THERMOS

Accelerating the development of low-carbon heating & cooling networks

Case Study: Development of Heat Network for San Lucido's (ITALY) Municipality Buildings

Eng. Santo ABATE, santo.abate@gmail.com, +393496161340

Berlin (GERMANY) 06.12.2019

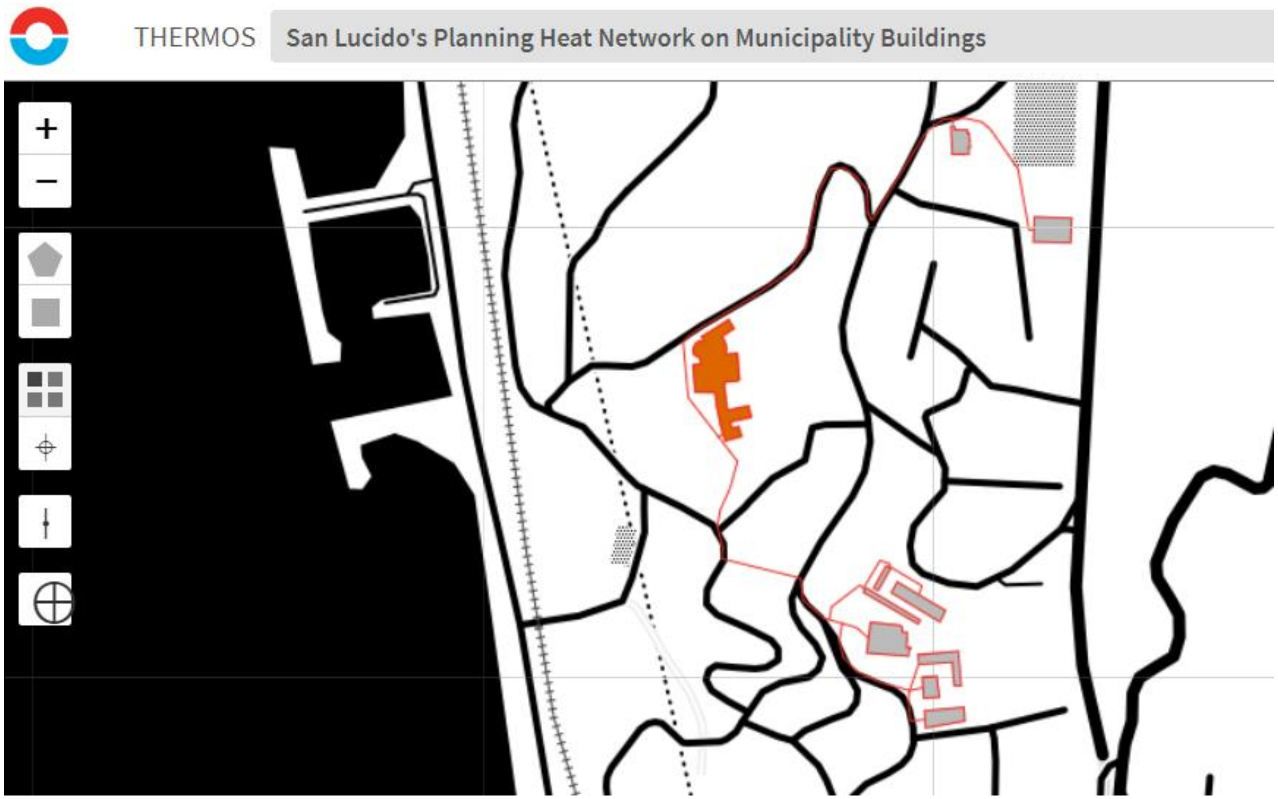
Development of Heat Network on San Lucido's (ITALY) Municipality Buildings

Development of Heat Network on San Lucido's (ITALY) Municipality Buildings

Our goal is development a study on Heat Network on Municipality Buildings of San Lucido, starting of an Building that have 2 great boilers gas (387 kW for each boiler) and a Solar Thermal Plant(5000l)

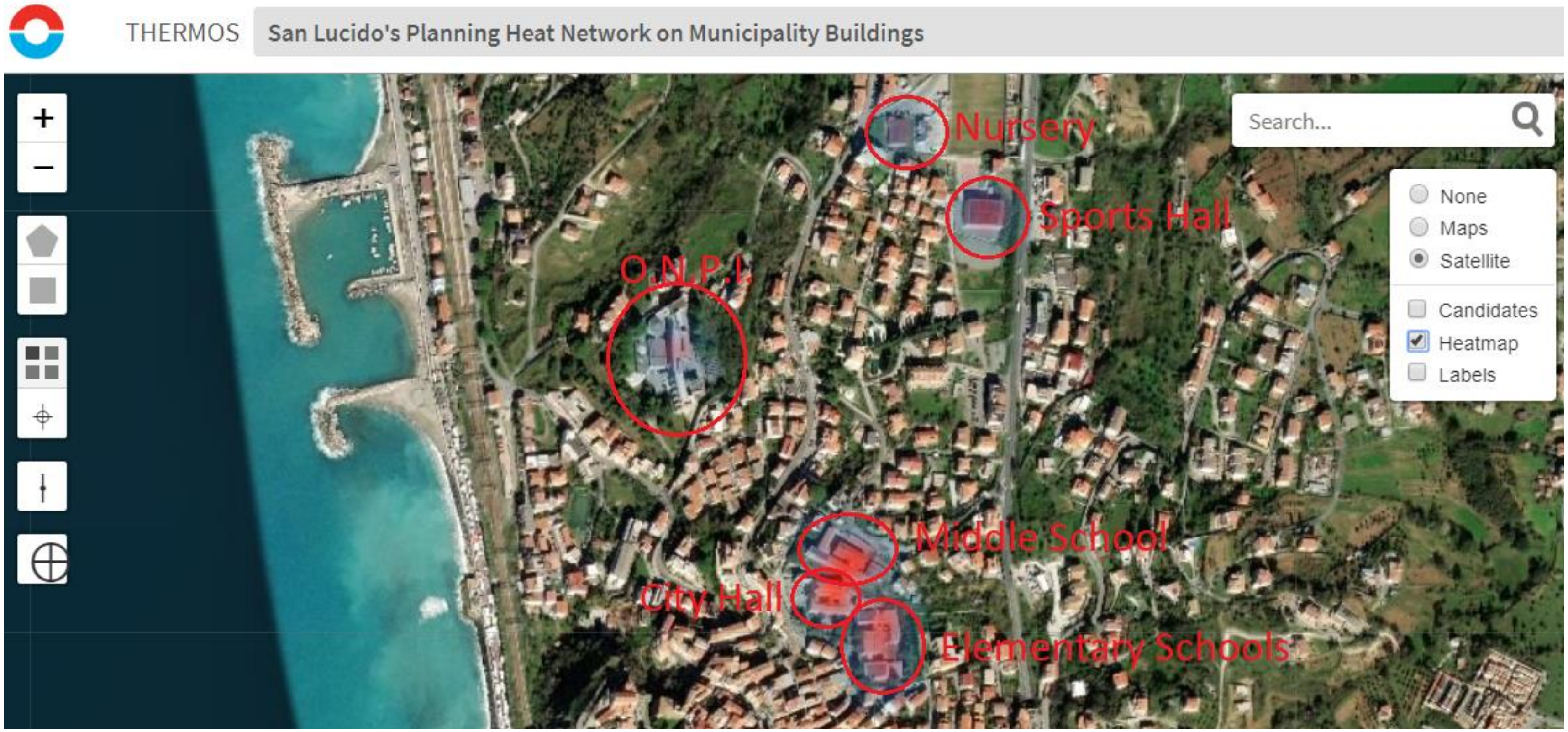
Development of Heat Network on San Lucido's (ITALY) Municipality Buildings

We have loaded the Municipality Buildings on GIS coordinate and then on Thermos Online Software



Development of Heat Network on San Lucido's (ITALY) Municipality Buildings

The Municipality Buildings are O.N.P.I. (Supply points), Sports Hall, Nursery, City Hall, Middle School and Elementary Schools



thermos-project.eu

Development of Heat Network on San Lucido's (ITALY) Municipality Buildings

THERMOS San Lucido's Planning Heat Network on Municipality Buildings **Save**

Objective

◉ Maximize network NPV

In this mode, the goal is to choose which demands to connect to the network so as to maximize the NPV *for the network operator*. This is the sum of the revenues from demands minus the sum of costs for the network.

The impact of non-network factors (individual systems, insulation, and emissions costs) can be accounted for using the *market* tariff, which chooses a price to beat the best non-network system.

○ Maximize whole-system NPV

In this mode, the goal is to choose how to *supply heat* to the buildings in the problem (or abate demand) at the *minimum overall cost*. The internal transfer of money between buildings and network operator is not considered, so there are no network revenues and tariffs have no effect.

☑ Offer insulation measures ☑ Offer other heating systems[i]

Accounting period

Sum costs and benefits over 40 years. Discount future values at 3,0 % per year.

Development of Heat Network on San Lucido's (ITALY) Municipality Buildings

Capital costs

Item	Annualize	Recur	Period	Rate	¤ 100	PV(¤ 100)
Pipework	☐	☐	0	0,0	0	0
Supply	☐	☐	0	0,0	0	0
Connections	☐	☐	0	0,0	0	0
Insulation	☐	☐	0	0,0	0	0
Other heating	☐	☐	0	0,0	0	0

Emissions costs

Emission	Cost/t
co2	10000,00
pm25	0,00
nox	0,00

Emissions limits

Emission	Limited	Limit (t/yr)
co2	☑	100
pm25	☐	0
nox	☐	0

Computing resources

Stop if solution is known to be at least this close to the optimum 10 %

Maximum runtime 0,5 h

Development of Heat Network on San Lucido's (ITALY) Municipality Buildings

THERMOS San Lucido's Planning Heat Network on Municipality Buildings

Tariffs

Each building can have an associated tariff, which determines the revenue to the network operator.

Tariff name	Standing charge	Unit charge	Capacity charge
Standard	100 ¤/yr	5,0 c/kWh	10 ¤/kWp.yr

Connection Costs

Each building also has associated connection costs, which determine the capital costs of connecting the building to the network. These costs are borne by the network operator.

Connection cost name	Fixed cost	Capacity cost
Standard	1000 ¤	10,0 ¤/kWp

Development of Heat Network on San Lucido's (ITALY) Municipality Buildings

Civil engineering costs

These parameters can be different for each bit of pipe, and cover the cost of digging a hole, installing pipework, and back-filling.

You can set the civil engineering cost category for a pipe from the map page by selecting the path and pressing **e**, or by right-clicking on it.

Calculate civil engineering costs as *fixed cost*¤/m + (*variable cost*× ⌀/m) 1,10 /m

Category	Fixed cost	Variable cost
Soft	150	150
Hard	300	300

thermos-project.eu

Development of Heat Network on San Lucido's (ITALY) Municipality Buildings

THERMOS San Lucido's Planning Heat Network on Municipality Buildings

Temperatures and limits

These parameters affect pipe heat losses and the relationship between diameter and power delivered.

Use a flow temperature of 90 °C, a return temperature of 60 °C, and an average ground temperature of 8 °C.

Allow pipes between 20 mm and 2000 mm.

Mechanical engineering costs

These parameters apply to every pipe, and cover the cost of buying the flow and return pipes, welding etc.

Calculate mechanical engineering costs as 50 ¤/m + (700 × ⌀/m) 1,30 /m

Development of Heat Network on San Lucido's (ITALY) Municipality Buildings

THERMOS San Lucido's Planning Heat Network on Municipality Buildings

Insulation

Buildings can have insulation measures, which reduce their heat demand. Here you can define insulation measures - each one has:

- The type of area it applies to
- A fixed cost and cost per unit area installed
- A maximum reduction - this is a percentage of annual demand that is removed if the measure is fully installed
- A maximum area - this is the percentage of the building's area that is used by installing the measure fully

To allow the model to use insulation measures configure the objective settings.

Name	Applies to	Fixed cost	Variable cost	Maximum Effect	Maximum area
Insulation Roof	(●) Roof ( ) Floor ( ) Wall	1000 ¤	80 ¤/m^2	25 %	100 %
Insulation Wall	( ) Roof ( ) Floor (●) Wall	1000 ¤	100 ¤/m^2	25 %	100 %

Development of Heat Network on San Lucido's (ITALY) Municipality Buildings

THERMOS | San Lucido's Planning Heat Network on Municipality Buildings

Individual Systems

Buildings can either use a heat network or an individual system as their heat source. Here you can define the parameters of individual systems.

Gas CH

Costs			Emissions factors		
Heat cost / kWh	5,0	c/kWh	co2	300	g/kWh
Fixed capital cost	2000	¤	pm25	0	g/kWh
Variable capital cost	0	¤/kWp	nox	0	g/kWh
Operating cost	0	¤/kWp			

Photovoltaic Plant

Costs			Emissions factors		
Heat cost / kWh	5,0	c/kWh	co2	300	g/kWh
Fixed capital cost	244	¤	pm25	0	g/kWh
Variable capital cost	20	¤/kWp	nox	0	g/kWh
Operating cost	0	¤/kWp			

thermos-project.eu

Development of Heat Network on San Lucido's (ITALY) Municipality Buildings

Cost summary | **Network** | Individual systems | Insulation | Emissions | Optimisation

Pipework | Demands | Supplies

Civils	⌀ mm	Length m	Cost ¤	Cost ¤/m	Losses Wh/yr	Capacity W
Soft	20-30	335,556	79,243 k	236,154	39,287 M	32,4 k
Soft	40-50	5,177	1,499 k	289,663	817,888 k	174,9 k
Soft	20-30	87,913	20,593 k	234,249	10,293 M	20 k
Soft	30-40	15,698	4,167 k	265,439	1,838 M	95 k
Hard	20-30	830,682	329,357 k	396,49	97,257 M	45 k
Hard	30-40	608,302	263,667 k	433,448	80,982 M	144,05 k
All		**1,883 k**	**698,527 k**	**370,9**	**230,474 M**	**174,9 k**

Development of Heat Network on San Lucido's (ITALY) Municipality Buildings

Cost summary | Network | Individual systems | Insulation | Emissions | Optimisation

Pipework | Demands | Supplies

Classification	Count	Capacity W	Demand Wh/yr	Conn. cost ¤	Revenue ¤
1	1	20 k	29 M	1,002 k	70 k
10	1	30 k	60 M	1,003 k	136 k
2	1	20 k	30 M	1,002 k	72 k
3	1	20 k	29 M	1,002 k	70 k
4	1	95 k	160 M	1,01 k	362 k
5	1	20 k	27 M	1,002 k	66 k
6	1	20 k	24 M	1,002 k	60 k
7	1	20 k	21 M	1,002 k	54 k
8	1	85,818 k	128,909 M	1,009 k	296,146 k
9	1	20 k	40 M	1,002 k	92 k

Development of Heat Network on San Lucido's (ITALY) Municipality Buildings

Cost summary | Network | Individual systems | Insulation | Emissions | Optimisation

Pipework | Demands | Supplies

Name	Capacity	Output	Capital	Capacity	Heat	Coincidence
	Wp	Wh/yr	¤	¤	¤	%
	231,54 k	779,384 M	300 k	463,079 k	1,559 M	66

Development of Heat Network on San Lucido's (ITALY) Municipality Buildings

Cost summary | Network | Individual systems | Insulation | Emissions | Optimisation

Item	Capital cost (¤)	Operating cost (¤)	Operating revenue (¤)	NPV (¤)
Pipework	698,527 k	--	--	-698,527 k
Heat supply	300 k	2,022 M	--	-1,503 M
Demands	10,035 k	--	1,278 M	750,724 k
Emissions	--	0	--	0
Network	**1,009 M**	**2,022 M**	**1,278 M**	**-1,451 M**
Emissions	--	0	--	0
Individual systems	--	**0**	--	**0**
Insulation	--	--	--	--
Whole system	**1,009 M**	**2,022 M**	**n/a**	**-2,212 M**[i]

Development of Heat Network on San Lucido's (ITALY) Municipality Buildings

The next step is study the introduction of Heat Network on Private Buildings of San Lucido

San Lucido
"The most beautiful town of the World"

Eng. Santo ABATE
santo.abate@gmail.com
+393496161340

Accelerating the development of low-carbon heating & cooling networks
BERLIN (DEUTSCHLAND), 06.12.2019

THERMOS

web	thermos-project.eu
email	info@thermos-project.eu
twitter	@THERMOS_eu
linkedin	THERMOS project

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 723636. The sole responsibility for the content of this presentation lies with its author and in no way reflects the views of the European Union.