Case study : Raseiniai (Lituania)

Name of the project:	Intergrating a solar plant in the district heeating of Raseiniai
Adress of the project:	City of Raseiniai, Pieninės str. 2, LT-60133 Raseiniai
Name and type of the owner:	The district heating is owned by the city of Raseiniai and service is delegated to UAB „Raseinių šilumos tinklai“
Owner contact person:	Stanislovas Bartkus - director of UAB „Raseinių šilumos tinklai“, phone number: +370-8-428-51 951, e-mail: info@raseiniust.lt; Gediminas Karpas - GTS engineer of UAB „Raseinių šilumos tinklai“, phone number +370-8-428-51 951

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

SDH plant

DH system

The largest department of the company - Raseiniai boiler-house, which supplies heating and hot tap water to residents and institutions of Raseiniai town. KVGM 20-150 water heating boiler with capacity 23.26 MW and two DKVR 4-13 steam boilers of capacities 2.68 MW are operating in the boiler-house. Total capacity of the boilers - 28.62 MW. Currently two biomass boilers of capacities 3 and 7 MW are currently installed also.

The second biggest is Ariogala boiler-house, which supplies heating to residents of Ariogala town. It contains two water heating boilers: VK-22, capacity - 3.15 MW and VK-21 - capacity 1.5 MWi. Since year 2004 VŠKD biomass boiler of the capacity of 1.5 MW is operating. District heating is also supplied to residents of Viduklė settlement. Viduklė boiler-house contains twoKPK water heating boilers of capacity 0.8 MW.

Heat network and boilers are serviced by UAB "Raseinių šilumos tinklai" :

Raseinių town - 13.8 km.

Ariogalos town - 5.1 km

Viduklė settlement. - 1.7 km

Total: 20.6 km

Boilers		Producer	Power	Efficiency	Fuel	Yearly running hours	Value of calorific
			MW_{th}	%		h	kcal/kg
Bioler Nr. 1	Steam bioler	DKVR 4/13	2.7	90	Oil	744	9530
Bioler Nr. 2	Steam bioler	DKVR 4/13	2.7	90	Oil	370	9530
Bioler Nr. 3	Water heating boiler	KVGM 20/150	20	90	Oil	0	9530
Bioler Nr. 4	Water heating boiler	VŠK-3	3	89	Biomass	6000	2200
Bioler Nr. 5	Water heating boiler	VŠK-7	7	89	Biomass	4000	2200

Temperature in networks:

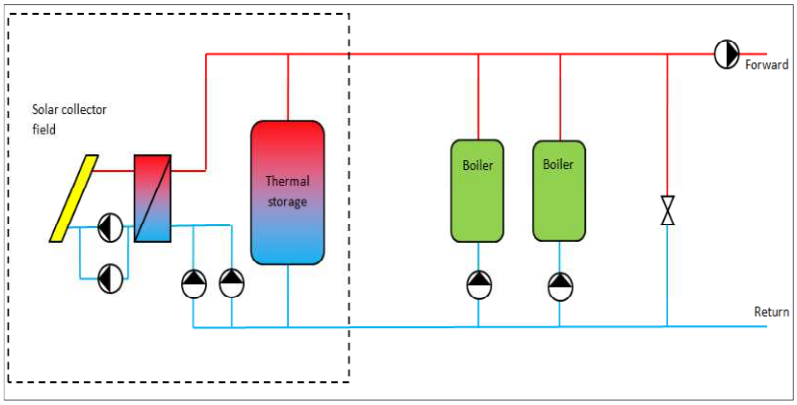
Forward and return temperature, °C	January	February	Mach	April	May	June	July	August	September	October	November	December
Forward temperature	70.2	65	69.6	62.2	61.7	61.4	62	61.9	61.8	62.3	62.1	62.7
Return temperature	44.9	42.6	44.5	42.1	47.5	47.3	47.5	47.6	47.3	42.4	40	41.7

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	
Steam bioler	DKVR 4/13	488	50	0	0	0	0	0	0	0	0	0	0	
Steam bioler	DKVR 4/13	390	0	0	0	0	0	0	0	0	0	0	0	
Water heating boiler	KVGM 20/150	0	0	0	0	0	0	0	0	0	0	0	0	
Water heating boiler	VŠK-3	1822	1630	1932	1015	969.5	829.8	775	818	801	636	0	1442	
Water heating boiler	VŠK-7	3730	3010	3658	1475	0	0	0	0	0	1395	3459	2976	
Total heat production		**6430**	**4690**	**5590**	**2490**	**969.5**	**829.8**	**775**	**818**	**801**	**2031**	**3459**	**4418**	**33301**

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.



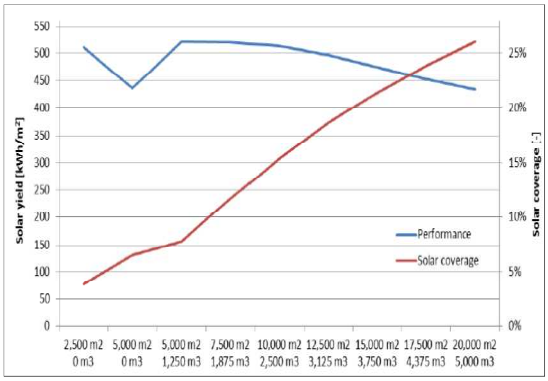
SDH technical data

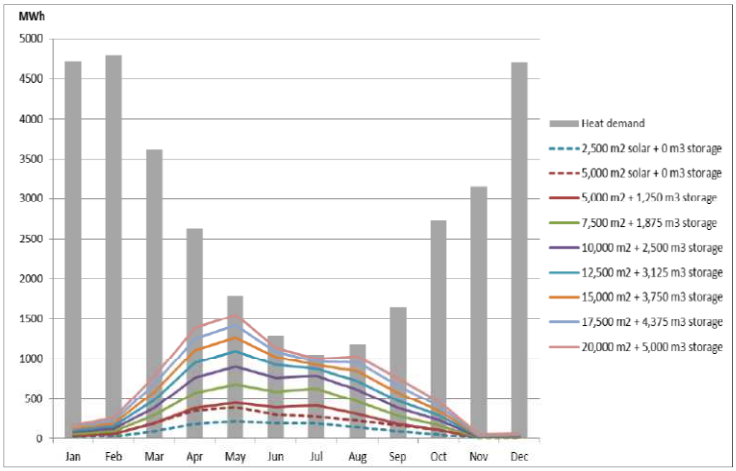
Investment costs:

Collectors area, m^2	2500	5000	7500	10000	12500	15000	17500	20000
Investment, €/m^2	300	280	255	235	230	225	215	210

The distribution of heat production based on biomass (wood chips) and

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
	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
	Unit	Reference	-	-	-	-	-	-	-	-	-
Biomass boiler	MWh	33.295	32.018	31.113	30.69	29.392	28.165	27.091	26.17	25.348	24.616
Solar heat	MWh	0	1.277	2.182	2.605	3.903	5.131	6.204	7.125	7.947	8.679
Total	MWh	33.295	33.295	33.295	33.295	33.295	33.295	33.295	33.295	33.295	33.295
Solar share	%	0%	3.80%	6.60%	7.80%	11.70%	15.40%	18.6%	21.4%	23.9%	26.1%





SDH energy balance (MWh)

In the future biomass can be sparse resource. It can therefore be beneficial to supplement the heat production with long term sustainable resources such as solar heat. In the following it is seen how much fuel the different shares of solar heat can save of fuel on annual basis:

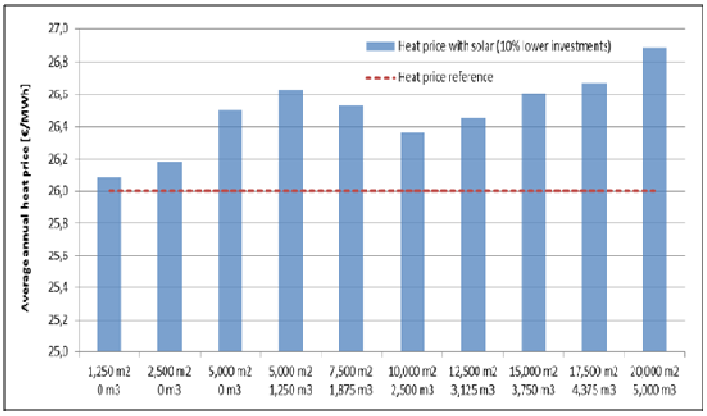
Fuel	Solar collectors		2,500 m^2	5,000 m^2	7,500 m^2	7,500 m^2	10,000 m^2	12,500 m^2	15,000 m^2	17,500 m^2	20,000 m^2
	Storage		0 m^3	0 m^3	0 m^3	1,875 m^3	2,500 m^3	3,125 m^3	3,750 m^3	4,375 m^3	5,000 m^3
	Unit	Reference	-	-	-	-	-	-	-	-	-
Biomass	MWh	37.408	35.973	34.957	34.481	33.022	31.644	30.438	29.403	28.479	27.657
	tonos	14.622	14.061	13.664	13.478	12.908	12.369	11.898	11.493	11.132	10.81

SDH economics

The Danish Energy Agency expects that the price of biomass will increase by approximately 1 % on annual basis. This corresponds to an average price of biomass over the next 30 years which is of 16 % higher than the price today. In Table 7 the annual average costs are shown for each calculation, where the biomass price is 16 % higher than in the basic calculations. The biomass price is in these calculations 46.5 €/ton.

Sensitivity analysis	Solar collectors		1,200 m^2	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
	Storage		0 m^3	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
	Unit	Reference	-	-	-	-	-	-	-	-	-	-
Operational costs	€/year	865.641	849.232	833.457	810.662	800.004	767.28	736.358	709.315	686.104	665.379	646.933
Operating savings	€/year		16.409	32.184	54.979	65.637	98.361	129.283	156.326	179.537	200.262	218.708
Investment	€		376.442	752.884	1,455,768	1,751,768	2,274,652	2,772,535	3,357,919	3,918,303	4,366,187	4,864,071
Capital costs	€/year		19.206	38.412	74.272	89.374	116.051	141.453	171.319	199.909	222.76	248.161
Simple pay back period	Year		23	23	26	27	23	21	21	22	22	22
Net savings	€/year		-2.797	-6.228	-19.293	-23.737	-17.69	-12.17	-14.993	-20.372	-22.498	-29.453
Heat production costs	€/MWh	26.0	26.1	25	24.3	24	23	22.1	21.3	20.6	20	19.4
Heat production costs incl. capital costs	€/MWh	26.0	26.1	26.2	26.6	26.7	26.5	26.4	26.4	26.6	26.7	26.9

With a higher biomass price, the simple payback period decreases and is in this case between 21 and 27 years. Figure shows the average heat price compared to the reference case when the increase in biomass price is taken into account. The smallest solar heating system reaches almost the same average heat price as 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:

Sensitivity analysis	Solar collectors		1,200 m²	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
	Storage		0 m³	0 m³	0 m³	0 m³	1,875 m³	2,500 m³	3,125 m³	3,750 m³	4,375 m³	5,000 m³
	Unit	Reference	-	-	-	-	-	-	-	-	-	-
Operational costs	€/year	771.915	757.338	743.326	723.078	713.61	684.541	657.073	633.052	612.434	594.024	577.639
Operating savings	€/year		14.577	28.589	48.837	58.305	87.374	114.842	138.863	159.481	177.891	194.276
Investment	€		376.442	677.595	1,310,191	1,576,591	2,047,186	2,495,282	3,022,127	3,526,473	3,929,568	4,377,664
Capital costs	€/year		19.206	34.57	66.845	80.437	104.446	127.307	154.187	179.918	200.484	223.345
Simple pay back period	Year		26	24	27	27	23	22	22	22	22	23
Net savings	€/year		-4.629	-5.981	-18.008	-22.132	-17.072	-12.465	-15.324	-20.437	-22.593	-29.069
Heat production costs	€/MWh	23	23	22	22	21	21	20	19	18	18	17
Heat production costs incl. capital costs	€/MWh	23	23	23	24	24	24	24	24	23	24	24

SDH plant opportunities & threats, benefits & limits

From the calculations with various coverage of solar panels with the given investments, amortized with an interest rate of 3 % over 30 years, it can be concluded that the investment is not economical beneficial to Raseiniai district heating plant with the given prerequisites. However if the biomass price is assumed to increase in the future, the solar heating system could prove to be a feasible solution after all. The future global demand for biomass may force the biomass prices upwards thus making it feasible to replace some of the biomass with solar heat and ship some of the biomass to other countries.

The average heat production price for a smallest solar heating system decreases to the reference level if the biomass price is assumed to increase corresponding to an annual increase of 1.5 %.

It can be concluded that though a solar heating system for the given assumptions is not economically feasi-ble for the district heating plant in question, solar district heat production in Raseiniai may be possible at competitive costs if biomass prices increases in the future.

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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