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The Model Database (WP4)

Database of selected geothermal district heating system

SLOVGEOTERM a.s.

User4GeoEnergy

Oto Halás
Managing director

INTRODUCTION

- Development of mathematical model for simulating generation, transmission and supply of heat to end users after applying retrofitting activities is one of the core activities of U4GE Project (WP5)
- For that purpose it was necessary to collect a wide range of data for calibration and as an input for the model
- WP4 was fully dedicated to creating a database containing comprehensive characteristics of geothermal resources, district heating systems (DHS) and heat end users
- Data from altogether 28 DHS from 3 countries were collected and processed
- Responsible partner for WP4: SLOVGEOTERM a.s.
- Contribution: All Project Partners

WORK PROGRESS AND UPDATES

- The main extensive database was created and all required and acessible data were collected and processed in the initial phase of the project (06/2021)

- Main database was used for calibration of the mathematical model

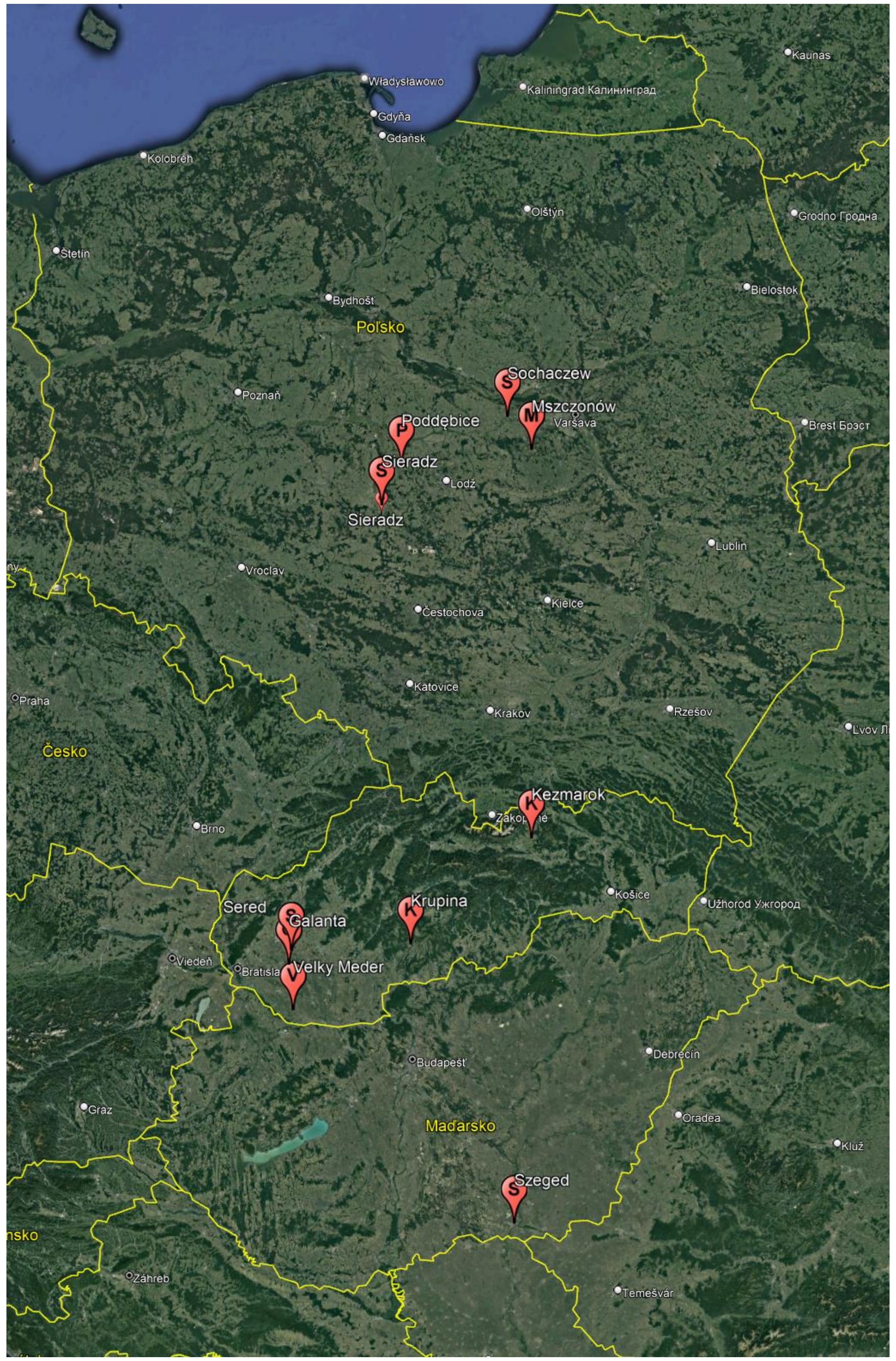
- Significant changes in prices of energy carriers and retrofitting works – update of prices was required

- Update and prediction of prices was made in the first half of the year 2023

- Simplified database with several new DHS was also created and is used as an input for the online version of the mathematical model

LOCALITIES OF INTEREST

- Poland – 4 localities
  - Mszczonów (geothermal energy is utilized by heat pumps)
  - Sochaczew (geothermal well is drilled, not connected to DHS yet)
  - Poddębice (using geothermal energy already)
  - Sieradz (geothermal well is drilled but not utilized yet)
- Slovakia – 5 localities with 7 DHS
  - Galanta (using geothermal energy already)
  - Sered (using geothermal energy already)
  - Velky Meder (using geothermal energy already)
  - Kezmarok (geothermal well is drilled, connection to DHS is being prepared)
  - Krupina (under investigation for geothermal energy utilization possibilities)
- Hungary – 1 locality with 23 DHS
  - Szeged (2 DHS already utilizing geothermal energy, 13 are being transformed to geothermal)



CONTENTS OF THE MAIN DATABASE

- Part 1 – short overview and general information
- Part 2 – information about geothermal production wells
- Part 3 – analogous to part 2, but referring to geothermal reinjection wells where applicable
- Part 4 – characteristics of the heat source
- Part 5 – characteristics of heat consumers
- Part 6 – general economic indicators
- Annex I – data for typical meteorological year
- Annex II – well construction schemes
- Annex III – principal scheme of the heat source
- Annex IV – data from the DH system operator control system (SCADA)
- Annex V – distribution network situation plan

PART 1

Short overview and general information

- Location
- Design climatic conditions
- Geological background
- Geothermal conditions

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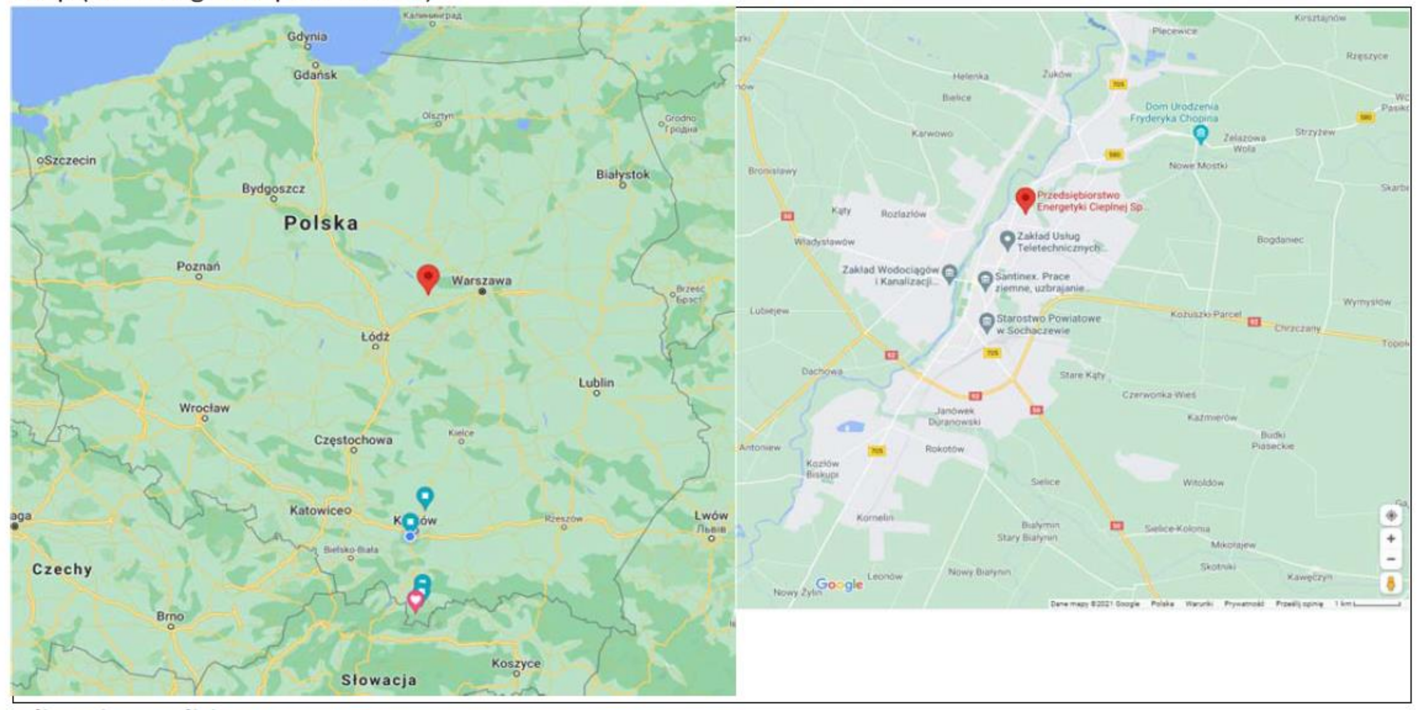
User4GeoEnergy Project Number: 2018-1-0502

Database **Dataset for particular project/locality** **Part 1** **Locality ID.:** **PL 2**

Location

Country:	Poland	Coordinates (UTM):	52.246050699447956
Town/City of:	Sochaczew		20.25587425650787

Map (use Google Maps or similar):



Climatic Conditions

Design ambient temperature:	-20 °C	Design humidity:	nta %
Design wind speed:	nta m/s	Design solar radiation:	nta W/m2

Typical climatic conditions (Typical meteorological year for period 2007 - 2016): See Annex I

Typical climatic conditions used from: https://re.jrc.ec.europa.eu/pvg_tools/en/tools.html#TM

(nta - is not taken into account)

Geothermal Conditions

Brief description of geological conditions:

The geothermal well Sochaczew GT-1 opens for exploitation the Lower Cretaceous reservoir in the depth interval of 1355-1485.5 m below the surface. The artesian free outflow conditions ocours, with the well head overpressure of waters, in natural and steady conditions, 2.24 bar. The water level in natural conditions is 103.4 m above sea level. During the operating conditions with outflow of 180 m3/h, the water level droped to the elevation 85.4 m above sea level and its temperature at the well head was 44.3°C. Water mineralization 0.962 g/dm3, with a possible slight increase in operating conditions. The Sochaczew GT-1 opening provides access to the bed with a filter with a diameter of 6 5/8 inches.

Name of geological locality:	Warsaw Through		
Geological type/Lithology:	Lower Cretaceous		
Aquifer rock:	sandstone		
Type of permeability:	porous aquifer		
Depth of aquifer top approx.:	1 355 m		
Depth of aquifer bottom approx.:	1 487 m		
Temperatue in aquifer:	43,4 °C	at depth of:	1307 m
Pressure in aquifer:	130,6 bar	at depth of:	1307 m
Existing production wells?	Yes	Number of production wells:	1
Existing reinjection wells?	No		

Description of geothermal system operation and control:

The geothermal system will ultimately consist of two holes forming a geothermal doublet. Due to the low temperature, the use of heat pumps is planned. The use of absorption heat pumps is envisaged.

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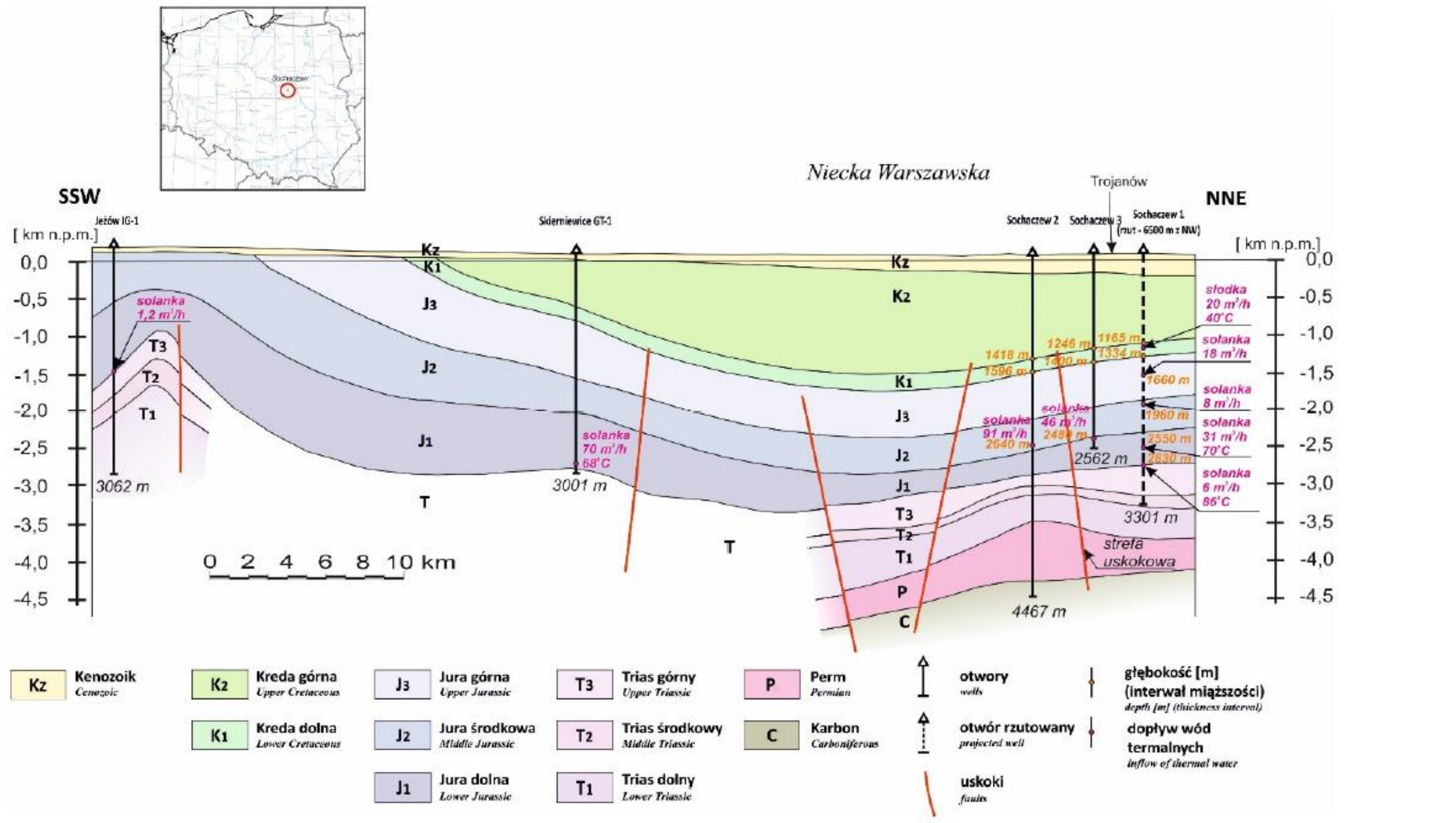

PART 2

Information about geothermal production wells

- Depth
- Casing design
- Wellhead temperature and pressure at the maximum flow rate
- Mineralisation (TDS) of water
- Pumping power required

Database Dataset for particular project/locality **Part 2** **Locality ID.:** **SK 1**

Production Well 1

Well name:	FGG-2	Maximal flow rate:	13,7 l/s
Well depth:	2 100 m	Maximal well head temperature:	81 °C
Production casing 1 diameter:	9 5/8 in	Well head pressure at maximal flow:	0,4 MPa
Production casing 2 diameter:	- in	Water level at static cond. (below surface):	12 m
Production liner diameter:	7 in	Water level at max. flow rate (below surface):	45 m
Outflow conditions:	Pumping	Mineralisation of geothermal water (TDS):	5,3 g/l
Depth of the pump:	100 m	Corrosive properties?	Yes
Electrical input of the pump:	30 kW	Scaling properties?	No
Well construction:	See Annex II	Dosing of inhibitor?	Yes

Water level depression resp. geothermal water temperature vs. flow rate dependence (if available): See Annex IV

Lithostratigraphic profile of the well:

Depth from	-	to [m]	Lithology/Stratigraphy	Rock type	Aquifer ?	Therm. conduct. [W/(K.m)]	Thermal capacity [J/(kg.K)]
0	-	150	Quaternary, Romanian	gravel, sand, clay	No	Clays 2,45±0,49; Sands 1,97±0,47; sandstones 2,66±0,63;	
150	-	880	Dacian	sand, clay	No		
880	-	1500	Pontian	sand, clay	No		
1500	-	2100	Pannonian	sands, sandstones, clays, claystones	Yes		996 - 1033
	-						
	-						
	-						
	-						
	-						
	-						

Production Well 2 (if aplicable)

Well name:	FGG-3	Maximal flow rate:	13,5 l/s
Well depth:	2 100 m	Maximal well head temperature:	77 °C
Production casing 1 diameter:	9 5/8 in	Well head pressure at maximal flow:	0,4 MPa
Production casing 2 diameter:	- in	Water level at static cond. (below surface):	m
Production liner diameter:	7 in	Water level at max. flow rate (below surface):	58 m
Outflow conditions:	Pumping	Mineralisation of geothermal water (TDS):	5,3 g/l
Depth of the pump:	100 m	Corrosive properties?	Yes
Electrical input of the pump:	30 kW	Scaling properties?	Yes
Well construction:	See Annex II	Dosing of inhibitor?	Yes

Water level depression vs. flow rate dependence (output of control system, if available): See Annex IV

Lithostratigraphic profile of the well:

Depth from	-	to [m]	Lithology/Stratigraphy	Rock type	Aquifer ?	Therm. conduct. [W/(K.m)]	Thermal capacity [J/K]
0	-	150	Quaternary, Romanian	gravel, sand, clay	No	Clays 2,45±0,49; Sands 1,97±0,47; sandstones 2,66±0,63;	
150	-	900	Dacian	sand, clay	No		
900	-	1500	Pontian	sand, clay	No		
1500	-	2100	Pannonian	sands, sandstones, clays, claystones	Yes		996 - 1033

PART 3

Information about geothermal reinjection wells

- Depth
- Casing design
- Reinjection pressure
- Reinjection power required

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Project Number: 2018-1-0502

Database **Dataset for particular project/locality** **Part 3** **Locality ID.:** **HU 1**

Reinjection Well 1 (if aplicable)

Well name:	Od-VS1		Maximal reinjection flow rate:	80	l/s
Well depth:	1 860	m	Maximal reinjection well head temperature:	55	°C
Production casing 1 diameter:	13 3/8	in	Maximal reinjection well head pressure:	0,84	MPa
Production casing 2 diameter:	9 5/8	in	Minimal reinjection well head temperature:	30	°C
Production liner diameter:	5,5	in	Minimal reinjection well head pressure:	0	MPa
Reinjection pump electric input:	2x37	kW	Well construction:	See Annex II	
Reinjection pressure resp. water temperature vs. flow rate dependence (if available):				See Annex IV	

Reinjection Well 2 (if aplicable)

Well name:	Od-VS2		Maximal reinjection flow rate:	80	l/s
Well depth:	1 900	m	Maximal reinjection well head temperature:	55	°C
Production casing 1 diameter:	13 3/8	in	Maximal reinjection well head pressure:	0,84	MPa
Production casing 2 diameter:	9 5/8	in	Minimal reinjection well head temperature:	30	°C
Production liner diameter:	5,5	in	Minimal reinjection well head pressure:	0	MPa
Reinjection pump electric input:	2x37	kW	Well construction:	See Annex II	
Reinjection pressure resp. water temperature vs. flow rate dependence (if available):				See Annex IV	

Reinjection Well 3 (if aplicable)

Well name:			Maximal reinjection flow rate:		l/s
Well depth:		m	Maximal reinjection well head temperature:		°C
Production casing 1 diameter:		in	Maximal reinjection well head pressure:		MPa
Production casing 2 diameter:		in	Minimal reinjection well head temperature:		°C
Production liner diameter:		in	Minimal reinjection well head pressure:		MPa
Reinjection pump electric input:		kW	Well construction:	See Annex II	
Reinjection pressure resp. water temperature vs. flow rate dependence (if available):				See Annex IV	

Reinjection Well 4 (if aplicable)

Well name:			Maximal reinjection flow rate:		l/s
Well depth:		m	Maximal reinjection well head temperature:		°C
Production casing 1 diameter:		in	Maximal reinjection well head pressure:		MPa
Production casing 2 diameter:		in	Minimal reinjection well head temperature:		°C
Production liner diameter:		in	Minimal reinjection well head pressure:		MPa
Reinjection pump electric input:		kW	Well construction:	See Annex II	
Reinjection pressure resp. water temperature vs. flow rate dependence (if available):				See Annex IV	

PART 4

Characteristics of the heat source

- Energy carriers used
- Installed capacity vs energy carrier
- Annual heat production
- Efficiency of use
- Emissions of pollutants
- Characteristics of heat distribution loops:
  - design parameters
  - length
  - heat losses
  - pipe materials
  - Insulation
  - pressure drop
  - circulation pumps power
  - age
  - control system
  - etc.

Database Dataset for particular project/locality **Part 4** **Locality ID.:** **SK 1**

District Heating System - Heat source

Operator of the heat source: GALANTATERM spol. s r.o.

Description of the system:

Two geothermal production wells are used for heating of large dwelling with approx. 1600 apartments, hospital and other objects. Geothermal energy represents main (base load) heat source with more than 95% share at total heat production. Natural gas boilers are used as a peak and back up heat source. Domestic hot water for dwelling is being prepared in central heat source.

Fee for geothermal water extraction? Yes Value: 0,0266 €/m3
Fee for geothermal water utilisation? No
Amount of extracted geothermal water per year: 430 306 m3/year
Amount of utilized geothermal water per year: 430 306 m3/year
Geothermal heat exchangers installed? Yes
Geothermal heat pumps installed? No
Geothermal storage tanks installed? No
Year of evaluation: 2020

Heat source	Type	Inst. output [kW]	Annual heat production [MWh/year]	Percentage of total heat production [%]	Annual consumption of fuel/energy carrier		Efficiency of use [%]
Geothermal	Baseload	10,46	16 698,61	99,42%	430 306	m3/y	-
Heat pumps						MWh/y	
Natural gas	Peak and backup	13,10	98,06	0,58%	18 457	m3/y	54,62
Biomass						ton/y	
Hard coal						ton/y	
Heating oil						m3/y	
Electricity					427,375	MWh/y	
TOTAL:		23,56	16 796,67				

Principal scheme of heat source: see Annex III Data from control system (if available): see Annex IV

Annual emissions based on measurements or calculation:

Heat source	B(a)P [kg/y]	PM [ton/y]	PM10 [kg/y]	PM2,5 [kg/y]	CO2 [ton/y]	CO [kg/y]	SOx [kg/y]	TOC [ton/y]	NOx [ton/y]
Geothermal	-	-	-	-	10,89	-	-	-	-
Natural gas	N/A	0,0014	N/A	N/A	37,785	0,0103	0,0002	0,0013	0,0309
Biomass									
Hard coal									
Heating oil									
Electricity									
TOTAL:	0	0,0014	0	0	48,675	0,0103	0,0002	0,0013	0,0309

District Heating System - Distribution Network

The same operator as of heat source? Yes

Description of the distribution network:

There are three heating/distribution loops: 1. Hospital 90/70 °C; 2. Dwelling Sever (North) 77/52 °C, 3. Hospital ceiling heating 52/42 °C. Distribution pipelines are placed under ground, in channels (except of distribtion loop 2. which is completelly reconstructed - preinsulated pipes are used). Two pipe system is used for loop 1 and 3, four pipe system is used for loop 2 (with central domestic hot water preparation).

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User4GeoEnergy
Project Number: 2018-1-0502

Number of heat distribution loops: 3 Distribution network situation plan: see Annex V

Heat distribution loop no.: 1 Type of network: Double pipe
Design temperature gradient: 90 / 70 °C Design heat capacity: 3 060 kW
Inner diameter of main pipe: 200 mm Total length of heat distribution loop: 640 m
Heat losses in heat distribution loop: 9,8 % of distributed heat
If heat losses unknown:

Pipe insde diameter [mm]:	200			
Leng of particular pipeline [m]:	640			
Distribution pipe material:	Steel			
Thermal insulation material:	Mineral wool			
Insulation thickness [mm]:	50?			
Protecting cover material:	Gypsum			
Preinsulated?	No			
Thermal conductivity [W/(m.K)]:	N/A			
Dominant placement of pipeline:	In channel			
Age of the network [years]:	25			

Pressure drop in distribution loop: 150 kPa Dependence on flow rate available? No
Circulation pump input: 11 kW Dependence on flow rate available? No
Considered modernization of heat distribution loop: No If yes, description of planned activities:

Expected reduction of heat loss: % of distributed heat Estimated costs: €

Control system Type of control system: Qualitative only
Outdoor air temperature measurement? Yes
Wind speed measurement? No
Solar radiation measurement? No
Other parameters measurement? No
Pump constant pressure difference control: Yes

Supply temperature dep.:

	Out. temp. [°C]	Supply temp. [°C]
1	-11	90
2	-5	79
3	0	72
4	10	48
5	20	20

Heat distribution loop no.: 2 Type of network: Four pipe
Design temperature gradient: 72 / 52 °C Design heat capacity: 6 500 kW
Inner diameter of main pipe: 250 mm Total length of heat distribution loop: 1 885 m
Heat losses in heat distribution loop: 5,25 % of distributed heat
If heat losses unknown:

Pipe insde diameter [mm]:	250	200	150	125
Leng of particular pipeline [m]:	720	387	190	50
Distribution pipe material:	Steel	Steel	Steel	Steel
Thermal insulation material:	PU	PU	PU	PU
Insulation thickness [mm]:	60	45	35	40
Protecting cover material:	HDPE	HDPE	HDPE	HDPE
Preinsulated?	Yes	Yes	Yes	Yes
Thermal conductivity [W/(m.K)]:	0,434	0,452	0,4122	0,3428
Dominant placement of pipeline:	In ground	In ground	In ground	In ground
Age of the network [years]:	4	4	4	4

Pressure drop in distribution loop: 150 kPa Dependence on flow rate available? No

PART 5

Characteristics of heat consumers

- Number of users
- Total ordered heat power
- Annual heat consumption
- Average floor space
- Type of heating system with design supply and return temperature
- etc.
- Similar data are gathered for hot tap water too.

Database Dataset for particular project/locality **Part 5** **Locality ID.:** **SK 1**

Energy Users (Consumers)

Distribution loop no.: **1** Brief description of energy users:

Hospital with polyclinic areal is supplied by heat. Also other building on the way are connected (Retirement home, social housing, apartment house).

Number of users/end points:	8		Typical unitary heat demand:	N/A	W/m2
Total ordered heat input:	507,86	kW	Typical unitary heat consumption:	N/A	MWh/(m2.year)
Annual heat consumption:	2 691,7	MWh/y	Typical/average floor space:	N/A	m2
Price of heat (energy + distribution):	50,78	€/MWh			

Central air conditioning (cooling) system? No

Number of users/end points:		Supply cooling water temperature:		°C
Total ordered cooling input:	kW	Return cooling water temperature:		°C
Annual cold consumption:	MWh/y			

Type of heating system:	Radiators	Floor heating	Ceiling heating	Fan coil
Approx. share in heat sales [%]:	100	0	0	0
Supply heating water temperature [°C]:	90			
Return heating water temperature [°C]:	70			
Share of users requiring retrofitting [%]:	0			

Suggested and possile retrofitting actions:	Share of users:		Estimated costs:	
Walls insulation:		%		€
Replacement of woodwork (windows, doors):		%		€
Increasing the area of radiators:		%		€
Insulation of roofs:		%		€
Insulation of floors on the ground floor:		%		€
Mechanical ventilation without recuperation:		%		€
Mechanical ventilation with recuperation:		%		€
Increasing the surface of radiators:		%		€

Actual Tin: °C Actual Tout: °C
Planned Tin: °C Planned Tout: °C
Other possible interference with the heating installations used: % €
Actual Tin: °C Actual Tout: °C
Planned Tin: °C Planned Tout: °C
Cascade connection of users: % €

Centralized hot tap water preparation? No

Number of users/end points:		Hot tap water supply temperature:		°C
Total ordered heat input for HTW:	kW	Hot tap water circulation temp.:		°C
Annual heat for HTW consumption:	MWh/y	Cold water temperature:		°C

Additional users/consumers planned to be connected? No

Number of planned new users:
Planned heat input/demand: kW
Planned annual heat consumption: MWh/y
Type of heating system:
Design temperature gradient: / °C
Cascade connection (on return pipe of the district heating)? No

Type of control system: Quantitative only

Flow rate dependence:

	Out. temp. [°C]	Flow rate [l/s]
1	-15	
2	-7,5	
3	0	
4	10	
5	20	

Planned hot tap water supply?		Hot tap water supply temperature:		°C
Planned heat input for HTW:	kW	Hot tap water circulation temp.:		°C
Planned heat for HTW consumption:	MWh/y	Cold water temperature:		°C

Distribution loop no.: **2** Brief description of energy users:

Apartment buildings in dwelling Sever (North), mostly prefabricated apartment houses, 8 above ground floors. Also new apartment building are connected and subsequently being built. Four other object are connected (kindergarten, elementary school, pension and retirement home Patria).

Number of users/end points:	1607		Typical unitary heat demand:	13,35	W/m2
Total ordered heat input:	1330,2	kW	Typical unitary heat consumption:	0,0708	MWh/(m2.year)
Annual heat consumption:	7 050	MWh/y	Typical/average floor space:	62	m2
Price of heat (energy + distribution):	50,78	€/MWh			

Central air conditioning (cooling) system? No

Number of users/end points:		Supply cooling water temperature:		°C
Total ordered coolin input:	kW	Return cooling water temperature:		°C
Annual cold consumption:	MWh/y			

Type of heating system:	Radiators	Floor heating	Ceiling heating	Fan coil
Approx. share in heat sales [%]:	100			
Supply heating water temperature [°C]:	77			
Return cooling water temperature [°C]:	52			
Share of users requiring retrofitting [%]:	5			

Suggested and possile retrofitting actions:	Share of users:		Estimated costs:	
Walls insulation:	5	%	90 000	€
Replacement of woodwork (windows, doors):	5	%	480 000	€
Increasing the area of radiators:	0	%		€
Insulation of roofs:	5	%	25 000	€
Insulation of floors on the ground floor:	0	%		€
Mechanical ventilation without recuperation:	0	%		€
Mechanical ventilation with recuperation:	0	%		€
Increasing the surface of radiators:	0	%		€

Actual Tin: °C Actual Tout: °C
Planned Tin: °C Planned Tout: °C
Other possible interference with the heating installations used: % €
Actual Tin: °C Actual Tout: °C
Planned Tin: °C Planned Tout: °C
Cascade connection of users: 0 % €

Centralized hot tap water preparation? Yes

Number of users/end points:	1604		Hot tap water supply temperature:	47 - 53	°C
Total ordered heat input for HTW:	1026,5	kW	Hot tap water circulation temp.:	36 - 47	°C
Annual heat for HTW consumption:	3 904	MWh/y	Cold water temperature:	12 - 15	°C

Additional users/consumers planned to be connected? Yes

Number of planned new users: 120
Planned heat input/demand: 120 kW
Planned annual heat consumption: 320 MWh/y
Type of heating system:
Design temperature gradient: 72 / 52 °C

Type of control system: Qualitative only

Flow rate dependence:

	Out. temp. [°C]	Flow rate [l/s]
1	-11	72
2	-5	64
3	0	57

PART 6

General economic indicators

- Calorific values of burned heat carriers
- Emission factors
- Unit price of heat carriers
- Net unit costs of retrofitting actions
- Net costs of preinsulated pipelines
- Net cost of pipeline laying and assembling

Database **Dataset for particular project/locality** **Part 6 Locality ID.: PL 1**

General Information

Primary energy carriers information:

Primary energy carrier:	Lower calorific value		Upper calorific value		Unit price of energy carrier		
Natural gas	36,37	MJ/m3	40,46	MJ/m3	0,0258	€/kWh	net value, relate
Heating oil	42,6	MJ/kg	44,73	MJ/kg	718,81	€/m3	
Industrial gases	-	kWh/m3	-	kWh/m3	-	€/kWh	only if utilised
Biomass	17	MJ/kg	19	MJ/kg	248,79	€/t	
Electricity	-		-		0,095	€/kWh	net value

General emission factors:

Heat source	B(a)P [kg/GJ]	PM [kg/GJ]	PM10 [kg/GJ]	PM2,5 [kg/GJ]	CO2 [kg/GJ]	CO [kg/GJ]	SOx [kg/GJ]
Natural gas	8E-10	5E-04	0,0005	5E-04	57,65	0,03	4E-04
Biomass	1E-05	0,09	0,086	0,081	101,1	0,4	0,025
Hard coal	1E-05	0,08	0,071	0,055	97,8	0,2	0,418
Heating oil	1E-07	0,002	0,002	0,002	72,48	0,03	0,08
Electricity	-	0,009	-	-	210,6	0,068	0,15

Net unit cost of retrofitting action:

Retrofitting action	Unit	Unit cost [€/unit]
Walls insulation	m2	28,89
Replacement of woodwork (windows, doors)	m2	37,36
Increasing the area of radiators	m2	19,78
Insulation of roofs	m2	22,22
Insulation of floors on the ground	m2	26,52
Mechanical ventilation without recuperation	m3/h	10,00
Mechanical ventilation with recuperation	m3/h	15,00
Increasing the surface of radiators	m2	23,07
Other possible interference with the heating installations used		
Cascade connection of users, share of users in cascade system		

Net cost of preinsulated pipelines:

Nominal diameter:	Cost of pipe [€/m]:	Cost of pipe laying and assembling [€/m]:	d [mm]
DN 50	59,80	73,27	50
DN 65	80,69	77,08	65
DN 80	101,58	81,90	80
DN 100	129,44	89,89	100
DN 125	164,26	102,37	125
DN 150	199,08	117,65	150
DN 200	268,73	156,56	200
DN 250	338,37	206,62	250
DN 300	408,02	267,83	300
DN 350	477,66	340,18	350
DN 400	547,31	423,68	400
DN 450	616,95	518,33	450
DN 500	686,60	624,13	500

ANNEX I

Data for typical meteorological year

- Data taken from Photovoltaic Geographical Information System
- Typical meteorological year for period 2007 - 2016)
- 8760 records (one value for each hour) during a year

Annex I - Typical Climatic Conditions **Locality ID.:** **SK 1**

Country: **Slovakia** **Town/city of:** **Galanta**

Latitude (decimal degrees): 48.191

Longitude (decimal degrees): 17.718

Elevation (m): 117.0

month	year
1	2013
2	2011
3	2007
4	2008
5	2008
6	2014
7	201
8	2008
9	2008
10	201
11	2009
12	2011

time(UTC)	T2m	RH	G(h)	Gb(n)	Gd(h)	IR(h)	WS10m	WD10m	SP
20130101:0000	0,8	84,55	0	0	0	267,33	3,66	156	100632
20130101:0100	0,48	82,27	0	0	0	259,17	3,94	158	100563
20130101:0200	0,17	80	0	0	0	251,01	4,22	159	100494
20130101:0300	-0,15	77,72	0	0	0	242,84	4,5	154	100442
20130101:0400	-0,47	75,44	0	0	0	234,68	4,78	150	100389
20130101:0500	-0,79	73,16	0	0	0	226,52	5,06	146	100337
20130101:0600	-1,11	70,88	0	0	0	218,36	5,34	144	100320
20130101:0700	-1,43	68,6	17	17,64	16	210,2	5,61	143	100304
20130101:0800	0,55	71,02	93	96,8	76	226,6	5,97	141	100287
20130101:0900	1,43	69,87	183	243,58	119	227,37	6,23	142	100228
20130101:1000	2,32	68,73	187	118,55	150	228,13	6,5	144	100169
20130101:1100	3,2	67,58	201	143,6	155	228,9	6,76	145	100110
20130101:1200	2,2	71,93	131	31,37	122	229,73	6,27	144	100153
20130101:1300	1,19	76,28	111	79,43	94	230,57	5,78	142	100195
20130101:1400	0,19	80,63	44	46,85	39	231,4	5,3	141	100238
20130101:1500	-0,54	82,8	0	0	0	232,22	5,09	136	100245
20130101:1600	-1,26	84,98	0	0	0	233,03	4,88	132	100251
20130101:1700	-1,99	87,15	0	0	0	233,85	4,68	127	100258
20130101:1800	-2,62	88	0	0	0	235,03	4,49	122	100261
20130101:1900	-3,24	88,84	0	0	0	236,22	4,31	118	100264
20130101:2000	-3,87	89,69	0	0	0	237,4	4,12	113	100268
20130101:2100	-4,26	90,08	0	0	0	237,87	3,8	112	100271
20130101:2200	-4,65	90,47	0	0	0	238,33	3,48	112	100274
20130101:2300	-5,04	90,86	0	0	0	238,8	3,16	112	100277
20130102:0000	-4,73	88,22	0	0	0	240,62	2,69	102	100366
20130102:0100	-4,42	85,58	0	0	0	242,43	2,23	93	100455
20130102:0200	-4,1	82,94	0	0	0	244,25	1,77	83	100544
20130102:0300	-3,94	82,43	0	0	0	243,05	1,7	87	100560
20130102:0400	-3,78	81,91	0	0	0	241,85	1,64	90	100577
20130102:0500	-3,61	81,4	0	0	0	240,65	1,57	93	100593
20130102:0600	-2,85	81,18	0	0	0	244,68	1,3	95	100665

ANNEX II

Well construction schemes

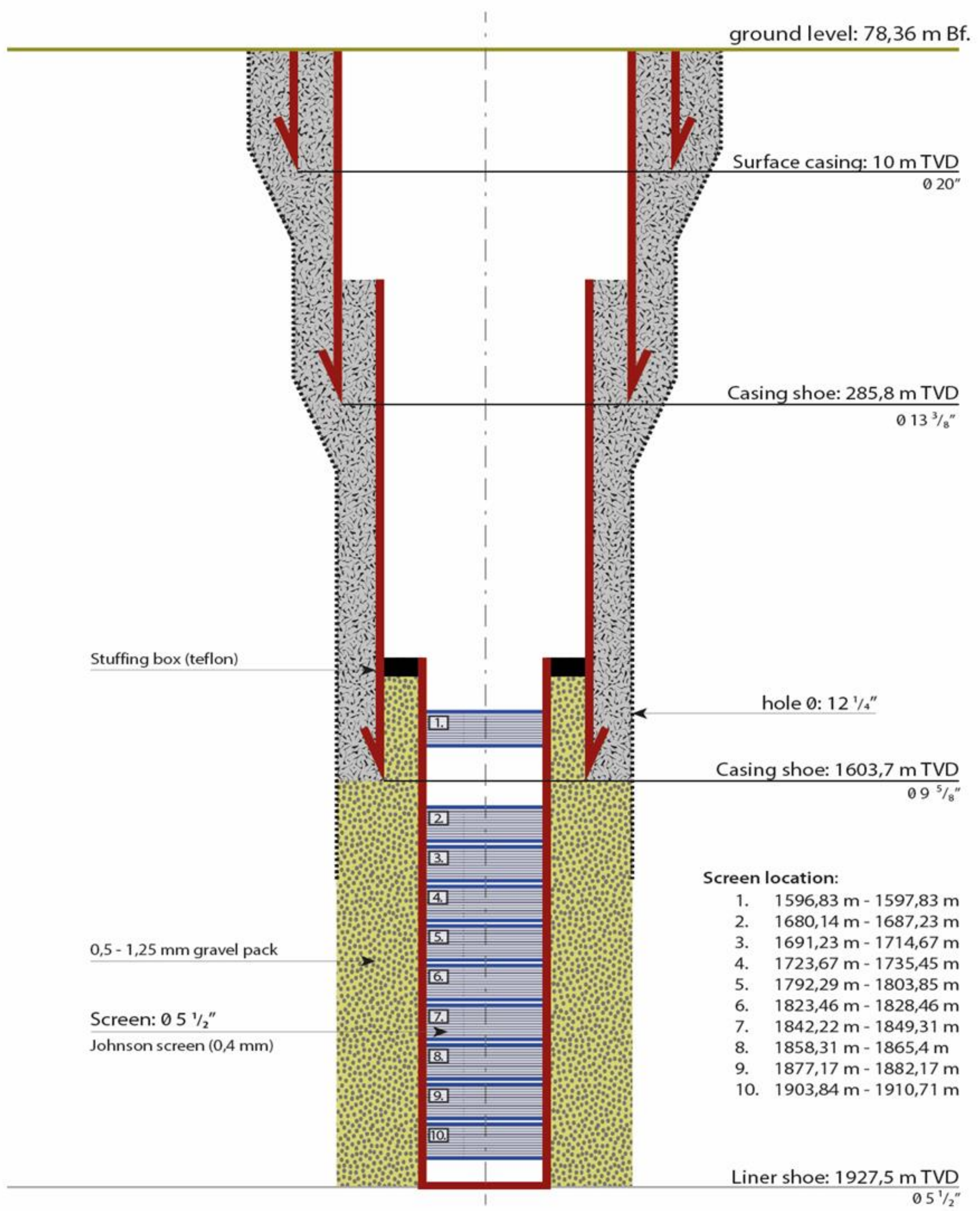
Annex II - Well construction schemes **Locality ID.: HU 1**

Country: Hungary **Town/city of: Szeged**

Production well 1 construction **Well name: Od-T1**

WELL CONSTRUCTION SCHEME

Szeged, Odessza T–1 production well



Screen location:

1. 1596,83 m - 1597,83 m
2. 1680,14 m - 1687,23 m
3. 1691,23 m - 1714,67 m
4. 1723,67 m - 1735,45 m
5. 1792,29 m - 1803,85 m
6. 1823,46 m - 1828,46 m
7. 1842,22 m - 1849,31 m
8. 1858,31 m - 1865,4 m
9. 1877,17 m - 1882,17 m
10. 1903,84 m - 1910,71 m

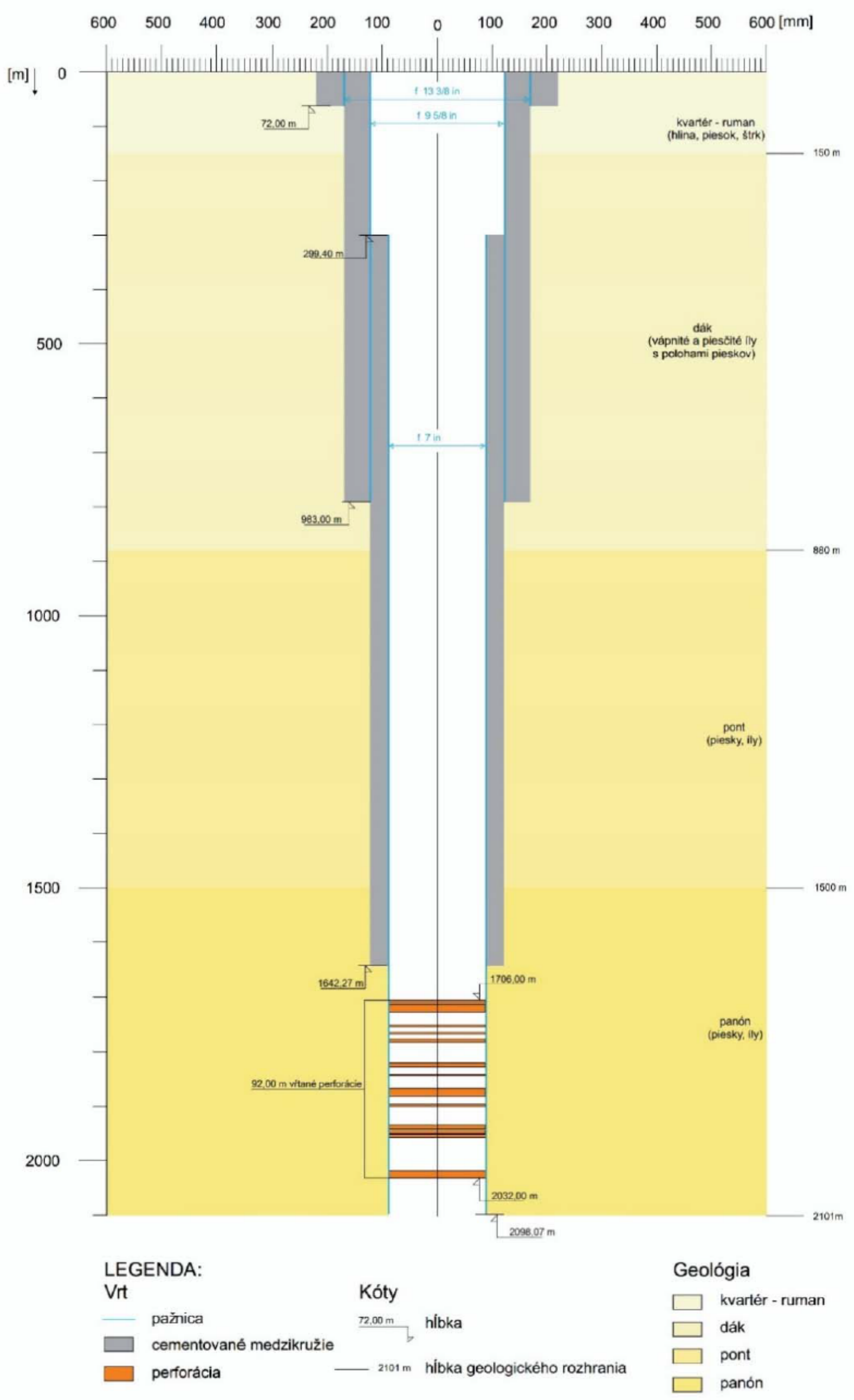
Wellsite name:	Szeged, Odessza T–1. production well
Location:	Szeged, 1950 hrsz.
Building contractor:	HANSA Kontakt Inv. Kft. 6728 Szeged, Back Bernát u. 6.

Annex II - Well construction schemes **Locality ID.: SK 1**

Country: Slovakia **Town/city of: Galanta**

Production well 1 construction **Well name: FGG-2**

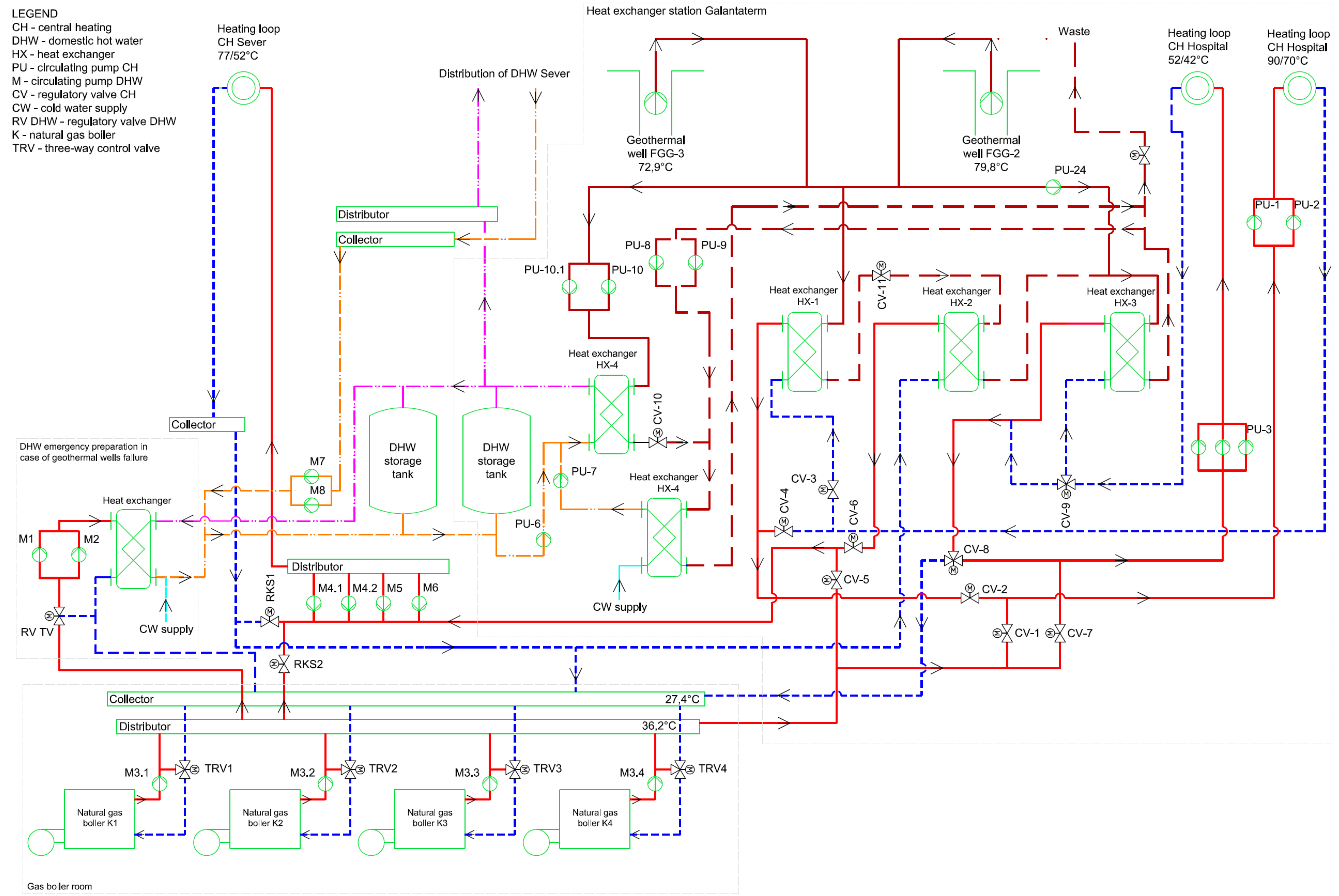
Názov vrtu: FGG2 Galanta



ANNEX III

Principal scheme of the heat source

Annex III: Principal Scheme of Heat Source   Locality: Galanta   Locality ID: SK 1



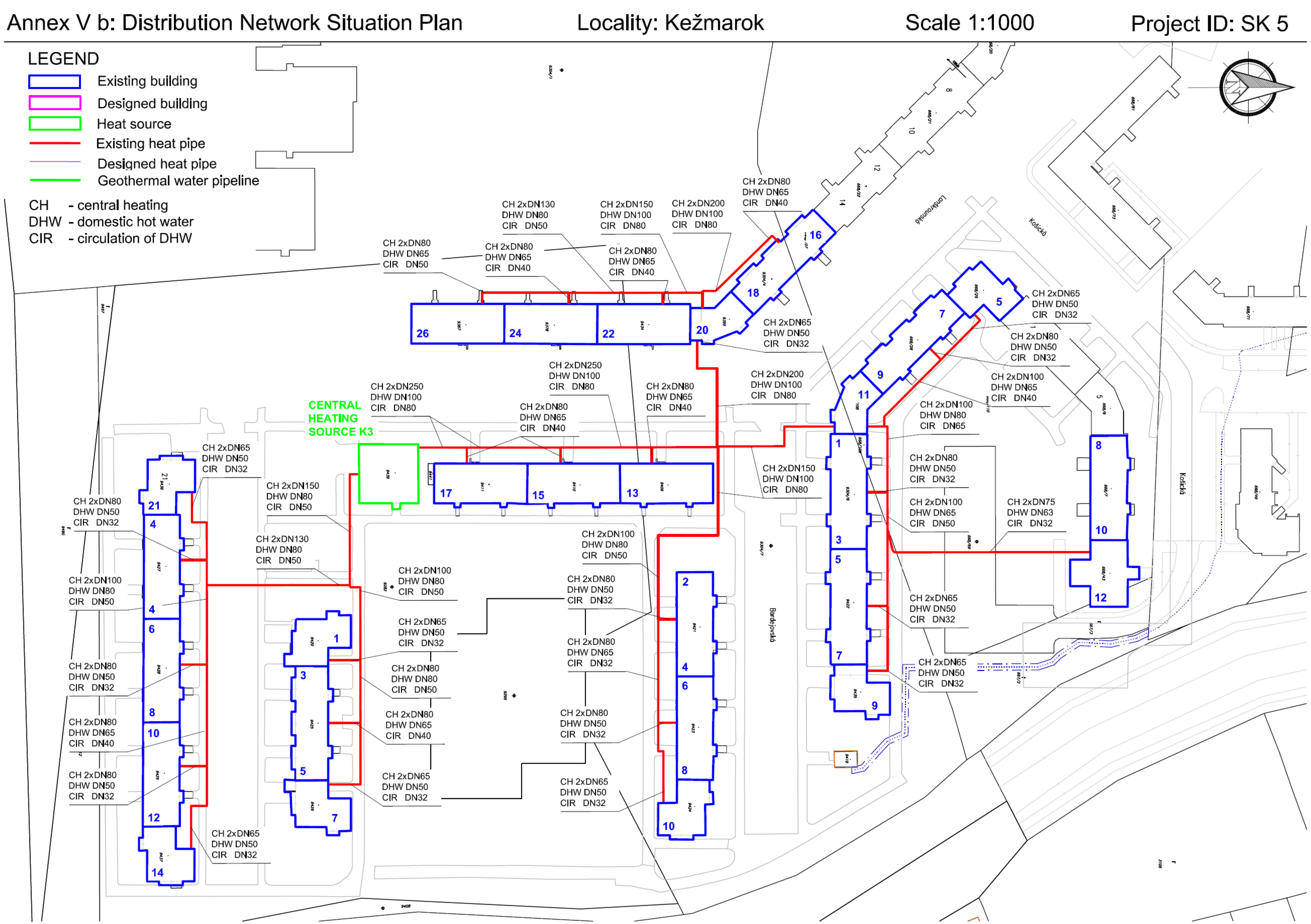
ANNEX IV

Data from the DH system operator control system (SCADA)

Column:	1	2	10				11	14		15		16		17	
Description:	Date/time	Outdoor air temperature	Temperature of heating water at output from boilers				Temperature of return heating water at input to boilers	Temperature of heating water at output from boiler room for each loop separately		Temperature of return water at entrace to boiler plat for each heating loop separately		Flow rate of heating water for each loop separately		Actual thermal output for each loop separately	
			K1	K2	K3	K4	K1,K2,K3,K4	UK1	UK2	UK1	UK2	UK1	UK2	UK1	UK2
Unit:		°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	m3/h	m3/h	kW	kW
	1.1.2020 1:06	1,8	71,8	56,3	56,3	65,7	52,6	49,7	49,6	42,6	42,9	88,8	36,9	745	281
	1.1.2020 1:18	1,8	72,8	56,3	56,3	65,7	53,2	49,7	49,5	42,6	42,9	88,8	36,1	729	276
	1.1.2020 1:29	1,6	72,8	56,3	56,3	65,5	53,3	49,7	49,6	42,6	43	88,6	36,7	719	278
	1.1.2020 1:40	1,6	72,2	56,3	56,3	65,5	53,5	49,7	49,6	42,6	43	88,1	37	718	269
	1.1.2020 1:51	1,2	73,1	55,8	55,8	64,8	52,4	50,6	50,5	42,9	43,3	90,5	34,7	796	308
	1.1.2020 2:02	1,2	72,8	55,8	55,8	64,8	52,9	50,6	50,5	42,9	43,2	89,8	36,7	796	308
	1.1.2020 2:13	1,3	72,9	55,8	55,7	64,8	53,3	50,7	50	43	43,3	88,3	34,7	788	267
	1.1.2020 2:25	1,5	72,3	55,8	55,7	64,8	49,9	50,7	50	43	43,3	90,5	33,7	788	286
	1.1.2020 2:36	1,3	74,5	55,3	55,3	64	54,5	50	50,5	43,4	43,7	87,6	36,3	695	246
	1.1.2020 2:47	1,3	74,2	55,3	55,3	64	53,5	50,5	50,1	43,4	43,7	88,1	35,3	726	262
	1.1.2020 2:58	1,2	72,2	55,2	55,2	63,9	53,5	51	50,4	43,4	43,7	88,8	34,6	771	246
	1.1.2020 3:09	1,2	75,3	55,2	55,2	63,9	47	50,3	50,1	43,3	43,6	90,2	36,4	774	246
	1.1.2020 3:20	0,8	72,2	54,8	54,7	63,1	54,3	51,1	51	43,5	43,8	87,4	33,3	690	285
	1.1.2020 3:31	0,8	72,2	54,8	54,7	63,1	53,5	51,1	50,9	43,5	43,8	88,8	33,3	766	271
	1.1.2020 3:43	0,8	71	54,7	54,7	63	53,6	50,7	50,6	43,5	43,9	88,8	35,4	733	274
	1.1.2020 3:54	0,8	64,1	54,5	54,4	63	52,3	50,1	50,6	43,5	43,9	89,3	32,3	700	224
	1.1.2020 4:05	0,3	77,4	78,3	74,6	62,3	57,5	52,3	52,1	43,8	44,1	81,6	36	866	334
	1.1.2020 4:16	0,3	77,4	77	74,6	62,3	57,2	51,6	51,6	43,7	44,1	87,4	35,6	835	304
	1.1.2020 4:27	0,3	77	75,3	74,9	62,2	57,3	51,9	51,6	43,8	44,2	87,1	36,3	810	310
	1.1.2020 4:38	0,3	77,5	76	75,6	62,2	54,9	52,3	52,4	43,8	44,2	85	34	839	315
	1.1.2020 4:50	0,4	71,3	71,8	73,6	61,6	60	51,1	50,9	44,3	44,6	88,3	36,6	700	253
	1.1.2020 5:01	0,4	76,9	73,1	73,6	61,6	59,9	51,3	51,3	44,3	44,6	88,3	36,6	710	283
	1.1.2020 5:12	0,4	77,3	72,8	73,4	61,6	60,6	51,5	51,7	44,3	44,7	87,4	35,6	717	284
	1.1.2020 5:23	0,4	77,7	72,6	73,4	61,6	61,6	51,2	51,8	44,4	44,7	88,6	34,1	687	288
	1.1.2020 5:34	0,3	76,4	73,5	72,3	61,3	60,5	51,8	51,1	44,3	44,5	86,4	35,7	748	261
	1.1.2020 5:45	0,3	76,7	72,9	72,3	61,3	60,5	51,8	51,5	44,3	44,6	87,4	35,7	748	281
	1.1.2020 5:57	0,3	76,9	73,7	72,2	61,3	61,7	51,9	51,1	44,4	44,7	88,8	33,8	754	248
	1.1.2020 6:08	0,4	76,2	73,7	72,2	61,3	62,1	51,9	51,1	44,4	44,8	89,3	33,7	771	248
	1.1.2020 6:19	0,2	78	72,7	71,2	60,9	60,6	51,2	51,8	44,3	44,5	84,7	35,4	688	294
	1.1.2020 6:30	0,2	76,9	72,7	71,2	60,9	61,1	51,7	51,8	44,3	44,5	87,8	35,1	741	294
	1.1.2020 6:41	0,3	76,8	72,5	71	60,9	60,8	51,8	51,4	44,3	44,4	87,4	34,1	745	271
	1.1.2020 6:52	0,3	76,3	72,3	71	60,9	61,6	51,4	51,3	44,4	44,4	86,2	34,1	705	271
	1.1.2020 7:04	-0,2	77,5	73,7	70	60,6	60	52,5	52,1	44,3	44,7	89,3	36	838	302
	1.1.2020 7:15	-0,2	77,5	73	70	60,6	60,6	52,5	52,1	44,3	44,7	89	35,3	838	301
	1.1.2020 7:26	-0,4	77,7	73,7	69,9	60,6	60,6	52,2	52	44,5	44,8	87,4	36	779	298
	1.1.2020 7:37	-0,3	77,7	74	69,9	60,6	60,6	52,2	52	44,5	44,8	89	34	777	301
	1.1.2020 7:48	-0,8	75,4	72,5	69	60,3	59,2	53	52,9	45	45,5	85,7	36,1	830	283
	1.1.2020 7:59	-0,6	76,7	72,5	69	60,3	59,2	52,8	52,7	45	45,5	87,4	36,1	794	298
	1.1.2020 8:10	-0,5	76,9	74	68,9	60,3	59,6	53	52,8	45	45,5	85,4	34,7	792	291
	1.1.2020 8:22	0	77,3	74	68,9	60,3	61,1	52,2	53	45	45,6	87,6	34,7	792	291
	1.1.2020 8:33	-0,8	76,7	72,1	68	59,9	59,3	53	52,1	45,3	45,4	85,2	33,7	680	254
	1.1.2020 8:44	-0,6	76,8	72,1	68	59,9	59,3	53	52,5	45,2	45,4	85,4	33,7	770	277
	1.1.2020 8:55	-0,3	77	72,6	67,9	59,8	58,8	53	52,3	45,1	45,2	86,6	33,3	784	270
	1.1.2020 9:06	-0,3	76,5	72,6	67,9	59,8	58,8	53	52,5	45,3	45,2	86,6	33,4	784	273
	1.1.2020 9:17	1,3	77,5	73,8	67,1	59,5	61,1	50,6	50,6	45	45,7	84,7	32	559	184
	1.1.2020 9:29	1,3	77,3	73,8	67,1	59,5	61,1	50,8	51	45	45,5	84,7	32,5	559	205
	1.1.2020 9:40	1,3	76,2	74,4	67	59,4	61,8	50,3	50,4	44,9	45,4	84,5	31,8	526	182

ANNEX V

Distribution network situation plan



RETROFITTING ACTIVITIES PRICE UPDATE

no	Cost retrofitting activities (all values gross - including VAT)	Poland	Hungary	Slovakia
1	EXTERNAL WALLS insulation			
	cost of purchasing styrofoam 15 cm [€/m2]	10	12,59	21,6
	cost of purchasing styrofoam 20 cm [€/m2]	11,77	16,18	31,85
	cost of purchasing styrofoam [€/m3] (CALCULATED based aboves)	62,76	82,42	151,63
	cost of purchasing rockwool 20 cm thick [€/m2]	16,77	16,7	24,26
	cost of purchasing rockwool 20 cm [€/m3] (CALCULATED based above) [€/m3]	83,85	83,49	121,30
	cost of additional materials (plaster, parget, mesh, etc.)	5	5	7,5
	assembly cost (work costs) [€/m2]	33,33	25	40
	total (20 cm styforoam) [€/m2]	50,1	46,18	79,35
2	ROOF insulation			
2a	Insulation of a floor abouve a last elevation			
	styrofoam - based above	11,77	16,18	31,85
	cost of additional materials (self-leveling screed etc.) [€/m2]	31,99	9,81	18,5
	assembly cost (work cost) [€/m2]	27	25	40
	total cost (20 cm styforoam) [€/m2]	70,76	51	90,35
2b	Insulation of roof slopes with finishing			
	cost of rockwool - based above [€/m2]	16,77	16,7	19,73
	additional materials [€/m2]	7	7	10
	assembly cost (work cost) [€/m2]	26	25	40
	total cost (20 cm rockwool) [€/m2]	49,77	48,7	69,73
3	FLOOR ON GROUND insulation			
	styrofoam (10 cm) - based above	6,28	8,24	13,1
	cost of additional materials (self-leveling screed etc.) [€/m2]	31,99	9,81	18,5
	assembly cost (work cost) [€/m2]	27	25	40
	total cost (10 cm of styrofoam) [€/m2]	65,27	43,06	71,60
4	WINDOWS exchange			
	cost of a window [€/m2]	195,28	130,18	300
	cost of assembly (work cost)	150	100	200
	total cost [€/m2]	345,28	230,18	500
5	VETILATION+RECUPERATOR (heat recovery)			
2a	Advanced method			
	cost of purchasing of a heating station equiped with recuperator [€/(m3/h)]	6,03	6,61	8,06
	additional costs (ventilation ducts, air vents, etc.) [€/(m3/h)]	2	2	3
	assembly cost (work cost) [€/(m3/h]	2,41	2,1	3,56
	total cost [€/(m3/h)]	10,44	10,71	14,62
2b	Simple method			
	total cost (besed on a house with size 100-200 m2) [€/m2]	22,22	33,86	65
6	TRANSMISSION LINES (redution of heat losses)			
	DN32 [€/m]	32,72	31,32	35,65
	DN40 [€/m]	33,57	33,2	42,54
	DN50 [€/m]	42,05	40,19	50,23
	DN65 [€/m]	43,81	42,67	56,15
	DN80 [€/m]	64,27	58,12	66,42
	DN100 [€/m]	62,22	60,13	86,96
	DN139 [€/m]	79,89	75,05	122,3
	DN168.3 [€/m]	113,43	109,32	145,23
	assembly cost (work cost) [€/m]	cost of a pipe	102	2 x cost of pipe
	total [€/m]	3 x pipe cost	2x pipe cost	4 x cost of pipe
7	RADIATORS or heating system [€/kW]			
	radiators aluminium design parameters 110/70/20°C	74,27	139,9945789	214,49
	plate steel radiators 75/65/20°C	119,6	121,3011248	186,62
	installation (work cost) [€/kW]	19,39	17,53	40,11
	total cost	1,1 * cost of radiators	1,1 * cost of radiat	1,1 * cost of radiators
8	EXTENDING OF HEAT EXCHANGERS TAP HOT WATER [€/kW]			
	steel plate heat exchanger heating 80/60 | cooling 55/10 [€/kW]	7,125	2,637635309	11,12
	installation (work cost) [€/kW]	20% of a exchanger	20% of a exchange	20% of a exchanger
	total cost (work cost) [€/kW]	1,2 * exchanger cost	1,2 * exchanger co	1,2 * exchanger cost

ENERGY SOURCES PRICE UPDATE

no	Carrier	Poland	Hungary	Slovakia
1	Gas boiler, natural gas			
	investments related to the heat source, conventional boiler [€/kW]	156,0976	148,91	180,51
	investments related to the heat source, condensing boiler [€/kW]	190,2439	186,7	220,45
	lower caloric value of gas [MJ/m3]	35	35	35
	purchasing price incl. fuel and distribution [€/m3]	0,8	0,872	0,7
	emission CO2 [kg/GJ energy contained in the fuel]	57,56	57,56	56,3
	emission SO2 [kg/GJ energy contained in the fuel]	4,00E-04	4,00E-04	0,000248
	emission NOx [kg/GJ energy contained in the fuel]	4,00E-02	4,00E-02	0,046488
	emission total dust [kg/GJ energy contained in the fuel]	5,00E-04	5,00E-04	0,00008
2	Heating oil			
	investments based with the heat source [€/kW]	156,10	148,91	N/A
	lower caloric value of gas [MJ/L]	34,86	34,86	
	purchasing price [€/L]	0,99	1,23	
	emission CO2 [kg/GJ energy contained in the fuel]	72,48	72,48	
	emission SO2 [kg/GJ energy contained in the fuel]	0,08	0,08	
	emission NOx [kg/GJ energy contained in the fuel]	0,07	0,07	
	emission total dust [kg/GJ energy contained in the fuel]	0,002	0,002	
3	Hard coal			
	investments based with the heat source [€/kW]	138,21	N/A	N/A
	lower caloric value of gas [MJ/kg]	25		
	purchasing price [€/Mg]	400		
	emission CO2 [kg/GJ energy contained in the fuel]	96,37		
	emission SO2 [kg/GJ energy contained in the fuel]	0,56		
	emission NOx [kg/GJ energy contained in the fuel]	0,17		
	emission total dust [kg/GJ energy contained in the fuel]	4,8		
4	Electricity - direct heating			
	investments based with the heat source [€/kW]	52,03	51,94	60,73
	purchasing price of the energy carrier (energy+transmissions fees) [€/MWh]	178	202,6	200
	emission CO2 [kg/GJ energy contained in the fuel]	196,67	74,72	70
	emission SO2 [kg/GJ energy contained in the fuel]	0,14	4,00E-04	N/A
	emission NOx [kg/GJ energy contained in the fuel]	0,14	4,00E-02	N/A
	emission total dust [kg/GJ energy contained in the fuel]	0,0061	5,00E-04	N/A
5	Heat pumps			
	investments based with the heat source [€/kW]	400	504	550
	COP possible to reach, average yearly	3,5	5,8	4
6	payment for CO2 emission [€/Mg]	70	80	80
7	Fee for geothermal water extraction [€/m3]	0	0	0,0266

SIMPLIFIED DATABASE FOR ONLINE CALCULATOR

no	Location	Country	Brief description	Total installed and used power [kW]	Additional energy carrier: type and power installed [kW]	Energy production [GJ/y]	Heating [kW]	Heating design parameters [tin/tret]	Hot water [kW]	Hot water design parameters [tin/tret]	Reservoir depth [m bgl]	Geothermal outflow [m3/h]	Wellhead temperature of geothermal [°C]
1	Poddębice	PL	Single well, geothermal fluid drinkable conditions, low TDS	15000	heating oil 7500; biomass 2000	130000	15000	75/50	500	65/45	1962-2063	252	68,4
2	Mszczonów	PL	Single well, a reinjection well ist just drilled, low TDS, heat pumps + natural gas, two heating loops	9300	natural gas 4600; absorption heat pump 2700; compression heat pump 1000	48190	5800	(1) 80/60 + (2) 70/50	500	65/45	1600-1700	55	42
3	Sochaczew	PL	Geothermal about 5 MW, absorption hest pumps 2 x 2,5 MW	28720	natural gas 3200; absorption heat pumps 5000	175000	18000	(1) 115/70 + (2) 90/70	1000	70/45	1355-1487	90 (based on a presentation 2023), in the WP4 52 m3/h is specified	40
4	Sieradz	PL	good geothermal conditions, low TDS, works in progress	63700	hard coal 63700; biomass	465451	63700	130/70	5000	70/45	1279-1499	249	69
5	Konin	PL	high TDS	124000	lignite, waste incineration, biomass	981000	123600	130/70	12400	70/50	2600	100	95
6	Koło	PL	high TDS	28000	hard coal	201000	25900	150/80	2000	75/40	2400-2800	225	81
7	Konstantynów Łódzki	PL	high TDS, peak heating coal based DH	7800	Veolia Łódź SA, coal based distruct heating	46000	7800	120/65	1500	75/45	up tp 3000	100	70
8	Choszczno	PL	high TDS, wells does not exist, that is only possible location, geothermar conditions good	9500	PEC Choszczno, coal based	88000	9500	130/70	800	70/45	1300	240	56
9	Pabianice	PL	installation does not exist, good geothermal conditions	9200	ZEC Pabianice, coal based	79000	9200	130/80	800	75/45	2600	270	70
10	Szczecin	PL	does not exist, good geothermal conditions, existing DH	189000	coal based Szczecińska	1660000	189000	130/70	16000	70/45	1500	245	67
11	Sala	SK	Single well, low TDS	16000	Natural gas boilers (peak and backup source) 14700 kW	65000	16000	80/50	local hot tap water peparation in domestic heat exchanger station, approx 33 % of annual energy production		1800	39,6	71
12	Samorín	SK	installation does not exist, good geothermal conditions, connections of 3 existing DHS	21850	Natural gas boilers (peak and backup source) 19500 kW	67680	21850	65/52	1500	55/45	1600	54	65
13	Sabinov	SK	installation does not exist, good geothermal conditions	20174	Natural gas boilers (peak and backup source) 16874 kW	36000	20174	70/45	1500	55/45	3500	54	105
14	Spisska Nova Ves	SK	installation does not exist, good geothermal conditions for heat pumps	15600	Natural gas boilers, 13600 kW	45000	15600	70/50	1200	55/45	1200	36	35
15	Zeliezovce	SK	installation does not exist, good geothermal conditions	6720	Natural gas boilers, 5720 kW	34200	6720	90/70	local hot tap water peparation in domestic heat exchanger station, approx 33 % of annual energy production		1200	9	60
16	Kežmarok	SK	Installation in phase of construction, one geothermal well was drilled, well testing phase is in preparation	7300	Natural gas boilers, 6145 kW	13500	2200	70/50	800	55/45	2500	50	70
17	Krupina	SK	installation does not exist, presumption of good geothermal conditions	10200	Natural gas boilers, 9200 kW	34200	2600	85/50	566	55/45	2200	50	65
18	Velky Meder	SK	Existing geothermal DHS, Single well, low TDS, two DHS loops united into the one syste	9988	Natural gas boilers (peak and backup source) 6890 kW	55800	7530	70/50	1000	56/50	2450	42,12	96
19	Sered'	SK	Existing geothermal DHS, Single well, low TDS, heat pums and gas burning cogeneration unit are installed	10124	Natural gas boilers (peak and backup source) 8500 kW, heat pumps 1029 kW, natural gas cogeneration unit (combined heat and power unit) 245 kWth	46800	9506	70/50	1000	50/40	1800	21,6	66
20	Galanta	SK	Existing geothermal DHS, two production wells, low TDS, two DHS loops united into the one system	23560	Natural gas boilers (peak and backup source) 13100 kW	61200	12300	90/42	1000	53/40	2100	48,6	81
21	Makó	HU	goethermal DH	14500	Natural gas boilers 5490	42150	10300	90/70	400	55/45	1948-2268	84	94
22	Csongrád	HU	geothermal DH	10000	Natural gas boilers 4300	21384	8250	70/40	380	55/45	1307-1526	29	60
23	Miskolc	HU	geothermal DH	408000	Biomass 39000, natural gas boilers 70000	432000	324000	90/70	240000	65/42	1430-1514	480	87
24	Szeged Odessza	HU	geothermal DH	20500	Natural gas boilers (peak and backup source) 15509 kW	65269	9176	90/70	1177	50/45	1900	126	94

CONCLUSIONS

- The WP4 database is probably the most detailed collection of data on the district heating systems in these countries ever created.
- Created database was the basic input to all activities in WP5.
- The database was updated (mainly in relation to significant changes in energy carriers and retrofitting works price).
- The main database will not be published (due to confidential data)
- Updated prices of energy sources and retrofitting activities will be freely available (part of the online calculator)

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Thank you!

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