

Clean District Heating in Jindřichův Hradec

Teplospol, a.s, Czech Republic

Summary

The project includes modernization of two independent district heating systems with a current total installed capacity of 50 MW, servicing in total 15,000 inhabitants of the town of Jindřichův Hradec in Southern Bohemia. It includes interconnection of the two DH systems, a complete switch from steam to hot water district heating and thus the increase in energy efficiency of heat distribution, and fuel switch from oil to natural gas and biomass (wood waste), and installation of a small co-generation unit and solar heating in a swimming pool.

End-user area	Target Audience	Technical
<input type="checkbox"/> New buildings	<input type="checkbox"/> Citizens	<input type="checkbox"/> Energy efficiency
<input type="checkbox"/> Refurbishment of buildings	<input type="checkbox"/> Households	<input type="checkbox"/> Heating
<input type="checkbox"/> Transport and mobility	<input type="checkbox"/> Property owners	<input type="checkbox"/> Cooling
<input type="checkbox"/> Financial instruments	<input type="checkbox"/> Schools and universities	<input type="checkbox"/> Appliances
<input type="checkbox"/> Industry	<input type="checkbox"/> Decision makers	<input type="checkbox"/> Lighting
<input type="checkbox"/> Legal initiatives (municipal regulations, directives, etc)	<input checked="" type="checkbox"/> Local and regional authorities	<input checked="" type="checkbox"/> CHP
<input checked="" type="checkbox"/> Planning issues	<input type="checkbox"/> Transport companies	<input checked="" type="checkbox"/> District Heating
<input type="checkbox"/> Sustainable communities	<input checked="" type="checkbox"/> Utilities	<input checked="" type="checkbox"/> Solar energy
<input type="checkbox"/> User behaviour	<input type="checkbox"/> ESCOs	<input checked="" type="checkbox"/> Biomass
<input type="checkbox"/> Education	<input type="checkbox"/> Architects and engineers	<input type="checkbox"/> Wind
<input type="checkbox"/> Other	<input type="checkbox"/> Financial institutions	<input type="checkbox"/> Geothermal
	<input type="checkbox"/> Other	<input type="checkbox"/> Hydro power
		<input type="checkbox"/> Other

Context

Jindřichův Hradec is a small town located in Southern Bohemia, Czech Republic, near the borders with Austria. The city has two major residential areas - housing estate "U nádraží" and "Vajgar - Hvězdárna" - for which two separate district heating (DH) systems have been built and expanded gradually since the 1970s.

Both systems are based primarily on steam, which is produced in two boiler houses firing mainly heavy and light fuel oil supplemented partly by natural gas. Their combined heat sales reach nearly 200 TJ annually, with majority coming to households (almost 4,600 households which is around 15,000 inhabitants, ca 3/4 of the city's population), and in a smaller part to a number of other commercial and public institutions and buildings.

Due to their age, however, the heat distribution networks are nowadays very inefficient and distribution losses reach as much as 40% of heat plant output. Therefore, a plan for the reconstruction of both systems has been worked out.

Table 1: - District Heating System „U nádraží“ – present situation

Heat Source	Three steam mid-pressure boilers with a total capacity of 18 MW _{th}
Fuel consumption in 2000	2,012 tons of fuel oil / year
Heat Production	65.8 TJ
Heat Distribution Network	2,700 m steam-based 2.070 m hot-water-based 6 heat exchange stations
Heat Consumers	924 flats, schools, shops and other commercial

Table 2: - District Heating System „Vajgar - Hvězdárna“- present situation

Heat Source	Four steam mid-pressure boilers equipped with combined fuel oil/natural gas fires, with a total capacity of 32,4 MW _{th}
Fuel consumption in 2000	2,674 t of fuel oil 4,045 thousand cubic meters of natural gas
Heat Production	215.2 TJ
Heat Distribution Network	3,800 m steam-based 6,160 m hot-water-based 6 heat exchange stations
Heat Consumers	Housing estate „Vajgar“ - 2,782 flats, 2 grammar schools, nurseries, retail and service facilities Housing estate „Hvězdárna“ - 921 flats, one grammar school, retail shops and service facilities

Objectives

Decrease emissions and provide affordable district heating to the community.

Process

Start date is scheduled for April 2003, completion date phase I – October 2003, complete reconstruction - October 2004.

Reconstruction of primary distribution network from steam to hot water. Steam/hot-water heat exchange stations will be reconstructed to hot water or substituted by compact heat exchangers installed right in the consumers' houses.

Reconstruction of the heat generation will include replacement of an old boiler plant burning heavy oil with a new boiler house with a hot-water boiler burning biomass and complemented by a gas boiler for peking. The biomass boiler will have the installed capacity of 6 MW and most of the fuel supplies to it (nearly 5.500 tons a year) will be covered by wood waste from a local wood-processing facility (saw mill). In the other plant three new hot-water boilers burning natural gas with the total heat capacity of 30 MW_{th} will be installed instead of the existing steam-based ones.

A co-generation unit will be installed in the boiler house (with an installed electric capacity of 150 kWe) to cover its own demand for electricity. A solar heating will be implemented for water heating in 2 swimming pools which will also be connected to the reconstructed district heating network. The district heating system will then supply heat demands not covered by solar energy.

Measures in DH "U nádraží“:

- Hot-water boiler house on biomass (6 MWth), with an auxiliary and stand-by gas-fires unit of the same capacity
- The reconstruction of the primary steam-based heating network to hot water
- The reconstruction of 6 heat exchange stations (from steam to hot-water-water ones)
- The Installation (replacement) of 49 in-house compact heat exchangers (for hot water-water ones)

Measures in DH "Vajgar - Hvězdárna“:

- Natural gas hot-water boiler house with the total capacity of 30 (3 x 10) MWth
- The Installation of a co-generation unit with the el. capacity 150 kW_e
- The Installation of thermosolar panels with the area of 160 m²
- The reconstruction of the primary steam-based heating network to hot water with a total length of 5,049 m
- The reconstruction of 9 heat exchange stations
- The Installation (replacement) of 86 in-house compact heat exchangers

Financial resources and partners

Total investment costs 3.3 million Euro, 70% subsidy from PHARE CBC Programme.

Table 3: Investment costs for the reconstruction of both DH systems

DH System	Investment costs (thousand EURO)
DH „Vajgar – Hvězdárna“	1 917
DH „U nádraží“	1 421
Of which investment costs of biomass boiler house	920
Total	3 338

Note: Investment costs include heat exchangers in the consumers' premises

The partners were Teplospol, a.s, district heating utility, Jindřichův Hradec, the Czech Republic.

Results

A major benefit of this project is in the first place a significant improvement in the air quality in the town of Jindřichův Hradec and the neighbouring region at the Czech-Austrian border. The emissions of sulphur dioxide, nitrogen oxides, and fly ash will decrease by as much as ca 86%, and carbon dioxide emissions will decrease by more than 20%.

Table 4: Emissions before and after project implementation

Pollutant	Emissions before (t/rok)	Emissions after (t/rok)	Decrease (t/rok)	Decrease (%)
Particulates	11,890	0,230	11,660	-98,07
SO ₂	93,759	0,095	93,664	-99,90
Nox	54,626	18,098	36,528	-66,87
CO	4,059	3,018	1,041	-25,65
CxHy	2,439	1,209	1,230	-50,44
Total emissions	166,773	22,649	144,124	-86,42
CO ₂	22,300	17,800	4,500	-20,2

Table 5: The fuel used before and after project implementation

DH System	Fuel consumption (in 2000)		Fuel consumption after project implementation		
	Fuel oils (t/y)	Natural gas (tis. m ³ /y)	Fuel oils (t/y)	Natural gas (tis. m ³ /y)	Wood waste (t/y)
“Vajgar-Hvězdárna”	2 674	4 045	0	6 251	0
“U nádraží”	2 012	0	0	438	5 467
Total	4 686	4,045	0	9,422	2 738

The 70% investment subsidy will allow a decrease in the current level of heat price from €13/GJ to €11.6/GJ, the internal rate of return of the remaining 30% investment is 12%.

Lessons learned and repeatability

The positive aspects of project implementation was the demonstrated sustainable reconstruction of district heating system. The problems encountered were high modernisation costs, without the subsidy the project in such a scope won't be competitive.

The technology and project concept are fully transferable, the scope of the project will highly depend on cost-effectiveness of local project and availability of subsidies.

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