CLEAN ENERGY FOR EU ISLANDS

Energy Efficiency in Buildings Webinar
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Buildings' energy performance upgrade in Mediterranean climate

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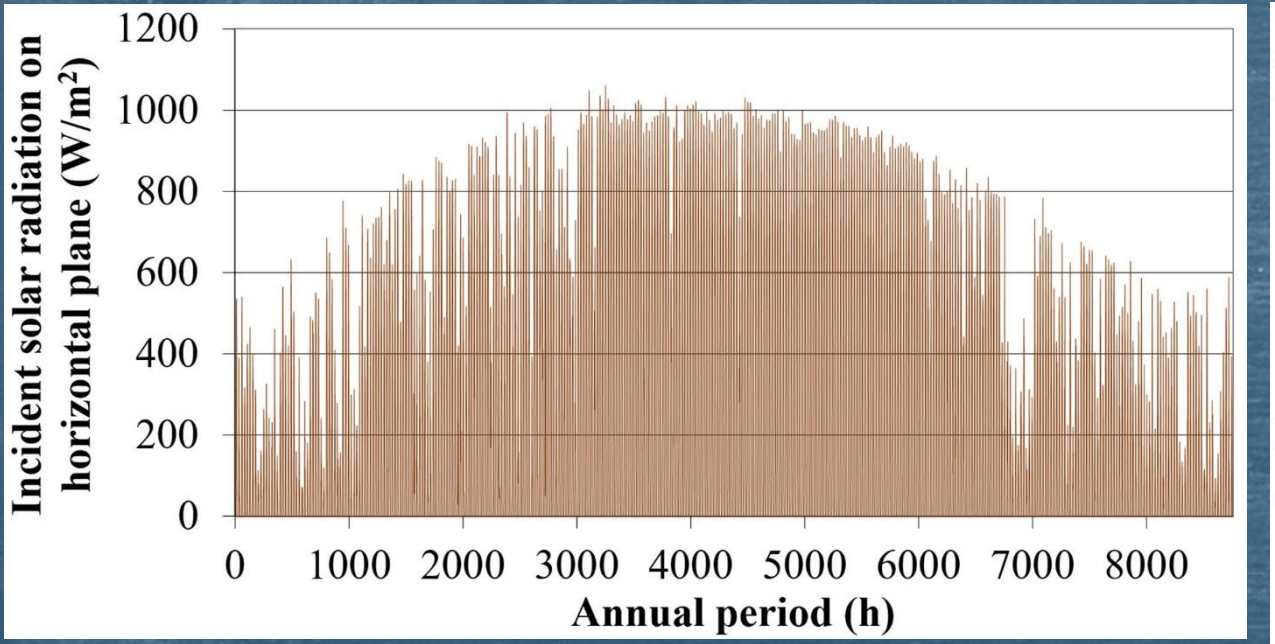
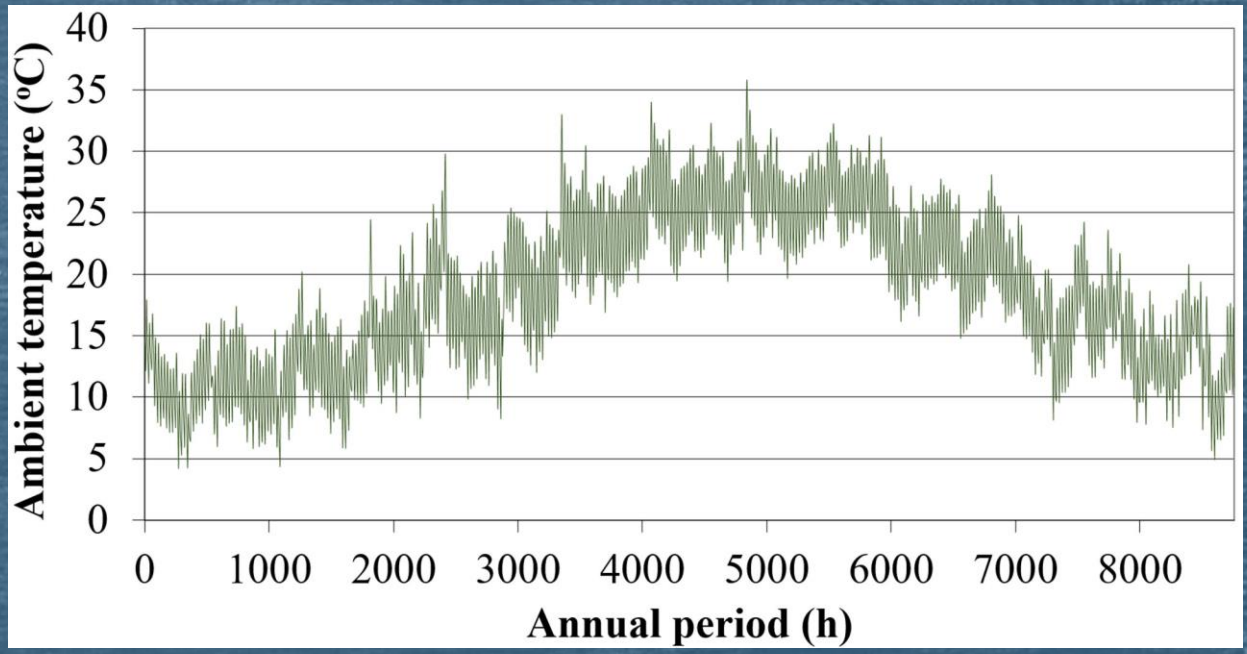
Mediterranean Climate

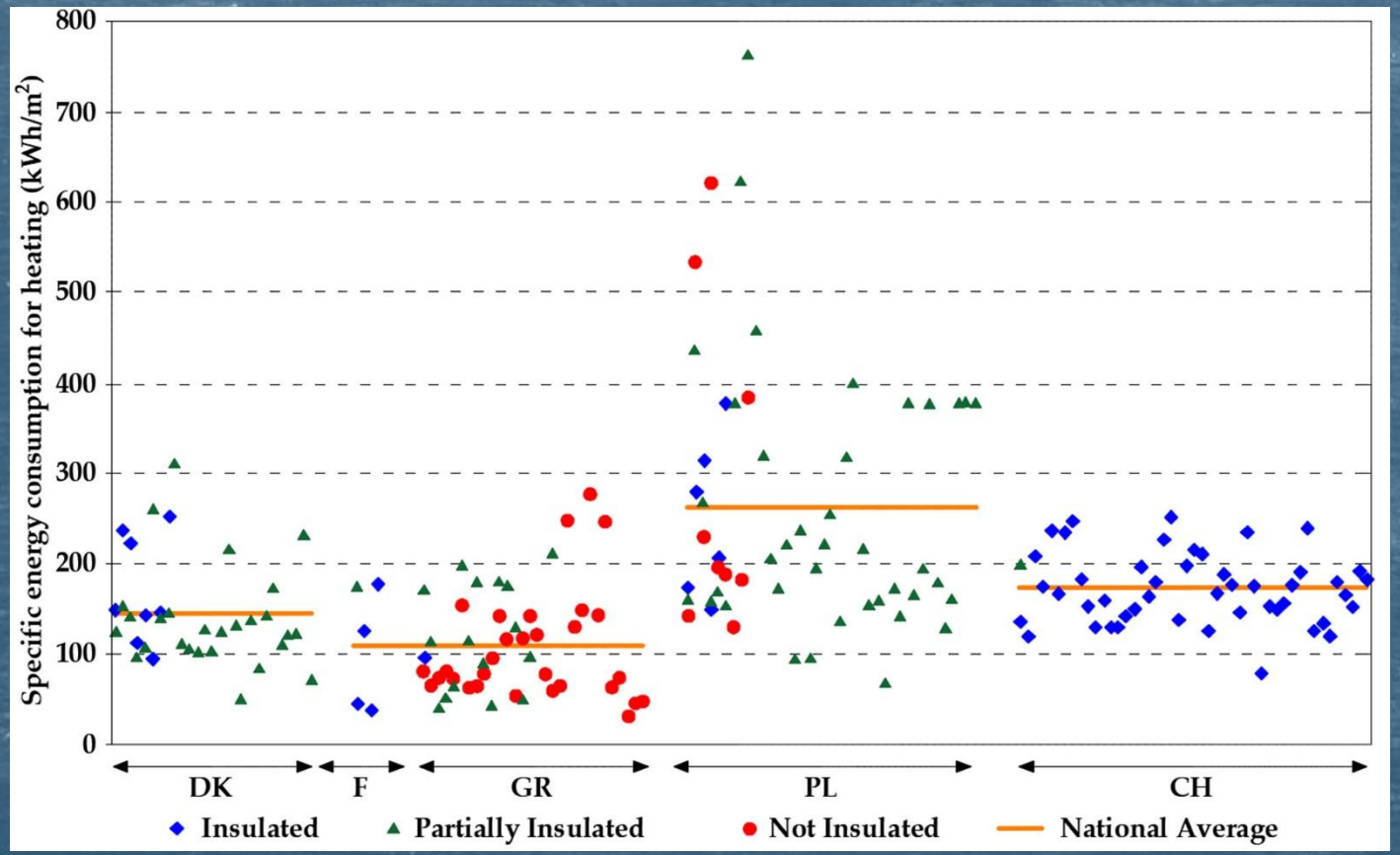
- Typical mild winters and cool summers, especially in the insular territory.
- Temperature rarely higher than 35 °C and lower than 5 °C
- Glocal Horizontal Irradiance higher than 1,000 W/m². Annual global irradiation at 1,800 kWh/m²





Inadequate insulation

- Typical feature of the existing buildings' stock in the Metirranean region: a large amount of the buildings remain inadequately insulated.



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Examples for five buildings in Crete

- 1. Residential building
- 2. School building
- 3. Municipality building
- 4. Museum
- 5. Sports facility

Existing consumptions

Final energy use	Residential building			School building			Municipality building			NHMC			Pancretan Stadium		
	Primary energy consumption														
	kWh	kWh/m²	%	kWh	kWh/m²	%	kWh	kWh/m²	%	kWh	kWh/m²	%	kWh	kWh/m²	%
Heating	6,070	50.6	60.9	61,516	30.8	63.2	91,885	94.6	38.5	307,891	60.6	28.2	74,214	7.0	1.3
Cooling	2,197	18.3	22.0	3,089	1.5	3.2	70,054	72.1	29.3	464,758	91.4	42.6	574,792	54.0	10.1
Hot water	1,160	9.7	11.6	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	590,402	55.5	10.4
Lighting	548.6	4.6	5.5	29,141	14.6	29.9	53,796	55.4	22.5	220,985	43.5	20.3	1,977,899	185.9	34.9
Swimming pools	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	151,373	14.2	2.7
Other	1.625	13.5	16.3	3,573.84	1.8	3.7	23,040	23.7	9.6	97,424	19.2	8.9	2,296,033	215.8	40.5
Reactive	0	0.0	-	0	0.0	-	33,408	34.4	-	683,587	134.5	-	1,126,380	105.9	-
Total	9.975	83.1	100.0	97,320	48.7	100.0	272,184	280.3	100.0	1,774,645	349.1	100.0	6,791,092	638.4	100.0
Energy performance rank	B+			D			D			E			D		

Traditional architecture

1. Narrow streets for protection from strong winds.

2. Thick stone walls for better insulation.

3. Southern orientation with appropriate shading.

4. Small northern openings for natural air infiltration during summer.

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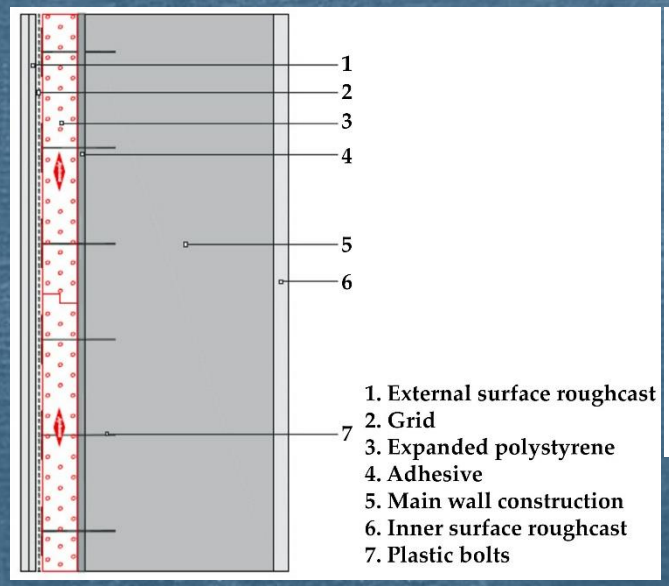
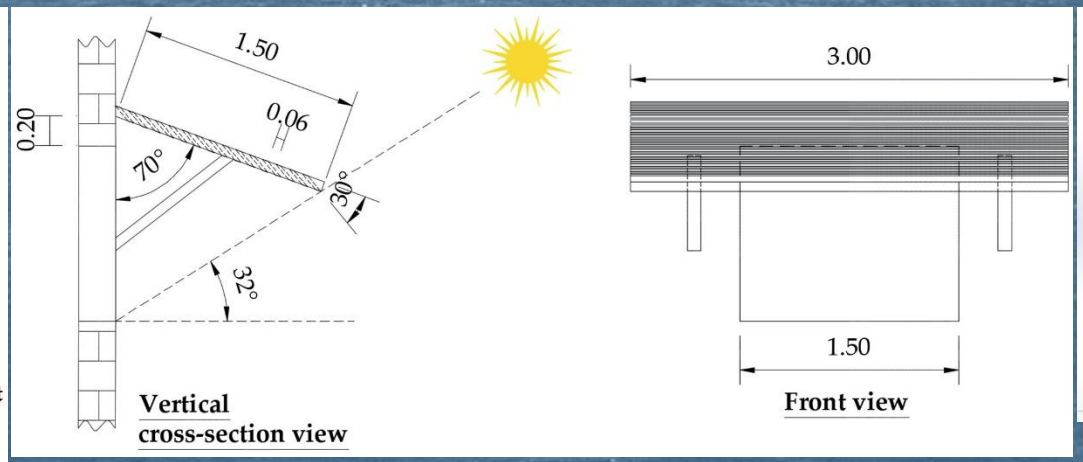
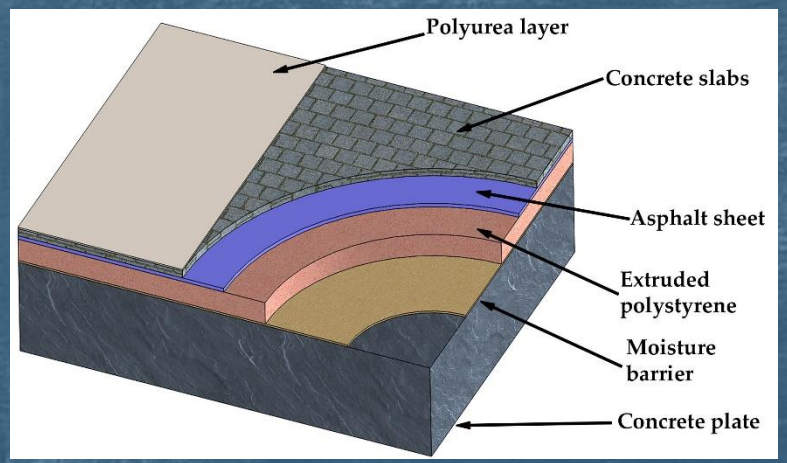
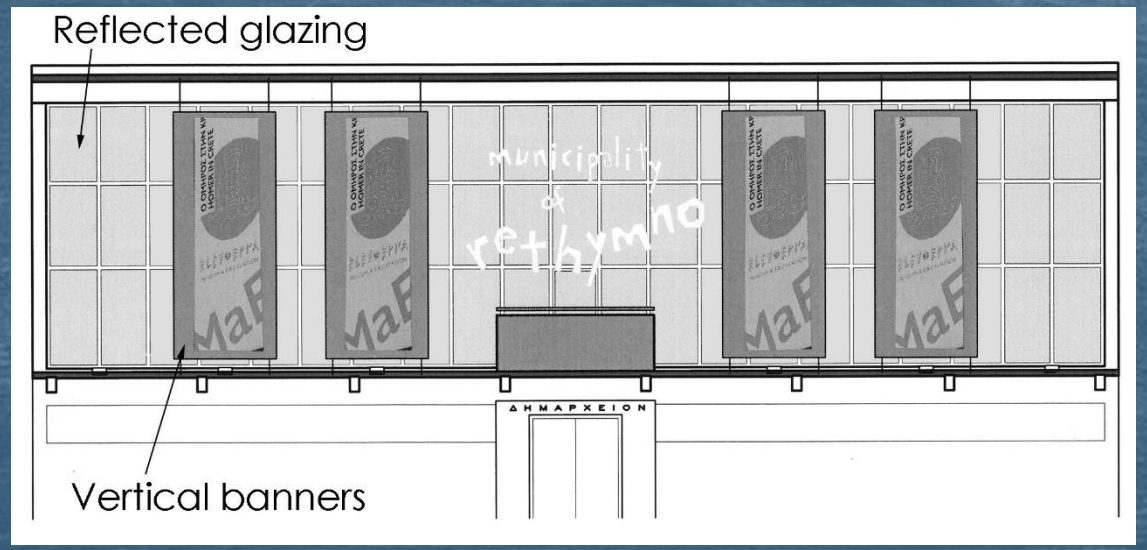
Introduction of passive measures





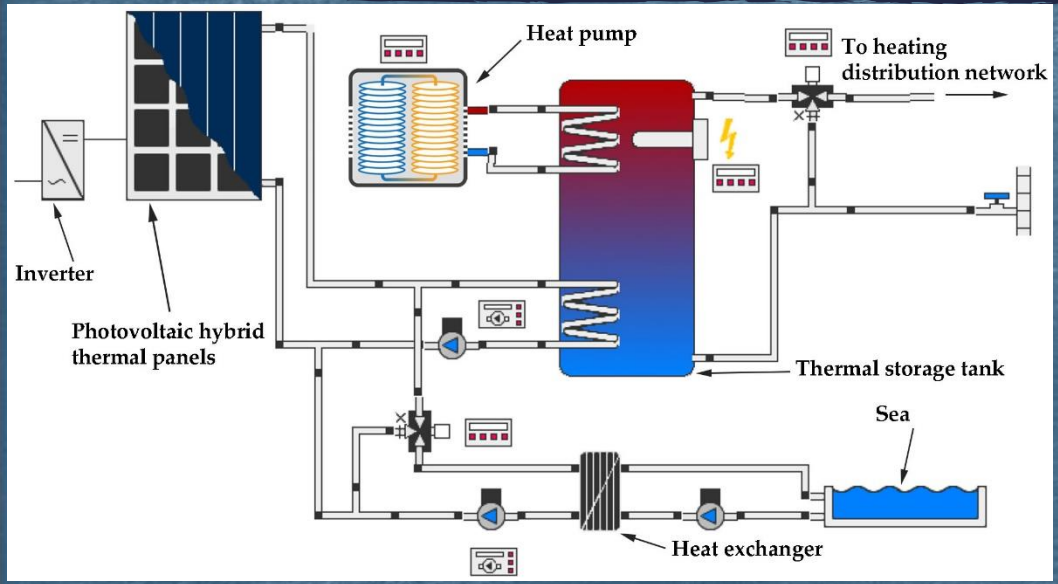


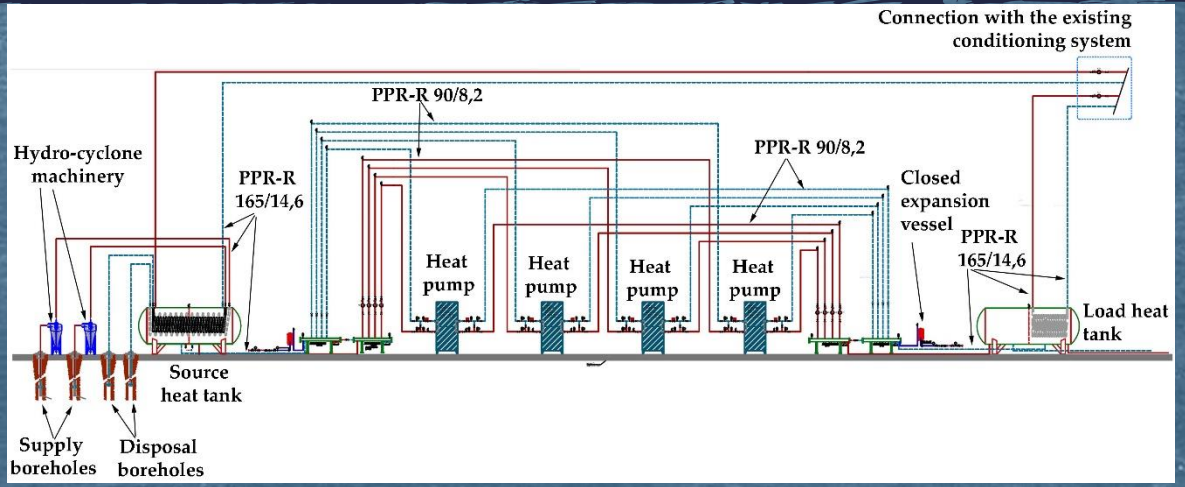


Reduction of heating and cooling loads

	Annual levelized load (kWh/m²)				Load reduction			
	Existing operation		Upgraded operation		Heating		Cooling	
	H	C	H	C	kWh/m²	%	kWh/m²	%
Residence	84.3	35.1	86.5	24.9	-2.2	-2.6	10.2	29.1
School building	29.7	25.8	14.0	18.5	15.7	53.0	7.3	28.3
Municipality building	25.9	54.3	12.3	19.6	13.6	52.6	34.7	64.0
NHMC	43.3	67.3	24.9	47.4	18.4	42.4	19.9	29.6
Pancretan Stadium	35.9	41.0	29.9	38.7	5.9	16.6	2.3	5.7

Introduction of active systems - Innovation

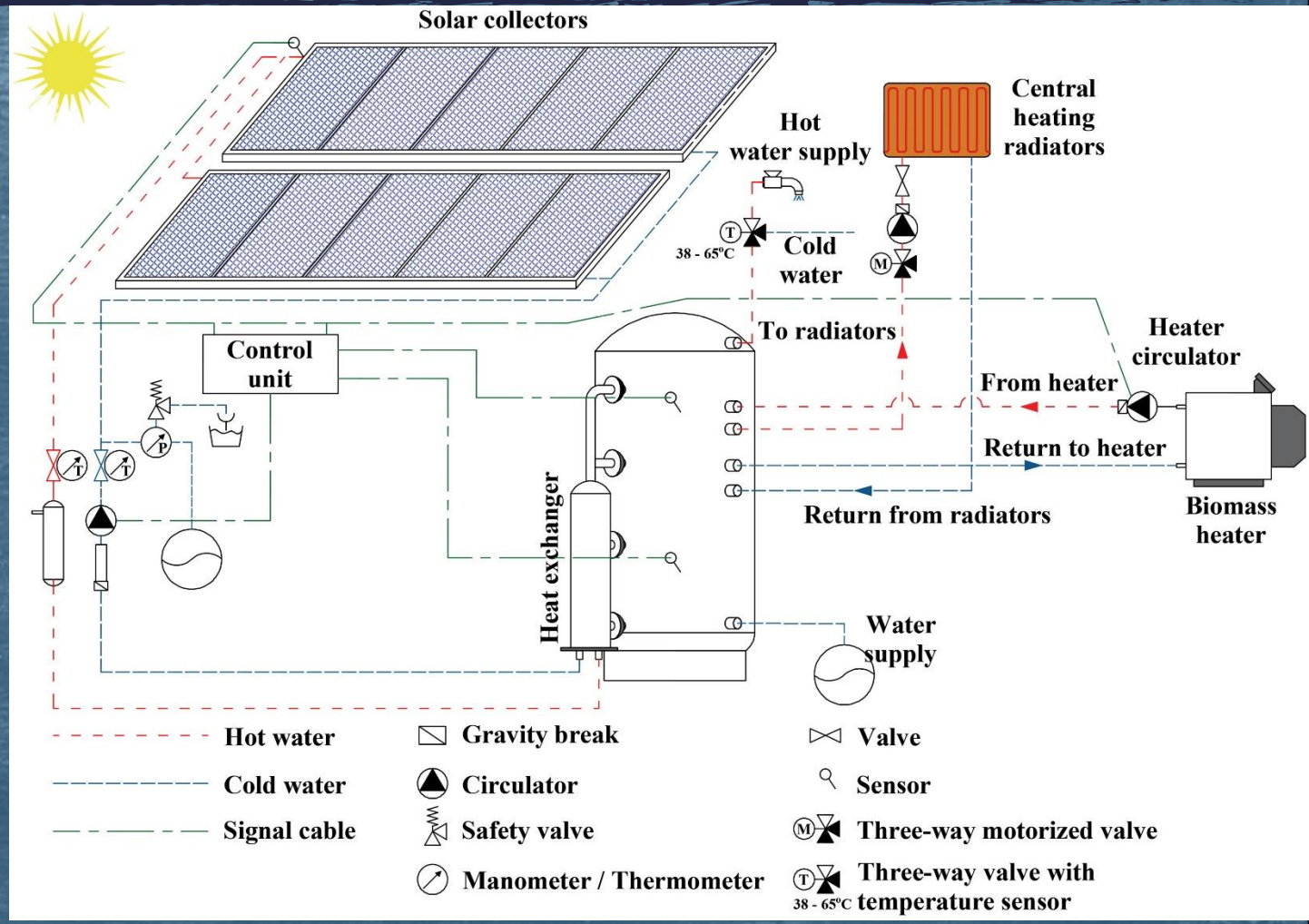




A combination of an open-loop geothermal system with photovoltaic hybrid thermal panels for indoor space conditioning and electricity production for the National History Museum of Crete

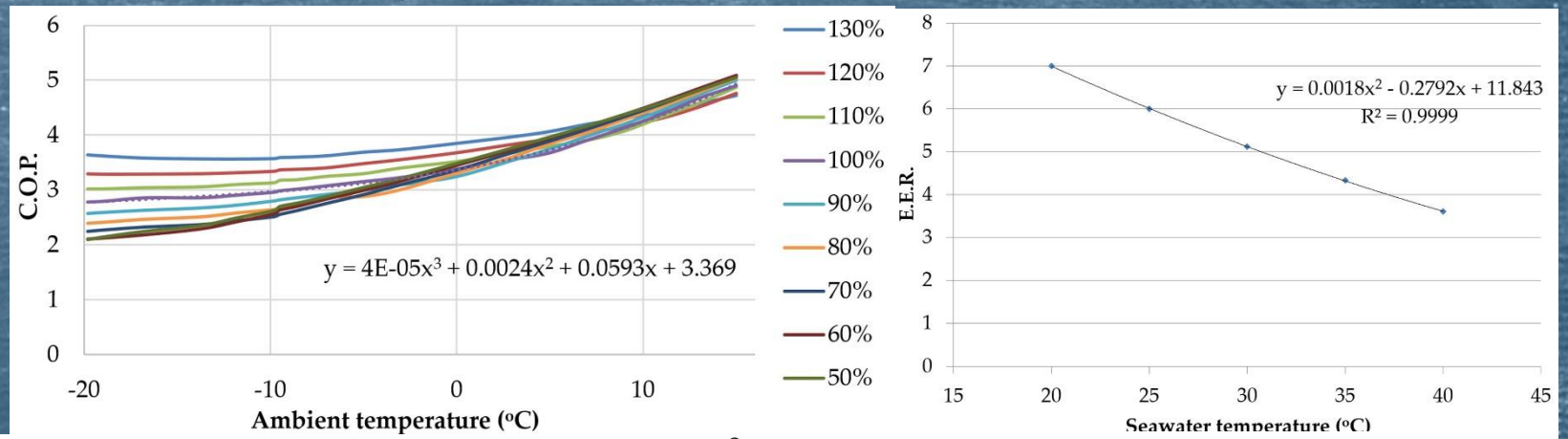
Introduction of active systems - Innovation

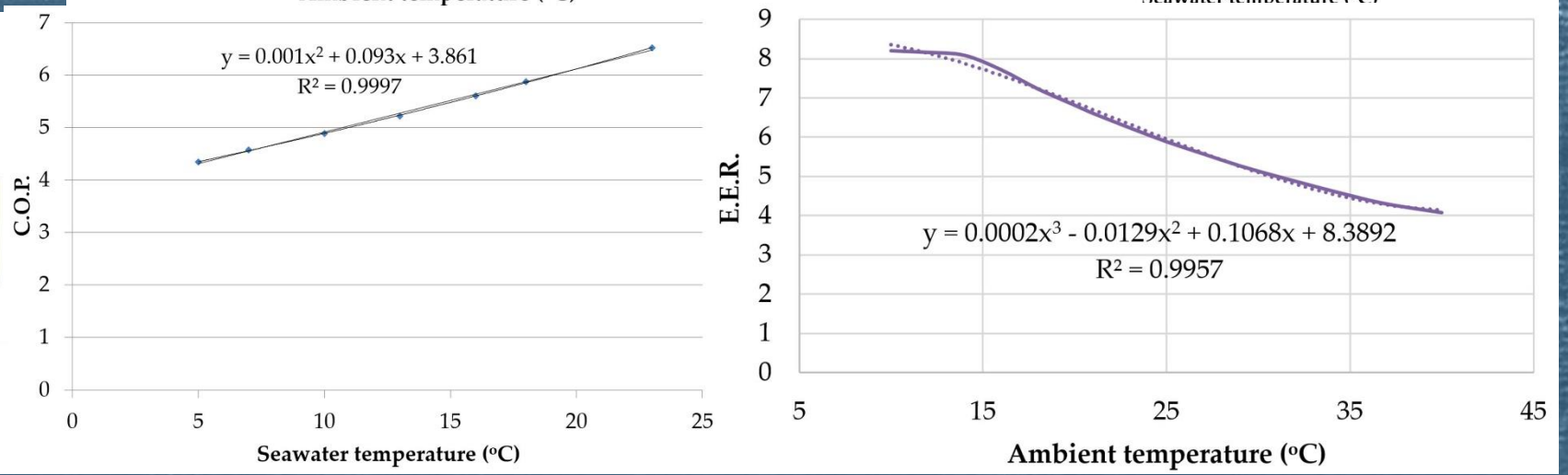
A solar-combi system for combined hot water production and swimming pools heating in the Pancretan Stadium.



Introduction of active systems – Typical systems

Typical COP & EER curves for VRV air-to-air heat pumps and geothermal heat pumps.





Consumption after the introduction of active and passive measures

Final energy use	Residential building			School building			Municipality building			NHMC			Pancretan Stadium		
	Primary energy consumption														
	kWh	kWh/m^2	%	kWh	kWh/m^2	%	kWh	kWh/m^2	%	kWh	kWh/m^2	%	kWh	kWh/m^2	%
Heating	6,221	51.8	56.0	36,746	15.4	36.0	11,912	12.3	8.1	51,890	10.2	13.6	159,793	15.0	4.8
Cooling	1,557	13.0	14.0	19,032	9.5	18.6	9,952	10.2	6.8	103,939	20.4	27.2	178,762	16.8	5.4
Hot water	1,160	9.7	10.4	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	119,365	11.2	3.6
Lighting	549	4.6	4.9	11,101	5.6	10.9	16,423	16.9	11.2	129,471	25.5	33.8	943,672	88.7	28.6
Swimming pools	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	61,326	5.8	1.9
PCs	0	0.0	0.0	32,387	16.2	31.7	90,480	93.2	61.5	0	0.0	0.0	0	0.0	0.0
Other	1,625	13.5	14.6	2,859	1.4	2.8	18,432	19.0	12.5	97,424	19.2	25.5	1,837,289	172.7	55.7
Reactive	0	0.0	0.0	0	0.0	-	15,854	16.3	-	36,038	7.1	-	650,844	61.2	-
PVs production	11,114			104,202			112,428	115.8		152,673	30.0		1,257,490	118.2	
Total	-3	0.0	100.0	-2,077	-1.0	100.0	50,626	52.1	100.0	266,089	52.3	100.0	2,693,561	253.2	100.0
Energy performance rank	Zero Energy Building			Zero Energy Building			A+			A+			B+		

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Consumption after the introduction of active and passive measures

	Residence		School building		Municipality building		NHMC		Pancretan Stadium	
	Primary energy annual saving									
	kWh/m^2	%	kWh/m^2	%	kWh/m^2	%	kWh/m^2	%	kWh/m^2	%
Heating	-2.3	-2.3	15.4	50.1	82.4	87.0	50.4	83.1	-8.0	-115.3
Cooling	40.8	40.8	-8.0	-516.2	61.9	85.8	71.0	77.6	37.2	68.9
Hot water	0.0	0.0	-	-	-	-	-	-	44.3	79.8
Lighting	0.0	0.0	9.0	61.9	38.5	69.5	18.0	41.4	97.2	52.3
Swimming pools	-	-	-	-	-	-	-	-	8.5	59.5
Other	0.0	0.0	0.4	20.0	4.7	20.0	0.0	0.0	43.1	20.0
Reactive	-	-	-	-	18.1	52.5	127.4	94.7	44.7	42.2
Total	83.1	100.0	49.7	102.1	228.2	81.4	296.7	85.0	385.2	60.3

Key Performance Indicators

	Primary energy annual saving (%)	Total set-up cost (€)	Energy procurement cost reduction (€)	Payback period (years)	RES penetration (%)	CO_2 emission reduction (tn)	CO_2 emission reduction (%)
Residence	100.0	4,500	588	7.7	100.0	11.0	100.0
School building	102.1	728,573	11,592	62.8	104.2	98.2	102.1
Municipality building	81.4	535,645	15,653	34.2	76.2	219.2	81.4
NHMC	85.0	806,338	24,574	32.8	57.4	1,492.0	85.0
Pancretan Stadium	60.3	2,585,646	166,193	15.6	66.4	4,164.0	60.3

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Thanks a lot for you attention

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