
Writeoffs	22,439
Operational Bookkeeping Balance	11,551

7.1.2 Plzeň Heating Company

Table 9 shows the actual economic indicators in Plzeň Heating Co.'s bookkeeping for 1993. Plzeň Heating Co. was still part of West Bohemian Energy Works.

Table 9. Results for Plzeň Heating Co. (in thousands of Kč)

Services, Including Internal			**1,042,893**
Inderdepartmental Transfers		113,174	
Internal Operations		584,967	
Earnings and Total Profit		344,752	
Costs, Including Internal			**1,023,924**
Total Internal Costs		656,664	
Share of Co-generation Plant Transfers	530,447		
Total Primary Costs		367,260	
Fuel Consumption	140,372		
Heat Purchases	58,885		
Repairs and Maintenance	34,283		
Payroll	27,141		
Writeoffs	39,885		
Economic Balance			**18,969**

7.1.3 Future Cash Flow Development

The expected development of future cash flow is presented for a company operating the network of all centralized heating sources as one unit. The calculation was made in 1993 real prices, thus eliminating the effect of inflation for the comparison period.

In estimating the development of cash flow, information was used from the input studies *An Evaluation of the Supply-Side Options for the Plzeň District Heating System* (Gilbert/ Commonwealth), *Assessment of the Buildings Sector Efficiency Resource for the City of Plzeň, Czech Republic* (Pacific Northwest National Laboratory), *Efficiency and Supply Resource Options for the Upgrade of the Plzeň District Heating System* (Pacific Northwest National Laboratory), *Heat Supply in Plzeň: Final Report* (SEVEn and Pacific Northwest National Laboratory), and from their appendices and supporting studies.

In forecasting the cash flow, the price for supplied heat (in Kč/GJ) was set every year so that it covered operational costs and loan payments. This method derives the minimum price of energy at which no profit is made. The reason for this approach is the assumption that a company in which the City is the majority owner will try to supply energy to the public at the lowest price possible. This assumption can be easily modified, however, to reflect a different management approach.

Cash flow projections are based on the following assumptions:

- a real discount rate of 10%
- an electricity purchase price in 1994 of 0.87 Kč/kWh and annual escalation in real prices of 5% to the year 1996, 2% to the year 2000, and constant after the year 2000
- an 8-year loan with a real interest rate of 7%. This loan is used for capital investment in new sources and the system, as well as in efficiency measures. The entire loan amount is used each year, which corresponds to the extent of investment needed in the given year.
- income tax of 42%.

It is expected that all electricity produced in the co-generation unit will be sold. The amount of produced and sold electricity will be determined by the amount of steam and hot water produced in the co-generation plant.

The amount of heat produced corresponds to the expected development of heat demand in the district heating system network (see Figure 5). This estimate is based on the likely development of the city's population, economic development, the amount and level of demand from new district heating system customers, and demand needed to maintain present customers. Under consideration at the same time was reducing customer heat consumption gradually by up to 10%, partially by increasing the price of energy and partially by installing heat meters and regulation devices in accordance with Decree No. 186/1991.

Cash flow projections are shown in Tables 10 and 11. Table 10 does not include investment in reducing energy losses for the consumer beyond achieving savings from installing heat metering. Table 11 includes investment in demand-side energy efficiency programs for a total of 450 million Kč.

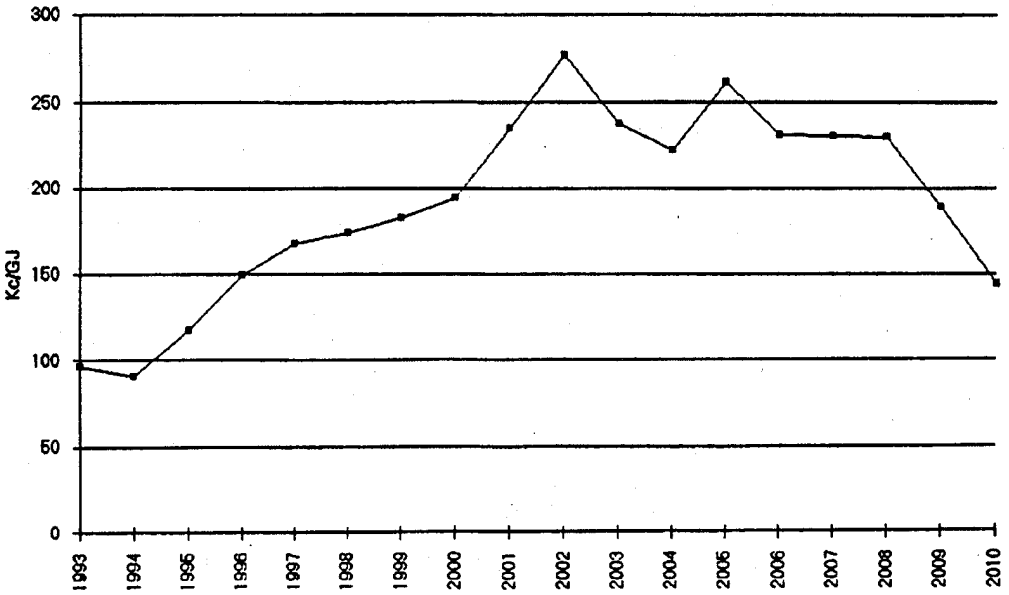


Figure 5. Heat Price Development for Each Year in Which Energy Efficiency is Implemented

For investment in efficiency programs, the average discounted price of heat supplied from the system is 166 Kč/GJ, and the average annual household payment for heat is 6976 Kč. If money is invested in efficiency measures, the average price of heat increases to 181 Kč/GJ, but the annual household energy bill falls by 526 Kč to 6450 Kč.

7.2 Fixed Assets

Tables 12 and 13 present the purchase and depreciated value of the fixed assets, including their average depreciation according to the property inventory of the Plzeň Heating Co. and TEZA.

Several independent evaluations were made of the current replacement value for fixed assets of the district heating system network. Costs were estimated at today's prices to be more than twice that of the depreciated value of the fixed assets.

Table 14 gives an expert evaluation of the technical state of TEZA's fixed assets by individual divisions compared with the level of depreciation of these assets. This evaluation was conducted during a company audit in January and February of 1994.

7.3 Possibilities for Reinvesting Income Tax

The City of Plzeň owns the majority of shares in Plzeň Heating Co. and is the founder of TEZA. This fact, together with current income tax legislation and conditions, makes it possible to improve the economic profile of the district heating system network through changes in ownership and operational relationships.

Table 10. Future Cash Flow Development - Variant Without Investment in Reducing Demand-Side Energy Losses

PLZEN DISTRICT HEATING SYSTEM FINANCIAL ASSESSMENT									Debt Terms					Efficiency Terms					
									Loan Term (Year):	8				Implementation Period:	1995-2004				
CASE:	COAL 2003 (C1), HIGH DEMAND								Annual Interest Rate:	7.00%				% Reduction at Full Implementation:	10				
PROGRAMMATIC EFFICIENCY:	NO								Payment Schedule:	Annual				Cost, Kč/GJ in 1st year:	1587				
ANALYSIS:	REAL								Debt/Expense Threshold:	250				Financing Method:	DEBT				
DISCOUNT RATE (%):	10													Depreciable Asset:	NO				
TAX RATE (%):	42																		
Ammounts Shown are in 1000 Kč																			
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
REVENUE																			
Electricity	106923	113558	120410	122787	125428	127810	130237	132710	132241	131818	251117	248416	245830	246060	246231	246461	246633	246862
Price -- Kc/kWh	0.8300	0.8715	0.9151	0.9608	0.9800	0.9996	1.0196	1.0400	1.0400	1.0400	1.0400	1.0400	1.0400	1.0400	1.0400	1.0400	1.0400	1.0400
*Production, MWh	128822	130301	131585	127793	127982	127855	127729	127602	127150	126744	241451	238854	236368	236589	236754	236974	237140	237360
Steam	83031	78024	104236	141550	153269	155311	158764	165230	196080	227913	190896	176491	205267	181367	183978	186613	154340	118175
Price -- Kc/MWh	345.94	327.21	440.01	545.43	589.41	597.26	610.54	635.41	754.04	877.34	735.58	680.75	792.54	701.03	710.34	720.52	595.91	456.28
*Production, MWh	240016	238455	236895	259519	260039	260039	260039	260039	260039	259779	259519	259259	258998	258998	258998	258998	258998	258998
Hot Water	184893	194486	274424	426450	468996	477630	490851	513381	605218	699504	582560	535514	619235	548484	556323	565262	468139	358933
Price -- Kc/MWh	345.94	327.21	440.01	545.43	589.41	597.26	610.54	635.41	754.04	877.34	735.58	680.75	792.54	701.03	710.34	720.52	595.91	456.28
*Production, MWh	534466	594383	623677	781859	795707	799701	803962	807957	802631	797305	791977	786653	781327	782392	783457	784522	785587	786653
Efficiency, MWh			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Revenue	374846	386067	499071	690787	747693	760751	779853	811322	933539	1059235	1024574	960420	1070333	976110	986732	998336	869111	723971
OPERATING COSTS																			
Operations & Maintenance	365708	388528	409416	515928	585816	594524	607572	632632	622440	620816	682612	690452	785120	682192	686028	690284	705376	708036
Efficiency Expenditures	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Depreciation	0	246	1339	4166	40085	42312	42647	42982	43316	43358	82489	82531	89270	87595	87627	87660	87550	86953
Existing Plant/Equipment																			
New Plant/Equipment	0	246	1339	4166	40085	42312	42647	42982	43316	43358	82489	82531	89270	87595	87627	87660	87550	86953
Efficiency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Operating Costs	365708	388774	410755	520094	625901	636836	650219	675614	665756	664174	765101	772983	874390	769787	773655	777944	792926	794989
OPERATING PROFIT																			
Before Tax	9138	-2707	88315	170693	121791	123915	129634	135708	267782	395061	259473	187437	195942	206324	213077	220392	76185	-71018
Operating Margin	2%	-1%	18%	25%	16%	16%	17%	17%	29%	37%	25%	20%	18%	21%	22%	22%	9%	-10%
After Tax	5300	-1570	51223	99002	70639	71871	75188	78711	155314	229135	150494	108714	113646	119668	123585	127827	44187	-41191
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CASH FLOW																			
Cash Flow From Operations After Tax	5300	-1324	52562	103168	110724	114183	117834	121693	198630	272494	232983	191245	202917	207262	211212	215487	131737	45762
Change in Working Capital																			
Working Capital																			
Capital Expenses - Plant	5300	23500	351300	358600	38800	7200	7200	7200	534900	534900	91400	91400	99400	700	700	700	700	700
Capital Expenses - Efficiency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Cash Flow from Operations after Tax	0	-24824	-298738	-255432	71924	106983	110634	114493	-336270	-262406	140583	98845	103517	206562	210512	214787	131037	45062

Table.10. (contd)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CAPITAL EXPENDITURES																		
Annual																		
Plant/Equipment	5300	23500	351300	358600	38800	7200	7200	7200	534900	534900	92400	92400	99400	700	700	700	700	700
Efficiency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cumulative																		
Plant/Equipment	5300	28800	380100	738700	777500	784700	791900	799100	1334000	1868900	1961300	2053700	2153100	2153800	2154500	2155200	2155900	2156600
Efficiency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DEBT																		
Total Funds Borrowed																		
Principal – Beginning Balance		28800	351300	358600	38800	7200	7200	7200	534900	534900	92400	92400	99400	0	0	0	0	0
Remaining Balance		25993	340049	623846	578825	495635	405415	307675	678153	989810	893164	834334	768726	593374	406933	208689	86124	44559
Principal Paid		2807	37244	74803	83821	90390	97419	104940	164422	223244	189045	151231	165007	175352	186421	198265	122565	41566
Interest Paid		2016	26411	48905	46385	41022	35198	28883	58980	84914	75755	68989	65361	53811	41536	28487	14608	6029
Total Payment		4823	63654	123708	130206	131412	132618	133823	223402	308157	264800	220220	230369	229163	227959	226751	137173	47594
HEAT PRICE NECESSARY FOR OPERATION																		
Combined Steam & Hot Water - Kc																		
Annual Price, Kc/MWh	346	327	440	545	589	597	611	635	754	877	736	681	793	701	710	721	596	456
Annual Price, Kc/GJ	96	91	122	152	164	166	170	177	209	244	204	189	220	195	197	200	166	127
Discounted Annual Price, Kc/MWh		297	364	410	403	371	345	326	352	372	284	239	253	203	187	172	130	90
Discounted Levelized Price, Kc/MWh		598																
Discounted Levelized Price, Kc/GJ		166.09																
Steam Share of Production	0.31	0.29	0.28	0.25	0.25	0.25	0.24	0.24	0.24	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Combined Steam & Hot Water - $																		
Annual Price, $/MWh	12.35	11.69	15.71	19.48	21.05	21.33	21.81	22.69	26.93	31.33	26.27	24.31	28.31	25.04	25.37	25.73	21.28	16.30
Discounted Annual Price, $/MWh		10.62	12.99	14.64	14.38	13.24	12.31	11.65	12.56	13.29	10.13	8.52	9.02	7.25	6.68	6.16	4.63	3.22
Discounted Levelized Price, $/MWh		21.35																
Steam Share of Production	0.31	0.29	0.28	0.25	0.25	0.25	0.24	0.24	0.24	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25

Table 11. Future Cash Flow Development - Variant Including Investment in Reducing Demand-Side Energy Losses

PLZEN DISTRICT HEATING SYSTEM FINANCIAL ASSESSMENT									Debt Terms					Efficiency Terms					
									Loan Term (Years):	8				Implementation Period:	1995-2004				
CASE:	COAL 2003 (C1), HIGH DEMAND								Annual Interest Rate:	7.00%				% Reduction at Full Implementation:	10				
PROGRAMMATIC EFFICIENCY:	YES								Payment Schedule:	Annual				Cost, Kč/GJ in 1st year:	1587				
ANALYSIS:	REAL								Debt/Expense Threshold:	250				Financing Method:	DEBT				
DISCOUNT RATE (%):	10													Depreciable Asset:	NO				
TAX RATE (%):	42																		
Ammounts Shown are in 1000 Kč																			
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
REVENUE																			
Electricity	106923	113558	120410	122787	125428	127810	130237	132710	132241	131818	251117	248416	245830	246060	246231	246461	246633	246862
Price -- Kc/kWh	0.8300	0.8715	0.9151	0.9608	0.9800	0.9996	1.0196	1.0400	1.0400	1.0400	1.0400	1.0400	1.0400	1.0400	1.0400	1.0400	1.0400	1.0400
*Production, MWh	128822	130301	131585	127793	127982	127855	127729	127602	127150	126744	241451	238854	236368	236589	236754	236974	237140	237360
Steam	83031	78024	100195	139293	156570	162997	170852	182096	219891	258901	222034	207605	244091	215362	214779	214341	176332	134100
Price -- Kc/MWh	345.94	327.21	422.95	536.74	602.10	626.82	657.03	700.26	845.61	996.62	855.56	800.76	942.44	831.52	829.27	827.58	680.82	517.76
*Production, MWh	240016	238455	236895	259519	260039	260039	260039	260039	260039	259779	259519	259259	258998	258998	258998	258998	258998	258998
Hot Water	184893	194486	261146	411259	464725	481216	501812	531837	631202	731042	616600	566931	662218	583163	584460	584130	481289	366569
Price -- Kc/MWh	345.94	327.21	422.95	536.74	602.10	626.82	657.03	700.26	845.61	996.62	855.56	800.76	942.44	831.52	829.27	827.58	680.82	517.76
*Production, MWh	534466	594383	617440	766222	771836	767713	763764	759480	746447	733521	720699	707988	702662	703727	704792	705857	706922	707988
Efficiency, MWh			6237	15637	23871	31988	40198	48477	56184	63784	71278	78665	78665	78665	78665	78665	78665	78665
Total Revenue	374846	386067	481750	673339	746722	772023	802901	846643	983333	1121761	1089750	1022952	1152140	1046584	1045470	1044951	904254	747531
OPERATING COSTS																			
Operations & Maintenance	365708	388528	409416	515928	585816	594524	607572	632632	622440	620816	682612	690452	785120	682192	686028	690284	705376	708036
Efficiency Expenditures	0	0	35632	53706	47043	46373	46906	47301	44030	43422	42812	42206	0	0	0	0	0	0
Depreciation	0	246	1339	4166	40085	42312	42647	42982	43316	43358	82489	82531	89270	87595	87627	87660	87550	86953
Existing Plant/Equipment																			
New Plant/Equipment	0	246	1339	4166	40085	42312	42647	42982	43316	43358	82489	82531	89270	87595	87627	87660	87550	86953
Efficiency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Operating Costs	365708	388774	446387	573801	672944	683209	697125	722915	709787	707596	807913	815188	874390	769787	773655	777944	792926	794989
OPERATING PROFIT																			
Before Tax	9138	-2707	35363	99538	73778	88813	105777	123728	273547	414165	281837	207764	277749	276798	271815	267007	111328	-47458
Operating Margin	2%	-1%	7%	15%	10%	12%	13%	15%	28%	37%	26%	20%	24%	26%	26%	26%	12%	-6%
After Tax	5300	-1570	20511	57732	42791	51512	61350	71762	158657	240216	163466	120503	161095	160543	157653	154864	64570	-27526
	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CASH FLOW																			
Cash Flow From Operations After Tax	5300	-1324	21850	61899	82877	93624	103997	114744	201974	283574	245955	203034	250365	248137	245280	242524	152121	59427
Change in Working Capital																			
Working Capital																			
Capital Expenses - Plant	5300	23500	351300	358600	38800	7200	7200	7200	534900	534900	92400	92400	99400	700	700	700	700	700
Capital Expenses - Efficiency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Cash Flow from Operations after Tax	0	-24824	-329450	-296701	44077	86624	96797	107544	-332926	-251326	153555	110634	150965	247437	244580	241824	151421	58727

Table 11. (contd)

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CAPITAL EXPENDITURES																		
Annual																		
Plant/Equipment	5300	23500	351300	358600	38800	7200	7200	7200	534900	534900	92400	92400	99400	700	700	700	700	700
Efficiency	0	0	35632	53706	47043	46373	46906	47301	44030	43422	42812	42206	0	0	0	0	0	0
Cumulative																		
Plant/Equipment	5300	28800	380100	738700	777500	784700	791900	799100	1334000	1868900	1961300	2053700	2153100	2153800	2154500	2155200	2155900	2156600
Efficiency	0	0	35632	89338	136381	182754	229660	276961	320991	364413	407225	449431	449431	449431	449431	449431	449431	449431
DEBT																		
Total Funds Borrowed																		
Principal -- Beginning Balance		28800	386932	412306	85843	53573	54106	54501	578930	578322	135212	134606	99400	0	0	0	0	0
Remaining Balance		25993	372208	700761	688620	632129	563193	480727	856676	1166262	1065548	1003640	897459	686458	469748	246996	105604	51164
Principal Paid		2807	40717	83754	97983	110064	123042	136967	202982	268735	235927	196513	205582	211001	216710	222752	141393	54440
Interest Paid		2016	28905	54916	55062	51954	48036	43239	74176	100450	91103	84011	77213	62822	48052	32882	17290	7392
Total Payment		4823	69622	138670	153046	162017	171078	180206	277158	369185	327030	280524	282794	273823	264762	255634	158682	61832
HEAT PRICE NECESSARY FOR OPERATION																		
Combined Steam & Hot Water - Kc																		
Annual Price, Kc/MWh	346	327	423	537	602	627	657	700	846	997	856	801	942	832	829	828	681	518
Annual Price, Kc/GJ	96	91	117	149	167	174	183	195	235	277	238	222	262	231	230	230	189	144
Discounted Annual Price, Kc/MWh		297	350	403	411	389	371	359	394	423	330	281	300	241	218	198	148	102
Discounted Levelized Price, Kc/MWh		650																
Discounted Levelized Price, Kc/GJ		180.65																
Steam Share of Production	0.31	0.29	0.28	0.25	0.25	0.25	0.25	0.26	0.26	0.26	0.26	0.27	0.27	0.27	0.27	0.27	0.27	0.27
Combined Steam & Hot Water - $																		
Annual Price, $/MWh	12.35	11.69	15.11	19.17	21.50	22.39	23.47	25.01	30.20	35.59	30.56	28.60	33.66	29.70	29.62	29.56	24.32	18.49
Discounted Annual Price, $/MWh		10.62	12.48	14.40	14.69	13.90	13.25	12.83	14.09	15.10	11.78	10.02	10.72	8.60	7.80	7.08	5.29	3.66
Discounted Levelized Price, $/MWh		23.23																
Steam Share of Production	0.31	0.29	0.28	0.25	0.25	0.25	0.25	0.26	0.26	0.26	0.26	0.27	0.27	0.27	0.27	0.27	0.27	0.27

Table 12. Structure of Plzeň Heating Company's Fixed Assets as of December 31, 1993

Fixed Assets	Purchase Price (10^3Kč)	Current Value (10^3Kč)	Writeoff (%)
1. Buildings	245,075	133,565	46
2. Construction	314,541	156,251	50
3. Energy Equipment	274,003	125,786	54
Share: Stage I - Heating Plant	25,781	4,485	83
Stage II - Co-generation Plant	236,463	114,022	52
4. Work Machines and Equipment	4,462	1,787	60
5. Instruments and Special Technical Equipment	39,869	17,027	59
6. Transportation Means	40,574	6,943	83
7. Inventory	1,956	1,022	48
Total Fixed Assets	920,514	442,399	52

Table 13. Structure of TEZA's Fixed Assets as of November 30, 1993

Fixed Assets	Purchase Price (10^3Kč)	Current Value (10^3Kč)	Writeoff (%)
1. Buildings	103,925	47,919	54
2. Construction	252,886	182,080	28
3. Energy Equipment	51,022	10,281	80
4. Work Machines and Equipment	6,771	1,312	81
5. Instruments and Special Technical Equipment	66,413	50,418	24
6. Vehicles	9,919	2,037	79
7. Inventory	354	42	88
Total Fixed Assets	491,289	294,089	40

Table 14. An Evaluation of the Technical State of TEZA's Fixed Assets

Division	Book Depreciation	Technical Depreciation
Heating Plant Světovar	94%	73%
Heating Plants Letná/Doubravka	81%	58%
Heating Plant Bory	81%	68%
Heat Exchanger Stations Skvrňany	61%	51%
Heat Exchanger Stations Lochotín	22%	12%
Support Operations	71%	60%
Heat-Metering Service	9%	16%
Company Headquarters	47%	64%
TEZA Total	**40%**	**30%**

The City plans to transfer TEZA to City ownership. At the same time, it will exchange property between Plzeň Heating co. and TEZA so that Plzeň Heating Co. will own all network heating sources and TEZA all the distribution lines and exchanger stations. The City will then rent the heat distribution lines to Plzeň Heating Co., who will thus operate the entire network, from the sources to the customer transfer stations. This plan will allow for overall optimization of the network and will reduce some costs.

Renting the municipal heating network to Plzeň Heating Co. will allow the City to take some of the profit from Plzeň Heating Co. into its budget. It can also take the income tax, which would otherwise go into the state budget.

Rental from the heating network will be a revenue for the city budget, and if current legislation stays in place, it will be taxed back into the city budget. If this tax (about 500 million Kč in today's prices for the period 1994-2010) is reinvested in the district heating system network, it will be positively reflected in the network's economic profile, and the price of supplied energy can be reduced by 6% to 7%.

8.0 Related Publications

This report is one of four containing an energy assessment of options for upgrading the district heating system for the City of Plzeň, Czech Republic. The other reports are

An Evaluation of the Supply-Side Options for the Plzeň District Heating System (Gilbert/Commonwealth)

Assessment of the Buildings Sector Efficiency Resource for the City of Plzeň (Pacific Northwest National Laboratory)

Efficiency and Supply Resource Options for the Upgrade of the Plzeň District Heating System (Pacific Northwest National Laboratory)

Heat Supply in Plzeň: Final Report (SEVEn, Pacific Northwest National Laboratory)

All of these reports were published by

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