

*Good practices and results of some
feasibility studies in the Adriatic coast*

Lesson Learned

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Adriacold



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General barriers: Solar Cooling

- ✓ The different types of solar collectors are the key component of the installation.
- ✓ Evacuated tube system, generally, operates at a much higher efficiency and temperature for a much longer period than a conventional single flat plate collector installed system.
- ✓ The investment cost of solar cooling installations is higher than conventional air conditioning systems, it is in the order of 700 €/m²- 1000 €/m².



The building conditioning by SOLAR COOLING

Cortea carried out two feasibility studies for the development of innovative energy systems for air conditioning of buildings based in coastal areas:

Description of the case studies:

Design assumptions (For both cases)

- 1 case study in Veneto: Wine Canteen in Fossalta di Portogruaro , Italy
- 1 case study in Puglia: Sport center in Putignano Bari, Italy

Evacuated tube solar collectors

Surface: 400 m²

Chiller absorption, Water-Lithium Bromide, single-effect

Power: 115 kW Cooling

Evacuated tube solar collectors

Surface: 800 m²

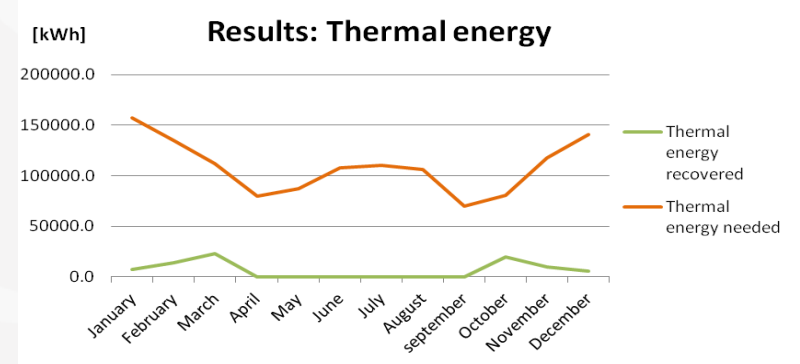
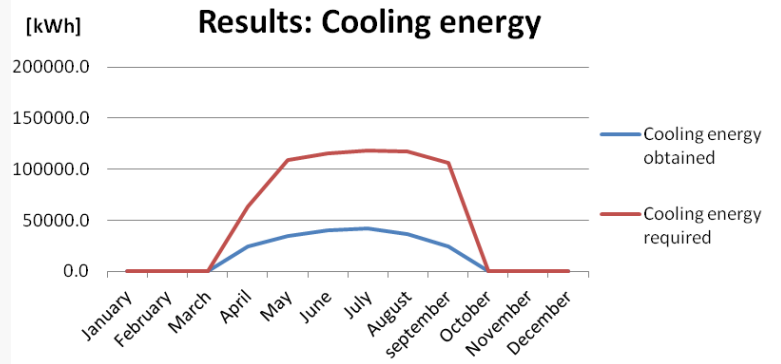
Chiller absorption, Water-Lithium Bromide, single-effect

Power: 230 kW Cooling

Feasibility study 1 - North of Italy - Portogruaro (VE)

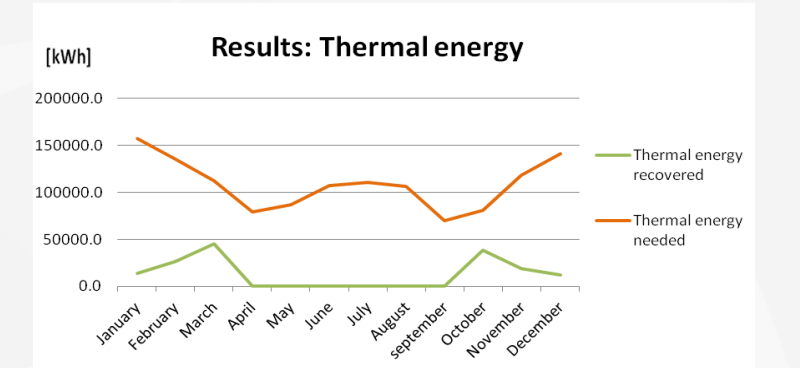
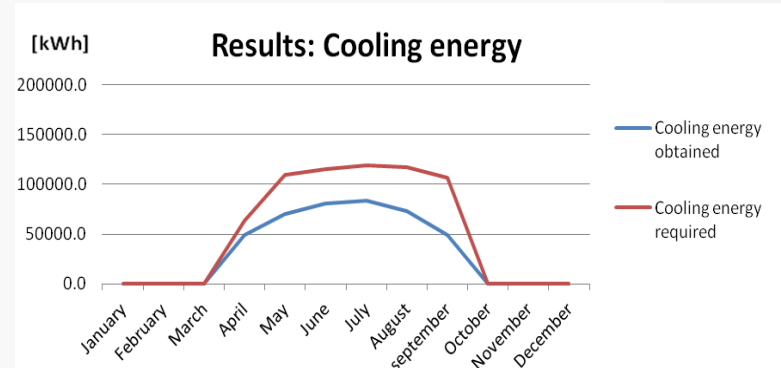
1. Possibility

surface: 400 m²
Power: 115 kW cooling



2. Possibility

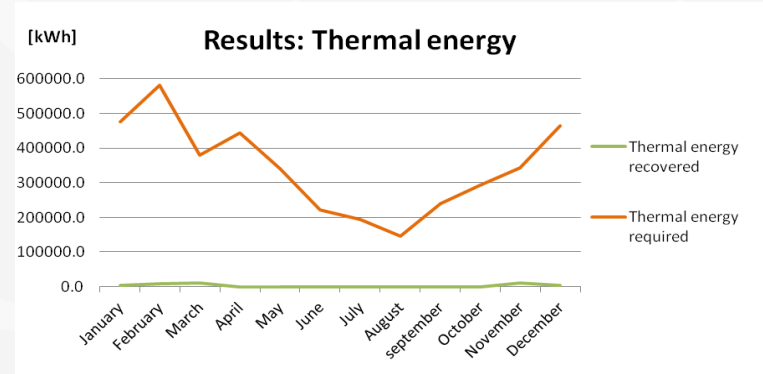
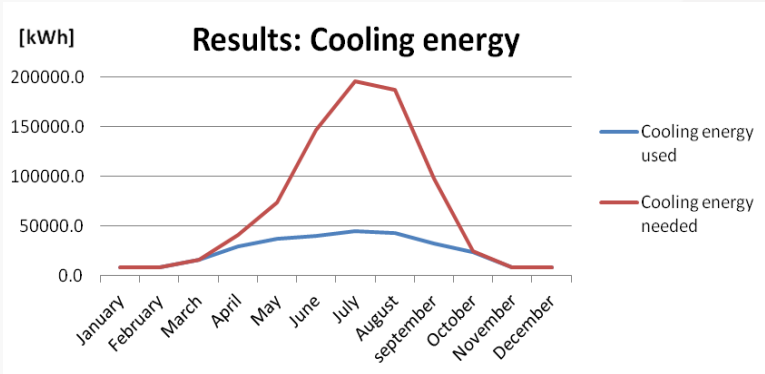
surface: 800 m²
Power: 230 kW cooling



Feasibility study 2 - South of Italy - Putignano (BA)

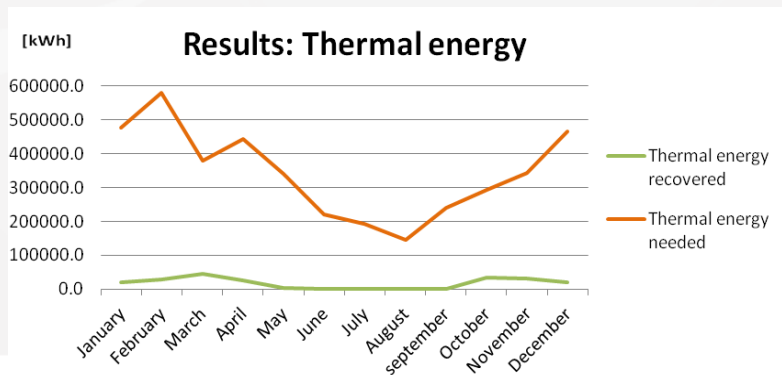
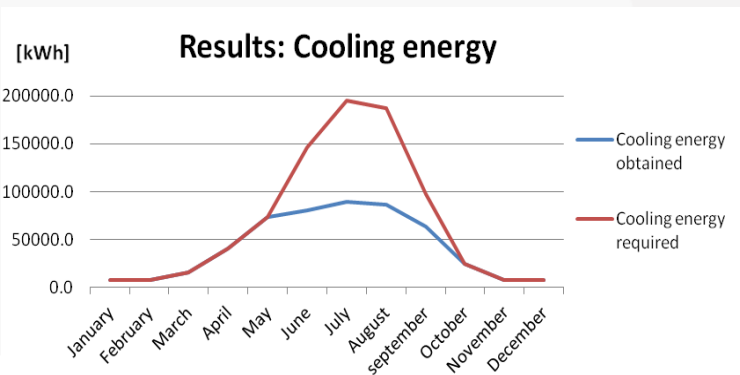
1. Possibility

surface: 400 m²
Power: 115 kW cooling



2. Possibility

surface: 800 m²
Power: 230 kW cooling



Case studies: Solar cooling

The energy obtainable in different hypotheses

		North - Portogruaro	South - Putignano
Solar radiation [kWh/m ² /y]		1.454,99	1.899,68
Solar energy [kWh/y]	Surface Collectors [m ²]		
	400	581.996	759.872
	800	1.164.000	1.519.744
Cooling energy [kWh/y]	Surface Collectors [m ²]		
	400	202.356	325.413
	800	404.712	650.827
Thermal energy obtained [kWh/y]	Surface Collectors [m ²]		
	400	78.147	102.155
	800	156.295	204.313

More cooling and thermal energy in the south

Case studies: Solar cooling

Economic analysis

Features		Portogruaro North		Putignano South	
Cooling capacity chiller [kW]		115	230	115	230
Solar collector area[m ²]		400	800	400	800
Installation cost [€/m ²]		1.000	700	1.000	700
National Grant [€,year]		83 €/m ² , 5 years			
Revenues [€/year]	Thermal	4.767	9.534	2.271	12.463
	Cooling	11.545	23.091	17.079	28.973
	Total	16.312	32.625	19.351	41.436
NPV [€]		93.245	426.479	108.445	603.254 €
Pay Back [years]		14,3	7	12,1	5,5

Big difference between North and South and between medium and large-scale

Case studies: Solar cooling

Sensitivity analysis of the Solar Cooling in Portogruaro – North of Italy

Cooling power of the chiller

115 kW → Pay Back: 14,3 [years]

230 kW → Pay Back: 7 [years]

Modification		Cooling power of the chiller			
		115 [kW]		230 [kW]	
		Pay Back [years]	NPV [€]	Pay Back [years]	NPV [€]
Electric energy	10 % +	13,4	116.406	6,5	472.813
	10 % -	15,3	70.083	7,5	380.167
Thermal energy	10 % +	13,9	102.808	6,8	44.616
	10 % -	14,8	83.682	7,2	407.364
Electric energy + Thermal energy	10 % +	13	125.929	6,4	491.939
	10 % -	15,9	60.480	7,8	361.041
Installation cost	10 % +	16,8	53.245	8,7	370.490
	10 % -	11,9	133.245	5,3	482.490

Big difference if the installation cost decreases

Case studies: Solar cooling

Sensitivity analysis of the Solar Cooling in Putignano – South of Italy



Modification		Cooling power of the chiller			
		115 [kW]		230 [kW]	
		Pay Back [years]	NPV [€]	Pay Back [years]	NPV [€]
Electric energy	10 % +	11,1	188.458	5,1	661.370
	10 % -	13,3	119.930	5,9	545.118
Thermal energy	10 % +	12	158.748	5,3	628.250
	10 % -	12,2	149.640	5,7	578.239
Electric energy + Thermal energy	10 % +	11	193.011	5	686.366
	10 % -	13,4	115.376	6,1	520.123
Installation cost	10 % +	14,2	114.174	6,9	547.254
	10 % -	10	194.174	4,2	659.254

Big difference if the installation cost decreases

Case studies: Solar cooling

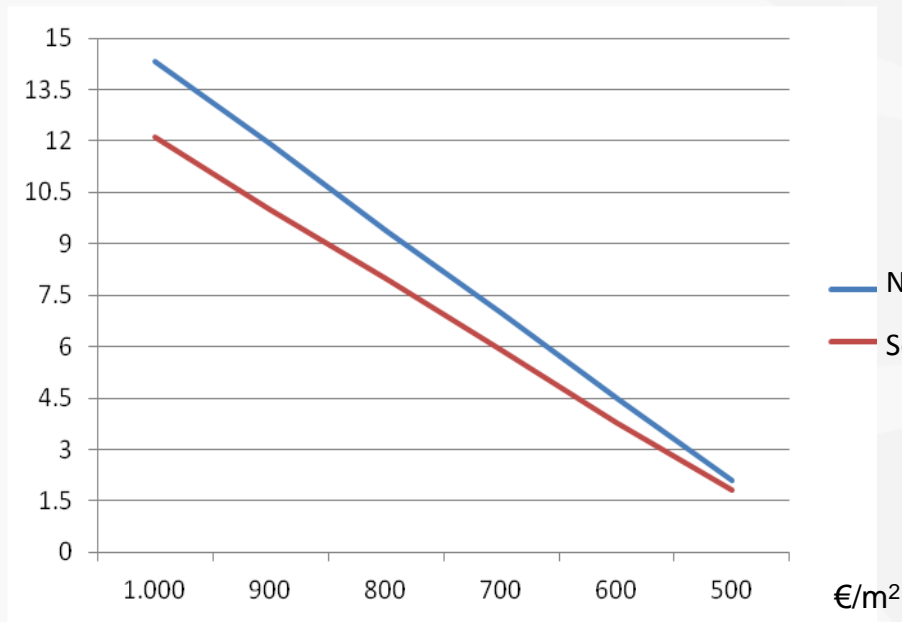
Sensitivity analysis - Solar Cooling - Pay Back determined

Cooling power of the chiller

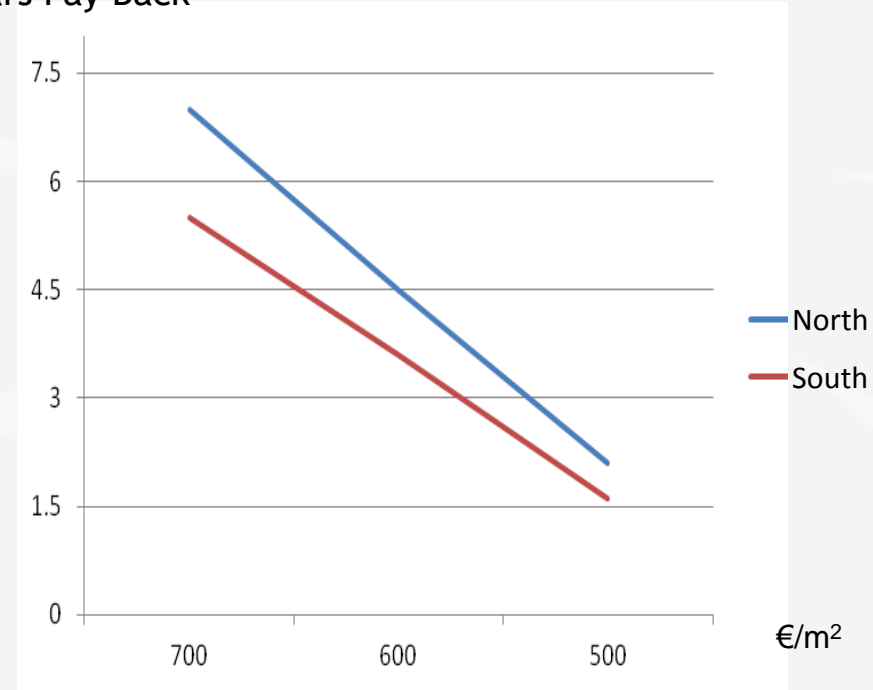
[100-130kW]

[200-250 kW]

Years Pay Back



Years Pay Back



Case studies: Solar cooling

Conclusions of the feasibility studies

1. The study shows that the production and use of thermal energy are essential elements of the system; in fact, the recovered thermal energy is higher than the cooling energy used.
2. In the south of Italy the cooling and thermal energy recoveries are always higher than on the North of Italy, as the incident solar radiation is on average 30% higher.
3. The pay-back of the investment is currently very high and not competitive with those of conventional systems, when the size of the plant is small. At higher dimensions the solar cooling system is competitive with the traditional ones. The investment cost is of the order of 700 €/m² - 1,000 €/m².
4. The sensitivity analysis shows that the changes in costs of thermal energy and electricity have little influence on the economic results.
5. The cost of investment is very important and affects greatly the economics values. In fact the reduction of the 40% in the small capacity scale and the 10% in the medium scale capacity allow to obtain interesting payback, in the order of 5-6 years.

Solar cooling: Lesson learned

Last but not least

- From the viewpoint of the performances the plants with a larger solar radiation provide best results in energy and economic terms. **The scale economy plays a crucial role**, as seen from the medium sized power performances are much more interesting. In our plants have been used different technologies for both solar collectors that for chillers. Necessarily different systems have very different needs, both for realization and for management, and give different performances.
- We must concentrate our efforts to **reduce the cost of initial investment** especially for the small power sized plants promoting a strong partnership between the public and private institutions. Nowadays there are working groups for this purpose, at the European level.

Solar cooling: Lesson learned

Last but not least

- We believe that more profound efforts should be made **to control and monitor** the functionality of the different systems in the different Mediterranean regions to overcome such technical and economic barriers that opposed to the actual development of the market for this technology.
- As regards the activity of monitoring we found a significant difference between plant with solar concentration and evacuated tubes. Nowadays it is crucial to lower the cost of the investment to allow the development of these facilities.
- It is necessary **to disseminate the knowledge** and the know how until now learned regarding these plants, especially to improve the design of solar cooling systems.

project coordinator



project partners

Cortea



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Thanks for the attention

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