SDH
solar district heating

Case study : Radviliskis (Lituania)

Name of the project: Intergrating a solar plant in the district heeating of
Adress of the project: City of Radviliškis, Žironų g.3, LT-82143, Radviliškis
Name and type of the owner: The district heating is owned by the city of Radviliškis and service is delegated to UAB"Radvilškio šiluma"
Owner contact person: Pranas Mickaitis - director of UAB "Radvilškio šiluma", phone number: +370-8-422-60872, e-mail: pranas@radsiluma.lt

Context of the study

Support

Renewable energy is supported using National and EU funds. Biomass boilers and CHP installation projects are supported according to the new EU support financing stage regulations in Lithuania.

SDH plant

DH system

Five boilers are installed in the boiler-house for heat and steam generation: four water heating boilers and one steam boiler. Currently total installed capacity of the boiler-house is 42 MW. Maximum hourly capacity demand from district heating consumers in Radviliškis town is 28 MW, and minimum - 1.9 MW. In total 70% of heat consumers are supplied from this boiler-house. Total numer of heat consumers reach 4730. The major share are residents. 91% of all sold energy is supplied to residental consumers.

The length of heat carrier pipelines in Radviliškis town, supplying district heating from the boiler-house to consumers, is 20,759 km. During 2006-2008 years period investment project "Modernization and development of energy transmission and distribution pipelines and related infrastructure in Radviliškis region" has been implemented by contractors and 7,018 km of pipelines were replaced by pre-insulated pipes in Radviliškis town. Project started on Dec 1, 2006. finished in August, 2008. Total value of the project 6.7 mill. Litas, including EU support - 2.9 mill. Litas.

In year 2007 the company has developed technical project for installation of two biomass pre-ovens, boilers and condensing economizers with capacity 5 MW each in Radviliškis boiler-house during 2009/2010 - as well as natural gas CHP plant. This investment project 'Construction of biomass boiler-house of condensing economizer and CHP units' was implemented during the period 2009-2010 using company's own means and EU support, by contractors.

Since the start of year 2010 the boiler-house operates two new biomass boilers of capacity 5 MW each, 2.0 MW condensing economizer and 4 MW water heating boiler using natural gas for covering peak demand, as well as CHP unit with power capacity 150 kW and thermal capacity of 190 kW operating on natural gas. Project was started in spring 2009, and finished in spring 2010. Total investment 9.59 mill. Litas, incl. EU support of 4.30 mill. Litas.

In year 2015 new water heating boiler with capacity of 8 MW together with machanized biomass pre-over and other subsidiary installations and systems will be installed with 2 MW condensing economizer and all necessary systems.

Heat production 2012:

Heat production	January	February	Mach	April	May	June	July	August	September	October	November	December	
Boiler	MWh	MWh	MWh	MWh	MWh	MWh	MWh	MWh	MWh	MWh	MWh	MWh	
Boiler No 1	3474.4	3417.1	2925.9	2164.6	1074.3	1485.1	1335.7	0.3	153.6	1981.3	2397.3	3431.4	
Boiler No 2	3605.1	3655.2	2785.8	1010.4	0	0	0	1497.8	1418.6	1191.4	2449.4	2917.3	
Boiler No 3	0	0	0	0	0	0	0	0	0	0	0	0	
Boiler No 4	364.1	499.6	420.7	0	0	0	0	0	0	0	0	0	
Boiler No 5	393	0	0	0	0	0	0	0	0	0	0	1340	
Condensation economizer	1232.9	1009.5	942.6	499.5	145.7	197.5	194.9	212.8	229.8	579.3	958.5	1311.5	
Total	**9069.5**	**8581.4**	**7075**	**3674.5**	**1220**	**1682.6**	**1530.6**	**1710.9**	**1802**	**3752**	**5805.2**	**9000.2**	**45904**

Heat and electricity production	Total productio	January	February	Mach	April	May	June	July	August	September	October	November	December
Cogeneration unit	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh
heat production	786490	145465	131091	136620	79709	0	0	0	0	0	36755	114950	141900
electricity production	561798	106452	98908	98404	49545	0	0	0	0	0	23876	77329	107284

Temperature in networks:

Forward and return temperature, °C	January	February	Mach	April	May	June	July	August	September	October	November	December
Forward temperature	78.09	84.66	69.63	67.64	67.61	67.84	68.69	67.25	67.75	67.72	67.94	79.28
Return temperature	38.27	42.76	37.49	38.23	38.8	40.74	38.94	39.1	38.77	37.12	36.22	39.99

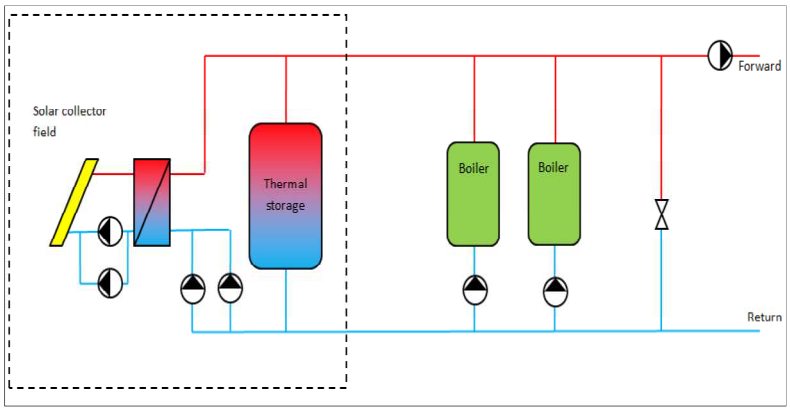
Equipment

Eqiupment	Producer	Capacity	Efficiency	Yearly running hours	Fuel	Calorific value of fuel
Boilers		**MW**	**%**	**h**	**-**	**kcal/nm3**
Boiler No 1	BBH-5000	5	85	6900	**Solid biomass**	2429
Boiler No 2	BBH-5000	5	85	4200	**Solid biomass**	2429
Boiler No 3	-	-	-	-	**-**	-
Boiler No 4	HWK 4000-6-300	4	98	410	**Natural gas**	8026
Boiler No 5	PTVM-30M	24	93.6	190	**Natural gas**	8026
Condensation economizer	Tedom Cento L150	3.5	86.4	8100	**Natural gas**	8026

Cogeneration unit	Producer and model	Power capacity	Heat capacity	Power and heat	Fuel	Calorific value	Exploitation time	Yaerly running
		kW	kW	%	-	kcal/nm3	year	h
Cogeneration unit	Tedom Cento L150	150	190	86.4	Natural gas	8026	4	4500

SDH system concept

A simple principle drawing of the solar collector field connected to a plant. The system requires a series of parts, here among solar collectors and foundation for these, a house for the technical equipment, heat exchangers together with transmission pipes and pumps, thermal storage, a nitrogen plant and valves.



SDH technical data

Investment costs:

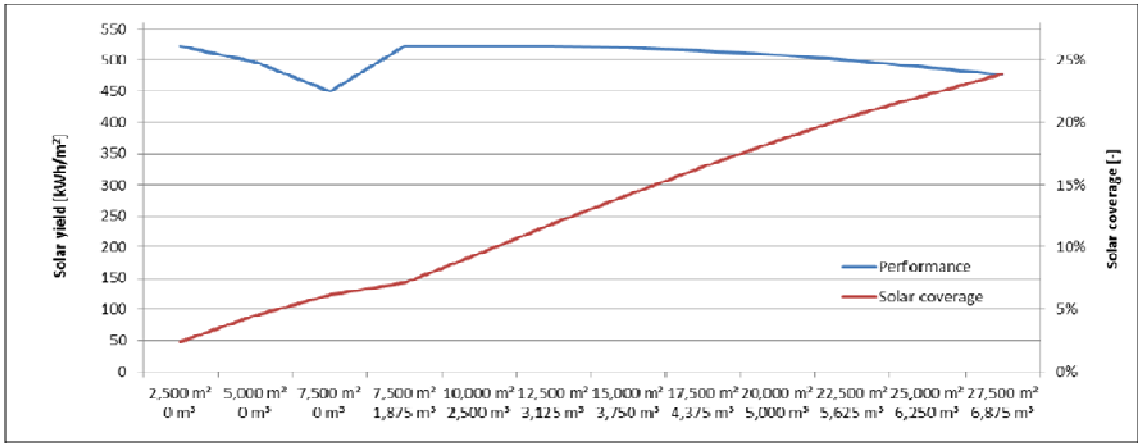
Collectors area, m^2	2000	5000	7500	10000	12500	15000	20000	22500	25000	27400
Investment, €/m^2	300	280	255	235	230	225	210	205	203	200

Heat production	Solar collectors		2,500 m^2	5,000 m^2	7,500 m^2	7,500 m^2	10,000 m^2	12,500 m^2	15,000 m^2	17,500 m^2	20,000 m^2	22,500 m^2	25,000 m^2	27,500 m^2
	Storage		0 m^3	0 m^3	0 m^3	1,875 m^3	2,500 m^3	3,125 m^3	3,750 m^3	4,375 m^3	5,000 m^3	5,625 m^3	6,250 m^3	6,875 m^3
	Unit	Reference	-	-	-	-	-	-	-	-	-	-	-	-
Biomass boiler	MWh	51.467	50.227	49.102	48.254	47.716	46.453	45.188	43.944	42.781	41.664	40,608,50	39,668,60	38.799
Natural gas boiler	MWh	3.429	3.364	3.312	3.266	3.266	3.225	3.185	3.146	3.108	3.074	3,045,90	3,021,70	2.999
Solar heat	MWh	-	1.305	2.482	3.376	3.914	5.218	6.523	7.806	9.007	10.158	11,241,30	12,205,50	13.098
Total	MWh	54.896	54.896	54.896	54.896	54.896	54.896	54.896	54.896	54.896	54.896	54.896	54.896	54.896
Solar share	%	0	0.024	0.045	0.061	0.071	0.095	0.119	0.142	0.164	0.185	0.205	0.222	0.239

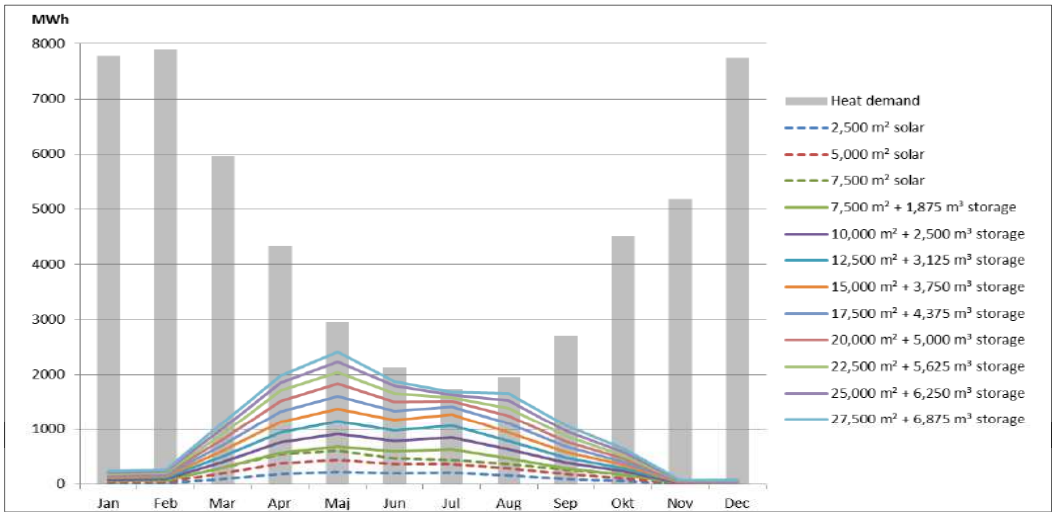
Anual consuption of solid biomass and natural gas

Fuel consuption	Solar collectors		2,500 m^2	5,000 m^2	7,500 m^2	7,500 m^2	10,000 m^2	12,500 m^2	15,000 m^2	17,500 m^2	20,000 m^2	22,500 m^2	25,000 m^2	27,500 m^2
	Storage		0 m^3	0 m^3	0 m^3	1,875 m^3	2,500 m^3	3,125 m^3	3,750 m^3	4,375 m^3	5,000 m^3	5,625 m^3	6,250 m^3	6,875 m^3
	Unit	Reference	-	-	-	-	-	-	-	-	-	-	-	-
Solid biomass	MWh	60.546	59.088	57.764	56.766	56.133	54.647	53.16	50.327	49.014	47.772	46.666	45.643	45.643
Solid biomass	ton	21.411	20.895	20.427	20.074	19.851	19.325	18.799	17.797	17.333	16.894	16.503	16.141	16.141
Natural gas	MWh	3.532	3.464	3.41	3.362	3.362	3.319	3.277	3.198	3,163,10	3.134	3.109	3.086	3.086
Natural gas	ton	326	320	315	310	310	306	303	295	292	289	287	285	285

The monthly production from the solar collectors in each calculation compared to the monthly heat demand



Monthly production from solar collectors



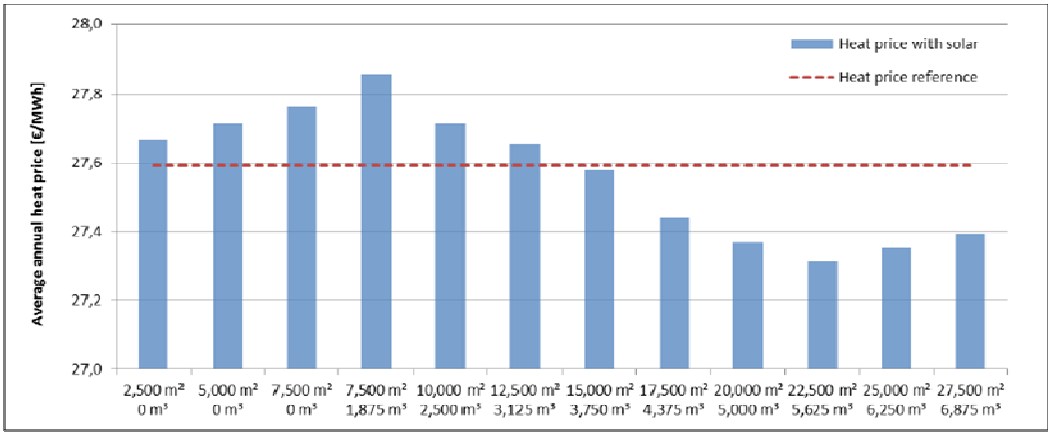
SDH economics

Heat production from solar panels is seasonal dependent with high production during summer and no or very little production during winter months. Since the natural gas boilers produce only a small amount of the heat in these calculations, the heat production from solar panels mostly replaces cheaper heat pro-duced from the biomass boilers.

Calculations for the investment amortized with a real interest rate† of 3 % over 30 years

	Solar collectors		2,500 m²	5,000 m²	7,500 m²	7,500 m²	10,000 m²	12,500 m²	15,000 m²	17,500 m²	20,000 m²	22,500 m²	25,000 m²	27,500 m²
	Storage		0 m³	0 m³	0 m³	1,875 m³	2,500 m³	3,125 m³	3,750 m³	4,375 m³	5,000 m³	5,625 m³	6,250 m³	6,875 m³
	Unit	Reference	-	-	-	-	-	-	-	-	-	-	-	-
Operational costs	€/metus	1,377,423	1,346,425	1,318,745	1,297,481	1,285,936	1,256,029	1,226,215	1,196,906	1,169,384	1,143,162	1,118,637	1,096,845	1,076,683
Operating savings	€/metus		30.998	58.678	79.942	91.487	121.394	151.208	180.517	208.039	234.261	258.786	280.578	300.74
Investment	€		752.884	1,405,768	1,921,152	2,274,652	2,772,535	3,357,919	3,918,303	4,366,187	4,864,071	5,336,955	5,859,838	6,345,222
Capital costs	€/metus		38.412	71.721	98.016	116.051	141.453	171.319	199.909	222.76	248.161	272.287	298.965	323.729
Simple pay back period	Metai		24	24	24	25	23	22	22	21	21	21	21	21
Net savings	€/metus		-7.414	-13.043	-18.074	-24.564	-20.059	-20.111	-19.392	-14.721	-13.9	-13.501	-18.387	-22.989
Heat production costs	€/MWh	25.1	25	24	24	23	23	22	22	21	21	20	20	20
Heat production costs incl. capital costs	€/MWh	25	25	25	25	26	26	26	25	25	25	25	25	26

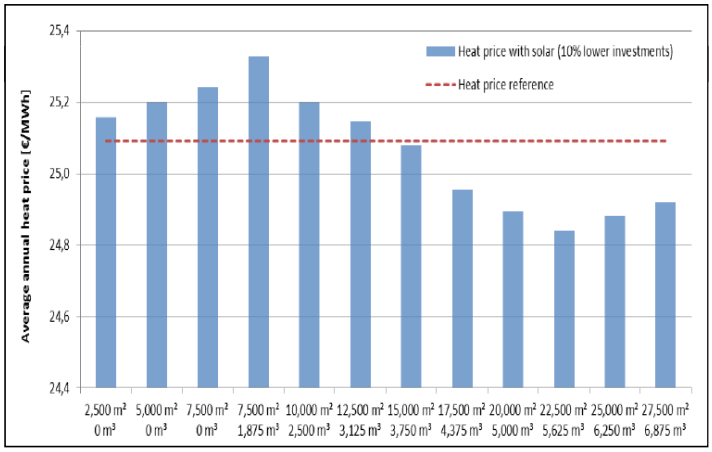
Even if the biomass price is only increased 8 % as an average over the calculation period the scenario with 22,500 m ^{2} solar collectors will still result in a lower average heat price than the reference.



As an alternative sensitivity analysis the following calculations investigates a situation where the investment shows to be 10 % cheaper. Hence all investments in these calculations are reduced by 10 %. A reduction in the investment amortized with a real interest rate of 3 % over 30 years gives the following result:

	Solar collectors		2,500 m²	5,000 m²	7,500 m²	7,500 m²	10,000 m²	12,500 m²	15,000 m²	17,500 m²	20,000 m²	22,500 m²	25,000 m²	27,500 m²
	Storage		0 m³	0 m³	0 m³	1,875 m³	2,500 m³	3,125 m³	3,750 m³	4,375 m³	5,000 m³	5,625 m³	6,250 m³	6,875 m³
	Unit	Reference	-	-	-	-	-	-	-	-	-	-	-	-
Operational costs	€/metus	1,514,667	1,480,365	1,449,683	1,426,157	1,413,178	1,379,903	1,346,717	1,314,091	1,283,465	1,254,266	1,226,926	1,202,627	1,180,148
Operating savings	€/metus		34.302	64.984	88.51	101.489	134.764	167.95	200.576	231.202	260.401	287.741	312.04	334.519
Investment	€		752.884	1,405,768	1,921,152	2,274,652	2,772,535	3,357,919	3,918,303	4,366,187	4,864,07	5,336,95	5,859,83	6,345,222
Capital costs	€/metus		38.412	71.721	98.016	116.051	141.453	171.319	199.909	222.76	248.161	272.287	298.965	323.729
Simple pay back period	Metai		22	22	22	22	21	20	20	19	19	19	19	19
Net savings	€/metus		-4.11	-6.737	-9.506	-14.562	-6.689	-3.369	667	8.442	12.24	15.454	13.075	10.79
Heat production costs	€/MWh	28	27	26	26	26	25	25	24	23	23	22	22	22
Heat production costs incl. capital costs	€/MWh	28	28	28	28	28	28	28	28	27	27	27	27	27

Net savings are seen for solar collector areas of 15,000 m ^{2} or larger. The average heat price compared to the reference case.



SDH plant opportunities & threats, benefits & limits

From the calculations with various coverage of solar panels with the given assumptions, amortized with a real interest rate of 3 % over 30 years, it can be concluded that the investment is not directly economical beneficial to Radviliškis district heating plant, but the economy in a solar project of a few thousand m ^{2} comes close since the heat production price including capital costs is almost as low as the heat production price in the reference.

Sensitivity analyses have been performed in order to find the strength of the economy in the project. In the future biomass might be a scarce resource and the biomass price is as a consequence expected to increase. The sensitivity analysis showed that the feasibility is sensitive to both investment costs and bio-mass price.

With a higher biomass price, the simple payback period decreases to 19-22 years. The average heat produc-tion price is lower than the reference in the scenarios with solar collector areas of 15,000 m ^{2} or more. This means that the operational savings is sufficient to cover capital costs. In other words if the biomass price is expected

It can be concluded that heat production from solar panels in connection to the Radviliškis district heating plant is not out of the question and is beneficial in terms of saving biomass and lower the average heat production price if the biomass price is assumed to increase.

Photos / Graph / Scheme

Authors

This factsheet was prepared by Aurimas Lisauskas. From Lithuania energy institute. With the help of company ***PlanEnergi***

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