ENPI CBCMED
CROSS-BORDER COOPERATION IN THE MEDITERRANEAN

DIDSOLIT-PB

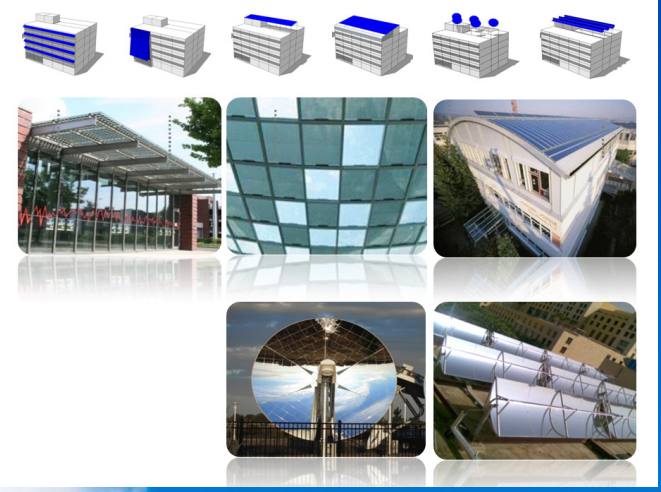
Project funded by the EUROPEAN UNION

DIDSOLIT-PB: Development and implementation of decentralised solar-energy-related innovative technologies for public buildings in the Mediterranean Basin countries.

Coordinating Institution: BEG-INCERS Research Group – Universitat Autònoma de Barcelona (UAB)

Report 6

"Chart of options" DIDSOLIT-PB solar systems selection



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INCERS line Increasing Energy from Renewable Sources

DIDSOLIT-PB: Development and implementation of decentralised solar-energy-related innovative technologies for public buildings, in the Mediterranean Basin countries. Project Identification number 94/431

ENPI-CBCMED Strategic Project I-A/2.3/233 [2012-2015]

Duration: 3 years (schedule: starting January 2013)

The project DIDSOLIT-PB is funded by the European Union through the ENPI CBC-MED Programme: European Neighbourhood and Partnership Instrument.- Cross Border Cooperation in the Mediterranean Sea Basin Programme (www.enpicbcmed.eu). The Programme aims at reinforcing cooperation between the European Union and partner countries regions placed along the shores of the Mediterranean Sea. The DIDSOLIT-PB project total budget is 4,3 million Euro, and it is financed, for an amount of 4,1 million Euro, by the ENPI CBC Med Programm"

Partnership:

- UAB, BEG Research Group (Leader), Spain, (Mediterranean Region: Catalonia)
- AEIPLOUS, Greece, (MR: Ditiki-Ellada)
- Egyptian Association for Energy and Environment, EAEE, Egypt (MR: Marsa-Matrouh)
- Balqa Applied University, BAU, Jordan (MR: Al Balqa)
- Alexandria University, AU, Egypt (MR: Alexandria)
- Mediterranean Agronomic Institute of Chania, MAICh, Greece (MR: Crete)
- Eco-System Europa, SL, *EsE*, Spain (MR: Catalonia)

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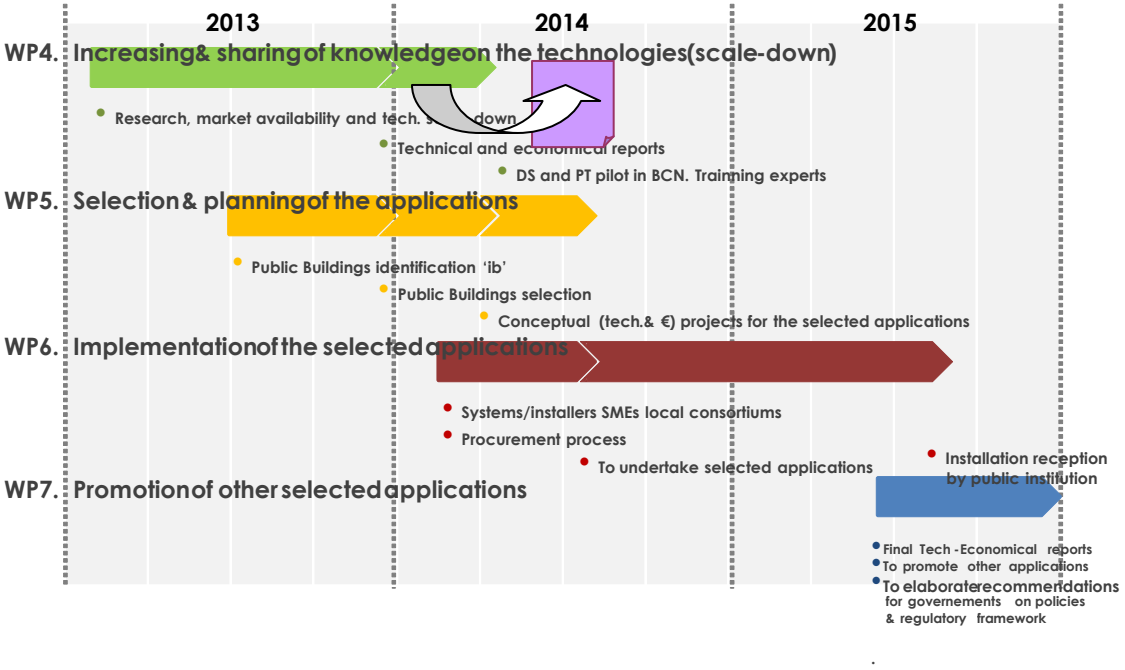
CONTENT

INTRODUCTION

The contents of this report responds to the overall, distilled, outcomes from the studies and tasks carried out as WP4 activities ("Increasing & sharing knowledge of the target technologies").

Project timeline



That assessment of the referred WP4 outputs has been carried out by the Project Technical Team (PTT), taking as basis specially the following studies,

- Report 1: DS assessment
- Report 2: PT assessment
- Report 3: PT-SCH assessment
- Report 4: BIPV assessment
- Report 5: Cost study

Which were in turn based in previous studies subcontracted to and delivered by the technological centres, as well as in the several working documents produced by the PTT itself.

This report is therefore the result of the assessment tasks and decision process carried out by the PTT regarding the initially selected solar technologies. The final *Chart of Options* proposal was then approved by the Project Management Board (3rd. meeting, in Barcelona).

To sum up, the present report builds on the previous ones, Reports 1 to 5, where we have set up the 'state of art' of the selected non-standard solar technologies, and developed and defined the technically and commercially viable units (conceptual models) for the systems to be applied in our

Project. That is, the 'Chart of system-models', in the way of generic conceptual designs, pre-defining the specific systems to be undertaken and promoted by Project's Partners. That is, this report is also a summary of the main innovation's component planned and then developed within our Project

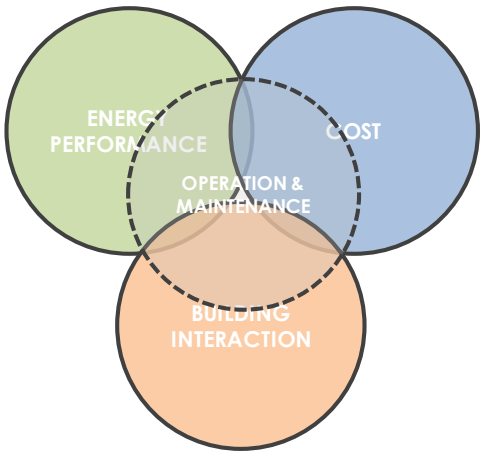
The contents of this Chart of Options, has been in turn the base for each Partner elaborating the subsequent *Concept Designs* and, later on, the *Technical Detailed Design & Economic Schedule,* for the specific solar-systems (sub-projects) defined for installing in the specific buildings/premises previously selected for each partner's Region.

1 THE PROJECT'S STARTING SCHEME: INNOVATIVE SOLAR TECHNOLOGIES TO EVALUATE

Global approach

Scale down Dish-Stirling, Parabolic Trough and PT Solar Cooling application

Maintaining an optimal performance ratio



Low maintenance scenario

Minimum, **10 buildings**

Building envelope requirements Aprox. 100-250 m2 / SUA

Structural and construction requirements

LEGISLATION & ADMINISTRATIVE PROCESS
The projects will follow the national current procedures.
Nevertheless, the Project will propose improvements to decision makers.

Chart of options: Initial objectives

Small scale 10-15-20 kW

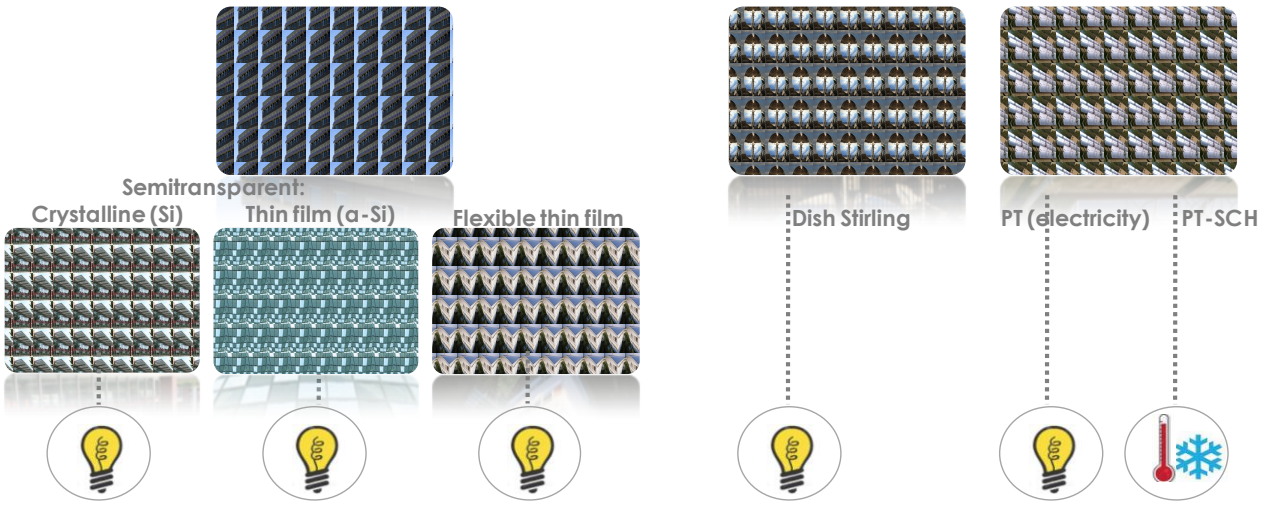
BIPV

1. Building integration
2. Passive effect
3. Cost-performance balance
4. Flexibility
5. Visibility

CSP

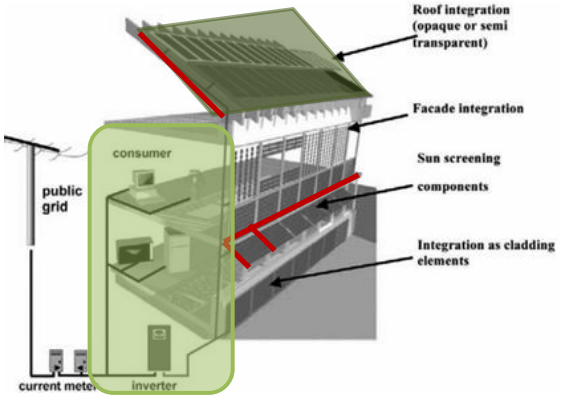
1. High performance at high Tª and radiation
2. Technology trigger
3. Decentralized experiences

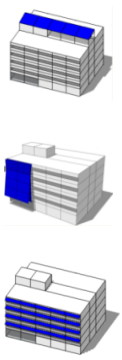
- The challenge to find small scale cost-efficiency
- First conclusions out of Technological research



2 ASSESSMENT OF « BUILDING-INTEGRATED PHOTOVOLTAIC » OPTIONS

BIPV system components overview





BIPV selected options (application/technology)

BOS (electrical)
- Inverter/management syst.
- Electrical accessories
- Monitoring systems (remote)

BOS (system engineering)
- Executive Project and legalization

BOS (transp+mount)
- Transportanion
- Installation/mounting

PV modules
- Crystalline semitransparent
- Thin film semitransparent (a-Si, CdTe)
- Thin film flexible

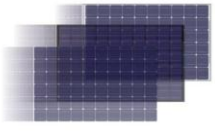
BOS (substructure)
- Roof/canopies
- Façade (single/double)
- Brise-soleil

PV modules

Module and Cell Efficiency

Technology	Thin Film				Semitransparent a-Si (10-20%)	Crystalline Silicon			
	(a-Si)	(CdTe)	CI(G)S	a-Si/ µSi	a-Si/ µSi	Mono	Multi	Semitransparent Si (35%)	
Cell efficiency	4-7%	8-10%	7-11%	6-8%	6-8%	16-22%	14-16%	16-22%	14-16%
Module efficiency						13-19%	12-15%	13-19%	12-15%
Area Needed per KW (for modules)	~ 15 m² 66 Wp/m²	~ 11m² 90 Wp/m²	~ 10m² 100 Wp/m²	~12m² 83 Wp/m²	-16 m² 60 Wp/m²	~7m² 140 Wp/m²	~8m² 125 Wp/m²	-11 m² 90 Wp/m²	

EPIA, source. Own edition



BIPV options available in the market: comparative parameters

	POLYCRYSTALLINE MODULES																
Bidder	Model	Manufacturer	Origin	Nominal power(W)	Wp/m2	Efficiency (%)	Module area(m2)	Size (m)	Weight kg	kg/m2	Glass thickness(mm)	Encapsulant	Transparency (%)	type of cells(mm)	Delivery time	€/m2	€/Wp
1. BIC	PX230	SUNSET	Germany	230		18	2,1	1.82x1.15	40	19,0	tempered 5	PVB	36	156x156	6weeks	142,4	1,3
2. ACROPOL		Solarwatt	Germany	250		14	1,66	1.68x0.99	24	14,5	tempered 2	EVA	19	156x156	8 weeks	150,6	1
VIDURSOLAR	VS37 C54 P213	VidurSolar	Spain	213			2,22	1.850 x 1.200	63	28,4	extra clear 5+5 tempered	PVB	37	156 X 156	6-8 weeks	259	2,7
	VS30 C60 P238 *(2)*			238			2,22	1.850 x 1.200	63	28,4	extra clear 5+5 tempered	PVB	30	156 x 156		236	2,2
	VS30 C60 P238 *(3)*			238			2,22	1.850 x 1.200	63	28,4	extra clear 5+5 tempered	PVB	30	156 x 156		221	2,1
	VS16 C36 P141			141			1,152	1.600 x 0.720	39	33,9	extra clear 6+6 tempered	PVB	16	156 x 156		282	2,3
ONYX		ONYX	Spain		85		0,71	1.475 x 0.480			tempered 4+4	PVB		156 x 156		221	2,6
					100		1,4	1.650 x 0.850			tempered 5+5	PVB		156 x 156		197	1,97

(1) Quotation for 100 kWp
(2) Quotation for 47 kWp
(3) Quotation for 85 kWp

- **Cost range: depending on dimensions, glass composition and quantity: 1-1,3 €/Wp to 2,7 €/Wp**
- **Availability of providers in Spain and Egypt**

	THIN FILM (a-Si) MODULES																
Bidder	Model	Manufacturer	Origin	Nominal power(W)	Wp/m2	Efficiency (%)	Module area(m2)	Size (m)	Weight kg	kg/m2	Glass thickness(mm)	Encapsulant	Transparency (%)	type of cells(mm)	Delivery time	€/m2	€/W
1. BIC	SUNONE	SUNSET	Germany	90	63	7	1,43	1.1x1.3	24	16,8	tempered	PVB	14		18weeks	62,94	1
2. ACROPOL	x3	INVENTUX	Germany	86,6	61	8	1,43	1.1x1.3	26	18,1	float 3,2	PVB		0	8 weeks	80,42	1
ONYX *(2)*		ONYX	Spain	34,76	44		0,79	1.245 x 0.635		16,2	3,2 + 3,2 mm	EVA	10%			45	1,0
				34,76	44		0,79	1.245 x 0.635		16,2	3,2 + 3,2 mm	PVB	10%			84	1,9
				31,68	44		0,72	1.200 x 0.600		16,2	3,2 + 3,2 mm	PVB	10%			97	2,2
				102	44		2,30	1.846 x 1.245		37,5	6T+3,2+6T mm	PVB	10%			193,6	4,4
				68,2	44		1,55	1.245 x 1.242		37,5	6T+3,2+6T mm	PVB	10%			193	4,4

(2) Quotation from 44-88 kWp. In case of less power installed (22-44 kWp) cost would increase approximately 10%

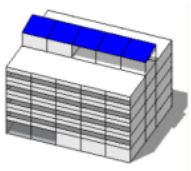
- **Cost range: depending on dimensions, glass composition and quantity: 1 €/Wp to 4,4 €/Wp**
- **Availability of providers in Spain and Egypt**

	ETFE FLEXIBLE MODULES																
Bidder	Model	Manufacturer	Origin	Nominal power(W)	Wp/m2	Efficiency (%)	Module area(m2)	Size (m)	Weight kg	kg/m2	Glass thickness(mm)	Encapsulant	Transparency (%)	type of cells(mm)	Delivery time	€/m2	€/W
1. BIC	PVL136	UNISOLAR	USA	136		5	2,16	5.486X0.394	7,7	3,6	Tempered extra white 6	ETFE	0	356x239	6weeks	170	2,7
2. ACROPOL	MONO107	APOLOFLEX SUNPOWER	Germany	107		22,3	0,6318	1.17x0.54	3	4,7	Tempered extra white, aerospace grade	ETFE	0		8 weeks	186,3	1,1

to be dou

- **Cost range: depending on availability, from 1,1 €/Wp to 2,7 €/Wp**
- **Difficulty to find providers (the technology has suffered from low crystalline prices)**
- **Nominal higher performance at high radiation and temperatures**
- **The EFTE (plastic) encapsulation might increase the dirty issues**

2.1 BIPV-1: Crystaline (Si) semitransparent (30-40%)

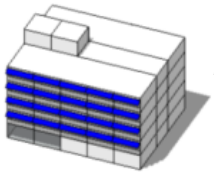


Roof / canopy (semitransparent laminated glass PV, Si)



Following references, from different PV providers. Among them: VIDUR SOLAR, ERTEX Solar, TFM, UNISOLAR, SCHOTT Solar, SOLARWAT, BATISOLAR,

2.2 BIPV-2: Crystaline (Si) thin film semitransparent (10-20%)



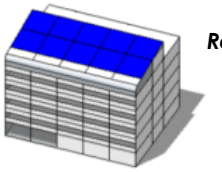
Brise-soleil (semitransparent laminated glass PV, Si and a-Si)





Following references, from different PV providers. Among them: VIDUR SOLAR, ERTEX Solar, TFM, UNISOLAR, SCHOTT Solar, SOLARWAT, BATISOLAR,

2.3 BIPV-3: Flexible thin layer



Roof / canopy (flexible thin film a-Si, laminated glass tf, a-Si, CdTe)

Following references, from different PV providers. Among them: VIDUR SOLAR, ERTEX Solar, TFM, UNISOLAR, SCHOTT Solar, SOLARWAT, BATISOLAR,

2.4 BIPV options: Comparative costs & output

BIPV COST ESTIMATION
07/04/2014

not included
estimated
reference
real bid

		Crystalline (Si) (semitransparent, glass)								thin film a-SI (semitransparent, glass)						flexible thin film a-SI (EFTE)			
		Reference PVsyst		Reference		Quotations (BIC)		Quotations		Reference		Quotations (BIC)		Quotations (ONYX)		Reference		Quotations (BIC)	
		€/Wp	kWp	€/Wp	kWp	€/Wp	kWp	€/Wp	kWp	€/Wp	kWp	€/Wp	kWp	€/Wp	kWp	€/Wp	kWp	€/Wp	kWp
		5,32	10	4,75	10	3,55	10	4,75	10	4,25	10	3,25	10	4,25	10	3,50	10	4,70	10
kWh/kWp.y			1750		1750		1750		1750		1750		1750		1750		1750		1750
annual output of the system kWh			17500		17500		17500		17500		17500		17500		17500		17500		17500
PV modules	53%	2,30	23.000 €	2,50	25.000 €	1,30	13.000 €	2,5	25.000 €	2,00	20.000 €	1,00	10.000 €	2,00	20.000 €	1,50	15.000 €	2,70	27.000 €
														4,40					
Balance Of System (BOS)	37%	2,77	26.225 €	2,00	17.500 €	2,00	17.500 €	2,00	17.500 €	2	17.500 €	2	17.500 €	2	17.500 €	1,75	15.000 €	1,75	15.000 €
Power block / electrical components		0,25	2.500 €	0,45	4.500 €	0,45	4.500 €	0,45	4.500 €	0,45	4.500 €	0,45	4.500 €	0,45	4.500 €	0,45	4.500 €	0,45	4.500 €
Inverter / management system		0,25	2.500 €	0,35	3.500 €	0,35	3.500 €	0,35	3.500 €	0,35	3.500 €	0,35	3.500 €	0,35	3.500 €	0,35	3.500 €	0,35	3.500 €
DC/AC accessories, combiner boxes, cabling and electrical components				0,10	1.000 €	0,10	1.000 €	0,10	1.000 €	0,10	1.000 €	0,10	1000,00	0,10	1.000 €	0,10	1.000 €	0,10	1.000 €
Power conditioning																			
Control and Management																			
Protections and system grounding																			
Support system components		1,07	10.667 €	0,45	4.500 €	0,45	4.500 €	0,45	4.500 €	0,45	4.500 €	0,45	4.500 €	0,45	4.500 €	0,2	2.000 €	0,2	2.000 €
Secondary substructure (fixation)		1,07	10.667 €	0,45	4.500 €	0,45	4.500 €	0,45	4.500 €	0,45	4.500 €	0,45	4.500 €	0,45	4.500 €	0,2	2.000 €	0,2	2.000 €
Primary substructure (foundations, steel structure)																			
Building interaction / site preparation		0	- €	0	- €	0	- €	0	- €	0	- €	0	- €	0	- €	0	- €	0	- €
Technical chamber conditioning																			
Transport				0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €
Installation / mounting		1,31	13.058 €	0,60	6.000 €	0,60	6.000 €	0,60	6.000 €	0,6	6.000 €	0,6	6.000 €	0,6	6.000 €	0,6	6.000 €	0,6	6.000 €
Installation works (includding safety and security)				0,60	6.000 €	0,60	6.000 €	0,60	6.000 €	0,6	6.000 €	0,6	6.000 €	0,6	6.000 €	0,6	6.000 €	0,6	6.000 €
Monitoring	5%	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €
Local and remote monitoring		0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €
Engineering and Legalization	5%		1.500 €		2.500 €		2.500 €		2.500 €		2.500 €		2.500 €		2.500 €		2.500 €		2.500 €
Project, Commissioning, Legalization & Administrative process		0,15	1.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €	0,25	2.500 €
Capital Cost		5,32	53.225 €	4,75	47.500 €	3,55	35.500 €	4,75	47.500 €	4,25	42.500 €	3,25	32.500 €	4,25	42.500 €	3,50	35.000 €	4,70	47.000 €
O&M (Operation and Maintenance) (€/year)		0,08	800 €	0,08	800 €	0,10	1.000 €	0,10	1.000 €	0,08	800 €	0,08	800 €	0,1	1.000 €	0,08	800 €	0,08	800 €
Infrastructures (3.2.-3.7. budget lines)				65%	31.000 €					61%	26.000 €					60%	21.000 €		
Services (6.15.-6.20. budget lines)				35%	16.500 €					39%	16.500 €					40%	14.000 €		

3 ASSESSMENT OF SCALE-DOWN: 'DISH STIRLING' OPTION

3.1 The starting evaluation

- **Dish Stirling technology: References (I)**

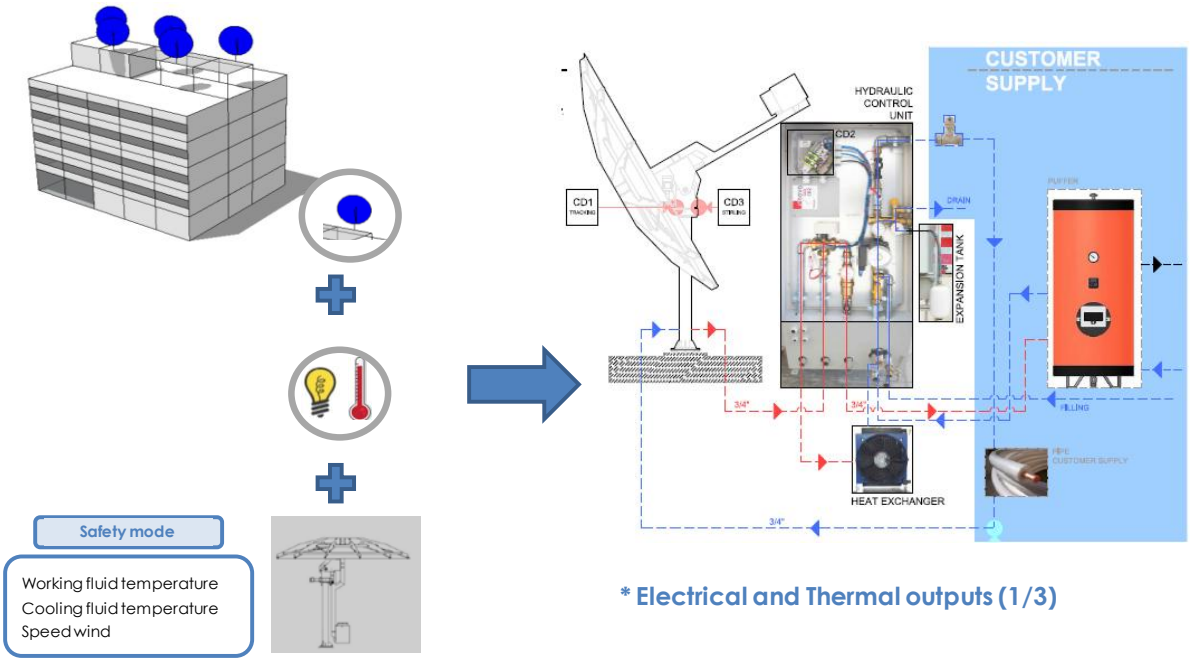
Company	Product	Diameter	Power/unit	Weight	Yield	Cost/unit
Ripasso Energy	Not specified	Not specified	30 kWe	Not specified	≈ 30 %el	Not specified
Cleanergy	Not specified	Not specified	11 kWe	Not specified	Not specified	Not specified
El.Ma.	Not specified	2.4 m	0.5 kW	600 kg	Not specified	50.000,0 €

- **Dish Stirling technology : References (II)**

Company	Product	Diameter	Power/unit	Weight	Yield	Cost/unit
Innova	Trinum	3.75 m	1 kWe 3 kWt	600 kg	≈ 13.8%el 41.4%th	19.900,0 €
Energon	Not specified	3.75 m	1.5 kWe 4.5 kWt	450 kg	≈ 20 %el 55 %th	Not specified
Infinia	PowerDish	6 m	3.2 kWe	1,525 kg	≈ 30%el	26.500,0 €

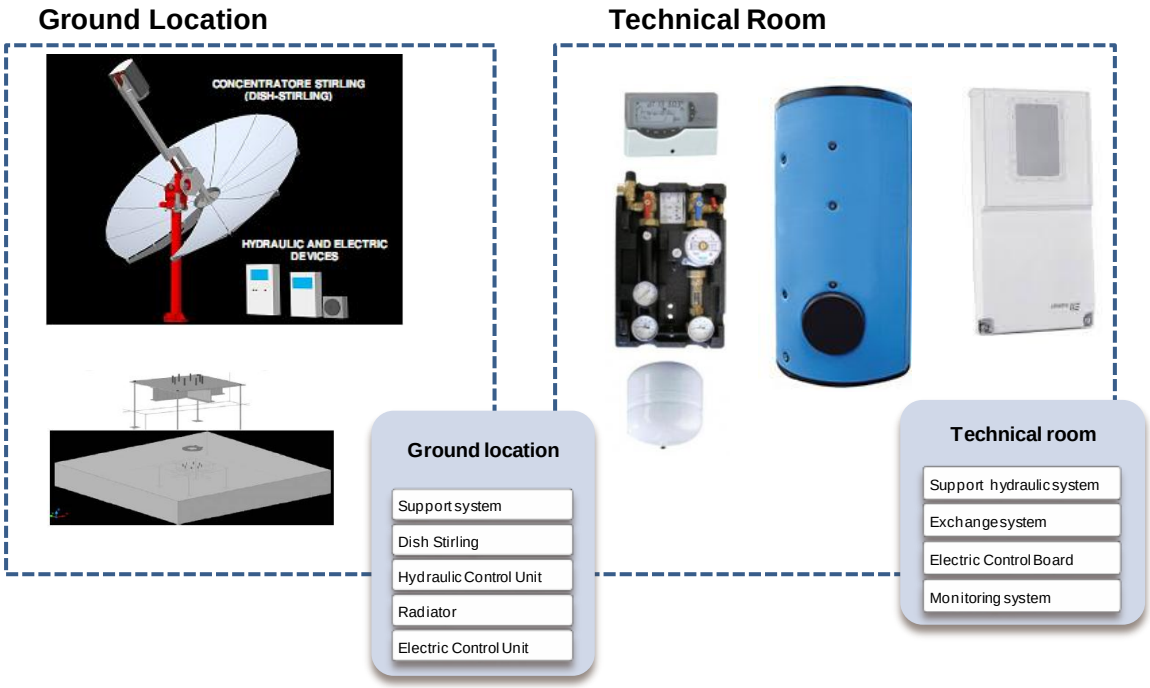
3.2 DS: Final decision

Dish Stirling Technology: Building Integration



* Electrical and Thermal outputs (1/3)

Dish Stirling Technology: System Components



3.3 System components

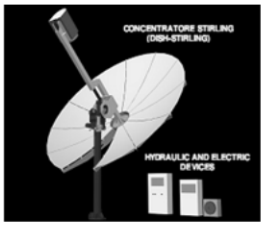
DISH STIRLING TECHNOLOGY

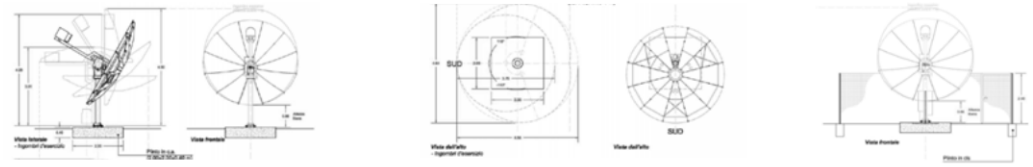
Cogeneration modular system, it generates 1 kWe-3 kWt

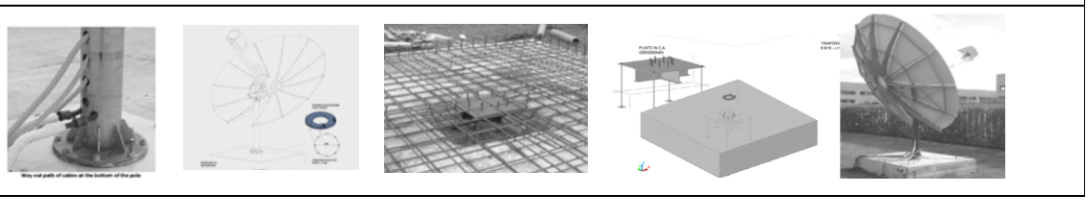
DS System	
Solar Thermal Power:	7,3 kWt
Solar Surface:	9,58 m^2
Impact Surface:	49 m^2
Diameter:	3,75 m
Maximum Height:	4,56 m
Maxium Lenght:	4,64 m
Weight:	650 kg
Structure:	Metal trunk
DNI:	750 W/m^2
Fluid:	Water antifreeze mixture

Main Features

11 individual mirror of highly reflective aluminium
Free-piston Stirling engine designed for cogeneration
Stirling engine cooling allows hot water production
Metal trunk support with a rust protection layer
Sun biaxial tracking system
Hydraulic and Electric Management System included
Monitoring sytem included
Environmental sensors
Rain sensor
Anemometer

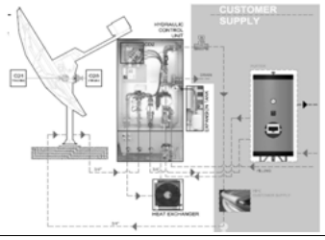






Requirements Energetic

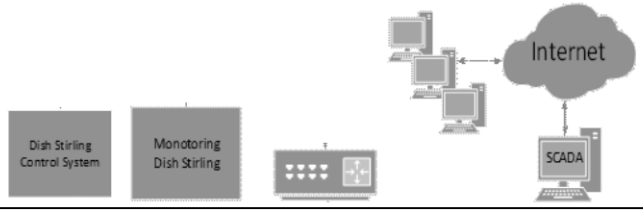
Electric System	Power:	1 kWe
		AC (not need inverter)
		220 V, 50 Hz
Thermal system	Power:	3 kWt
	Solar Tank	> 500 L
	Thermal demand	> 17.500 Kcal



Monitoring System

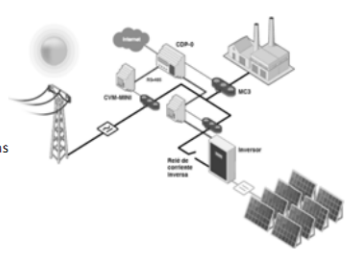
Monitored variables

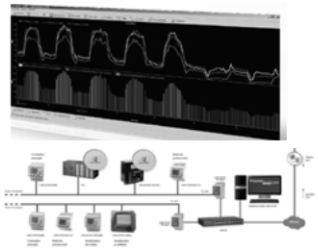
Data
Time
Energy produced (kWh)
Wind Speed (km/h)
Head temperature set point
Temperature Stirling head
Temperature entry cooling fluid
Temperature exit cooling fluid
Cooling fluid flow
Environment temperature
Boiler water temperature
Voltage
Current delivered
Power
Frequency



SCADA System

Remote parameterization of equipment
Viewing parameters real time
Multi Software (Embedded Web Server)
Integrated XML Server
In a charge distribution (or remote installations)
Energy management system. Subsistence Solutions



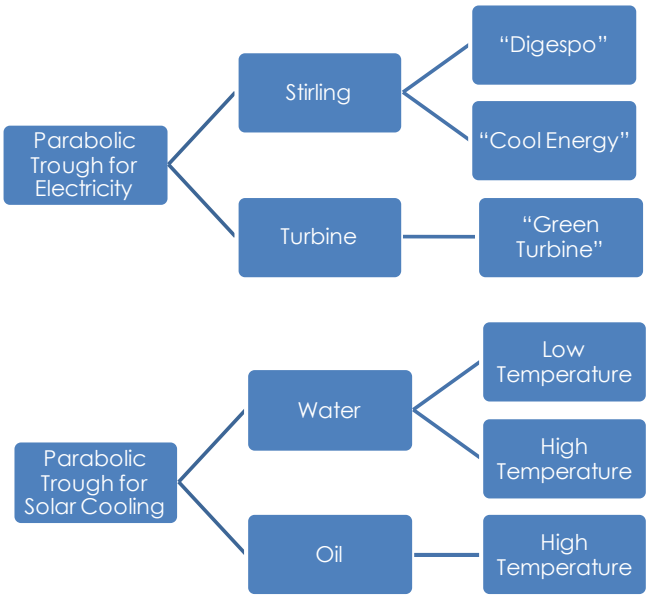


3.4 Economical aspects

DS COST ESTIMATION 12/02/2014		Disth Stirling €/Wp	KWe	KWt	Greece+Spain kWeq total	Egypt+Jordan kWeq total
		9,40	1	3	4	4
kWh/kWp y			2100	2133		
Annual output of the system kWh			2100	6399		
Dish Stirling System	51%				19.000 €	19.000 €
Cogeneration modular system, it generates 1 kWe-3kWt					19.000 €	19.000 €
It include the following components:						
Solar field						
Parabolic reflective concentrator						
Solar tracking system						
Structure (metal framework, focal support and metal trunk support)						
Power Block						
Receiver						
Stirling engine						
Exchange chamber						
Alternator (AC monophase)						
Electric Control Unit						
Stirling engine control board (ECU)						
Solar tracking control board (GPS coordinates - TCU)						
Grid Protection board						
Hydraulic Control System						
Management of thermal energy produced						
Control safety mode						
Radiator						
Balance Of System (BOS)	30%				11.170 €	13.670 €
Power block / Cooling System					4.120 €	4.120 €
Solar hydraulic circuit					665 €	665 €
Cooling fluid					85 €	85 €
Exchange system - Thermal tank with internal exchanger					2.000 €	2.000 €
Filling system					70 €	70 €
Support primary hydraulic system*					1.300 €	1.300 €
*In this case it is necessary, when the exchange system is placed farther away than 20 metres of DSS. In this case is considered 50 m of						
Control and Management					1.900 €	1.900 €
Electric Control Board					1.900 €	1.900 €
Support system components					1.000 €	2.000 €
Ground structure - concrete foundations					1.000 €	2.000 €
Building interaction / site preparation					- €	- €
Technical chamber conditioning						
Storage					- €	- €
Transport					1.000 €	2.500 €
Installation / mounting					3.150 €	3.150 €
Mounting					1.250 €	1.250 €
Piping system					1.300 €	1.300 €
Electrical system					600 €	600 €
Monitoring System	13%				4.800 €	4.800 €
Control and Management						
Monitoring system					4.800 €	4.800 €
Project	7%				2.640 €	2.640 €
Project, legalization & administrative process						
Capital Cost	Greece+Spain	9,40			37.610 €	40.110 €
	Egypt+Jordan	10,03				
O&M (Operation and Maintenance) (€/year)		0,08			320 €	320 €
Infrastructures (3.2.-3.7. budget lines)	61%				23.120 €	23.120 €
Services (6.15.-6.20. budget lines)	39%				14.490 €	16.990 €

4 ASSESSMENT OF SCALE-DOWN: 'PARABOLIC TROUGH' OPTION

4.1 The starting evaluation scheme



4.1.1 For electricity

Parabolic Trough for electricity
Technology research evolution

REJECTED

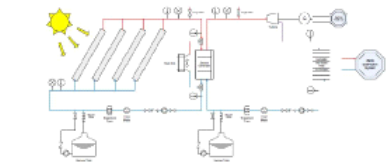
Drawback

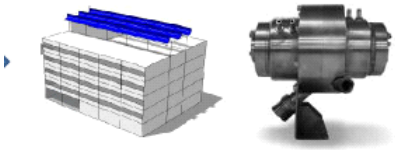
- High system Cost: 90.000€ for 3,3kWe
- Initial FP7 project
- Electrical and thermal outputs (1/3)
- No experience in similar projects
- No right deadline for Didsolit timming (market availability and warranties)

Parabolic Trough for electricity — Turbine — "Green Turbine"

REJECTED

Turbine Engine. Scaled down model





Turbine Engine 1.4-15kWe
7.000-30.000€
Direct systems has been studied

~~Drawback~~

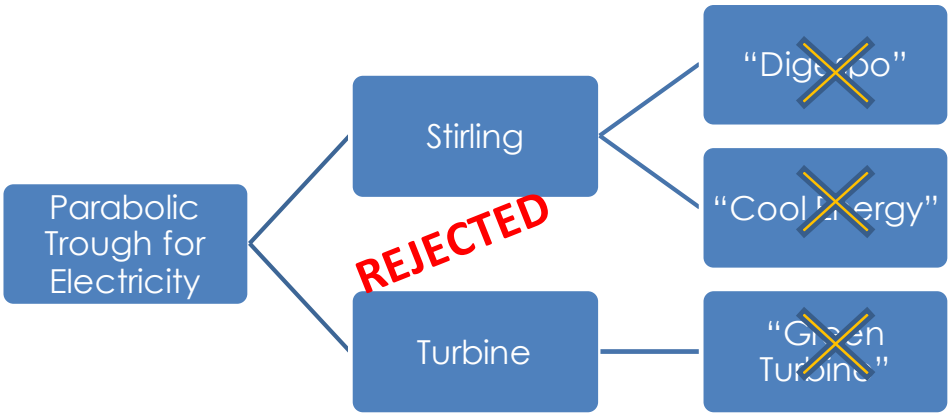
•High cost of the turbine: 35.000 € for 3 kWe (15 KWe cheaper)

•Only Initial prototypes, with no warranty

• Commercial products: from 50 kWe

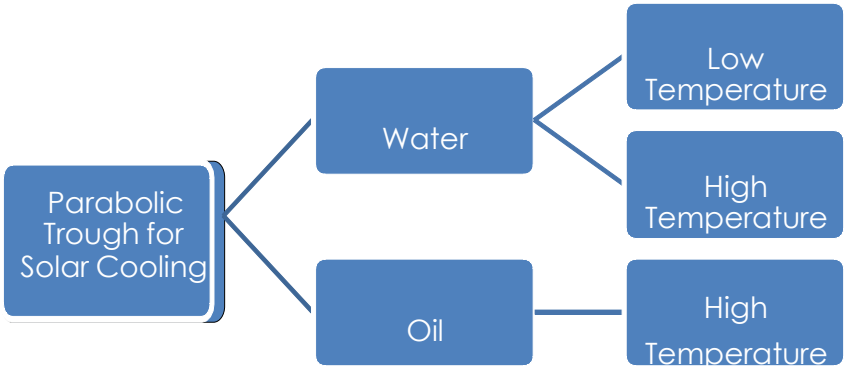
•Directly Steam. Risk of breaking operation. Not enough experience

Parabolic Trough for electricity Technology research evolution

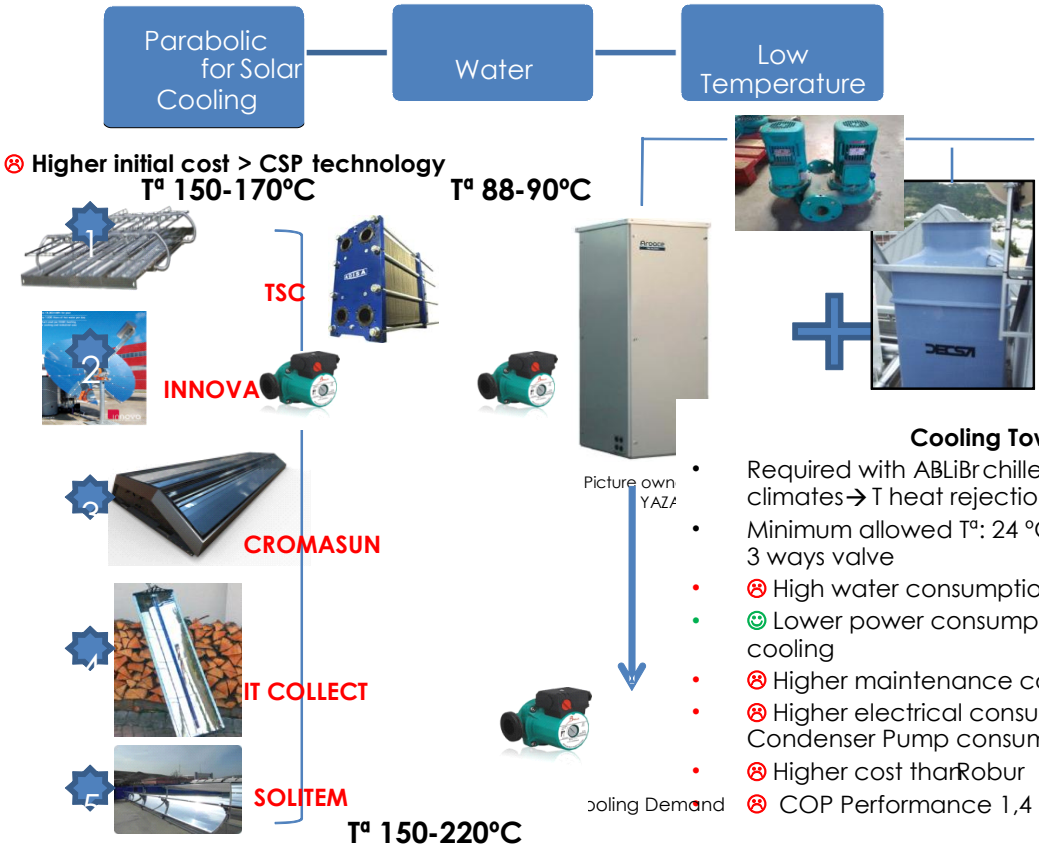


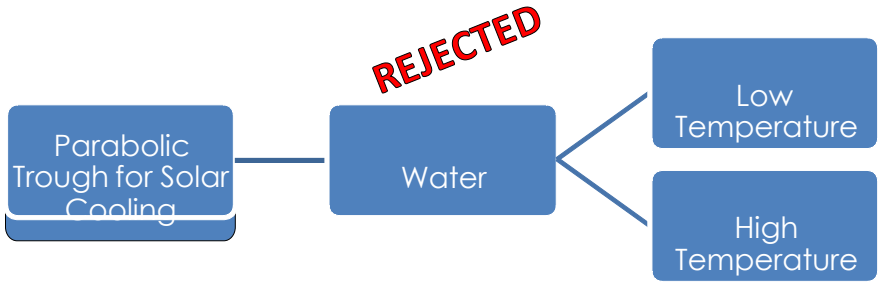
4.1.2 For solar cooling and heating (SCH)

Technology research evolution



Technology research evolution



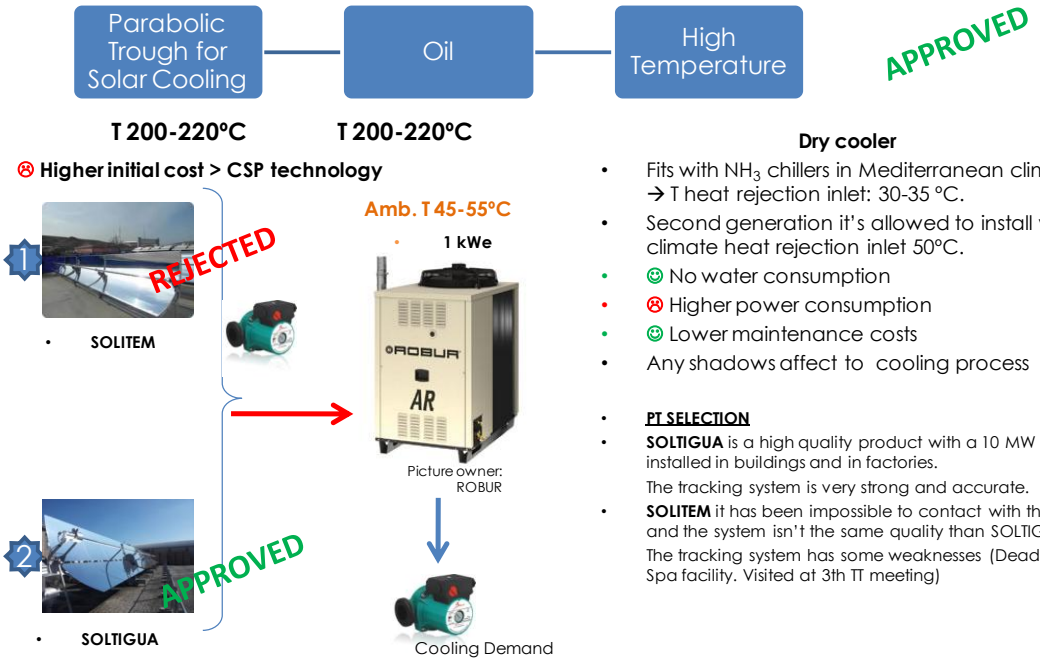


With water at high temperature the pressure in the main circuit it's 25 bar

- Problems with operation plant
- Risk of leaks, with high pressure
- Legalization process Pressure > 15 bar

4.1.3 Conclusion on PT-SCH

Technology research evolution

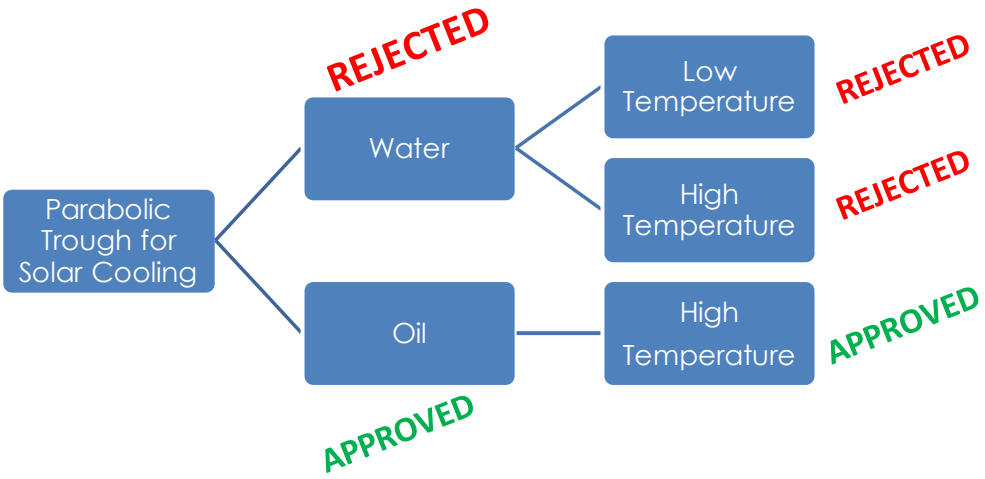


Dry cooler

- Fits with NH_3 chillers in Mediterranean climates → T heat rejection inlet: 30-35 °C.
- Second generation it's allowed to install with climate heat rejection inlet 50ºC.
- ☺ No water consumption
- ☹ Higher power consumption
- ☺ Lower maintenance costs
- Any shadows affect to cooling process

- **PT SELECTION**
- **SOLTIGUA** is a high quality product with a 10 MW installed in buildings and in factories.
  The tracking system is very strong and accurate.
- **SOLITEM** it has been impossible to contact with them and the system isn't the same quality than SOLTIGUA.
  The tracking system has some weaknesses (Dead Sea Spa facility. Visited at 3th TT meeting)

4.2 PT-SCH: Final decision



4.3 System components

PT-Solar Cooling Heating

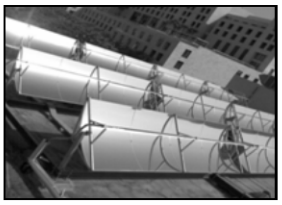
Parbolic Trough CSP collectors + double effect absorption Solar Cooling/Heating system

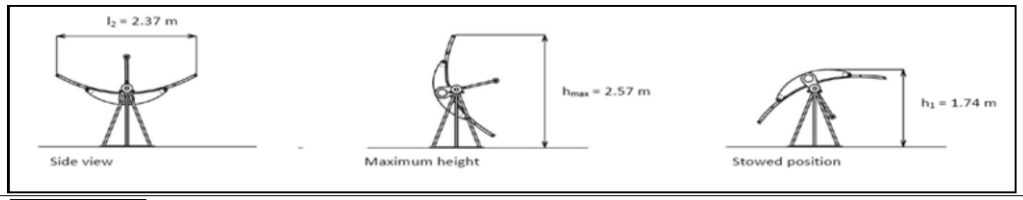
Collector	
Lenght:	20 m
Number units:	2
Maxium Height:	2,57 m
Width:	2,37 m
Structure:	M20 cement block
Required width:	4,57 m
DNI:	900 W/m2
Net Surface:	41 m2
Thermal Power (x2):	46 kW
Fluid:	Oil Therminol 66

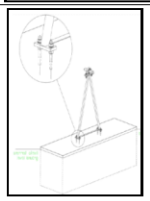
Main Features

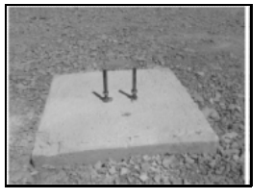
Selectively coated receiver
Weather-resistant low iron tempered glass mirrors
Sun tracking drive and motor
Hot-dip galvanized metal structure and pylons

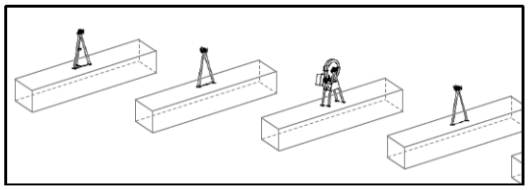
Flanged connecting elements to fixed pipes
Sensors to measure:
- Angular position
- Fluid temperature
- Wind speed









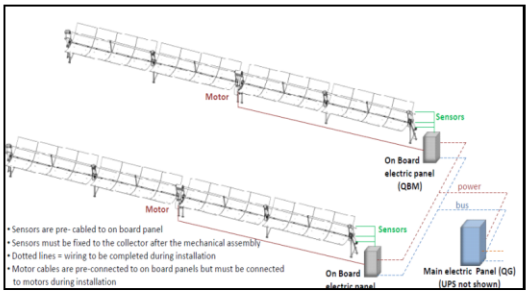


Power Cool Block	Main Features (Solar Cooling Machine)
Absorption Machine	ROBUR ACF 60HT_HW
Power:	17,1 kWc
Inlet Temperature:	240ºC
Outlet Temperature:	210ºC
Operation:	Max External temperature: 50ºC
Weight:	370kg
Fluid:	Oil / Water

Monitoring System | **Main Features**

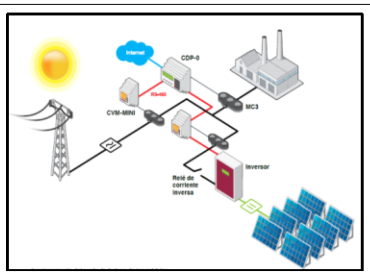
Controlling PLC with the following features:
Automatic / Manual
Web based remote control
Safety procedures against:
- High wind
- Overheating
- Lack of flow

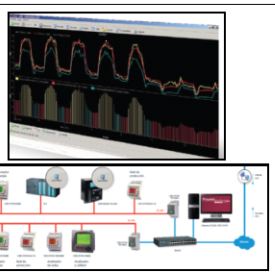
Stowing procedure in case of bad weather
Stowing procedure in case of bad weather
Electric panel at 230 VAC



SCADA System | **Main Features**

Remote parameterization of equipment
Viewing parameters real time
Multi Software (Embedded Web Server)
Integrated XML Server
In a charge distribution (or remote installations)
Energy management system. Subsistence Solutions.





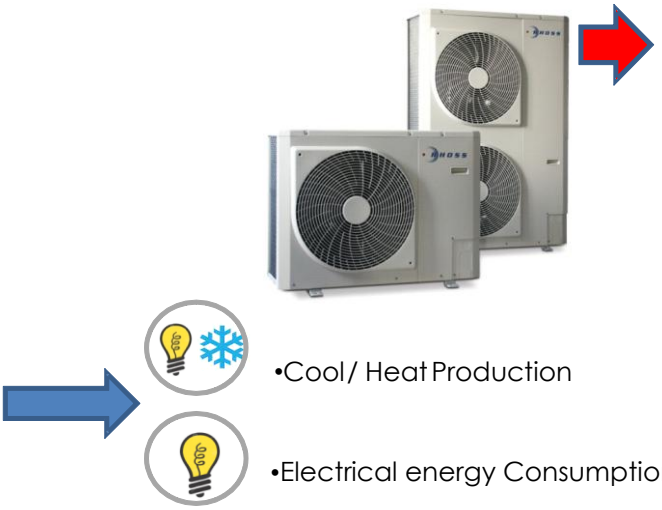
4.4 Economical aspects

PT-SCH COST ESTIMATION 07/04/2014		PT-SCH €/Wc 8,03	kWc 17,1
kWh/kW y			
anual output of the system kWh			0
Solar Field		**35%**	**48.070 €**
	Parabolic Trough Collector (80m2) 2 units		40.000 €
	Supervision Screen, DNI Sensor		2.477 €
	Electrical Panel		511 €
	Site preparation and Building structure		5.082 €
	Packaging & shipping		**included**
Balance Of System (BOS)		**54%**	**74.491 €**
Power block / electrical components			**37.387 €**
	Absorption Machine		33.000 €
	HWP control		700 €
	Heat Exchanger		3.687 €
Support system components (Hidraulic Energy transfer System)			**14.460 €**
	Pipping System,Oil fluid energy transfer, auxiliari accesories		9.960 €
	Oil Pump, storage oil tank and safety devices		4.500 €
Transport	Transport from Italy		**2.500 €**
Installation / mounting			**20.144 €**
	Mounting		11.942 €
	Piping system		6.500 €
	Electrical system		1.702 €
Monitoring system		**7%**	**9.740 €**
Control and Management			**9.740 €**
	Monitoring system		9.740 €
	PLC Secundary control		
Project		**4%**	**5.000 €**
Project, legalization & administrative process			**5.000 €**
	Project Legalization administrative		**2.500 €**
	Comissioning		2.500 €
Capital Cost		**8,03**	**137.300 €**
O&M (Operation and Maintenance) (€/y	(60€ kWt year) (1200 € / y, minimum 2 years)		**2.400 €**
Infrastructures (3.2.-3.7. budget lines)		**62%**	**85.457 €**
Services (6.15.-6.20. budget lines)		**38%**	**51.844 €**

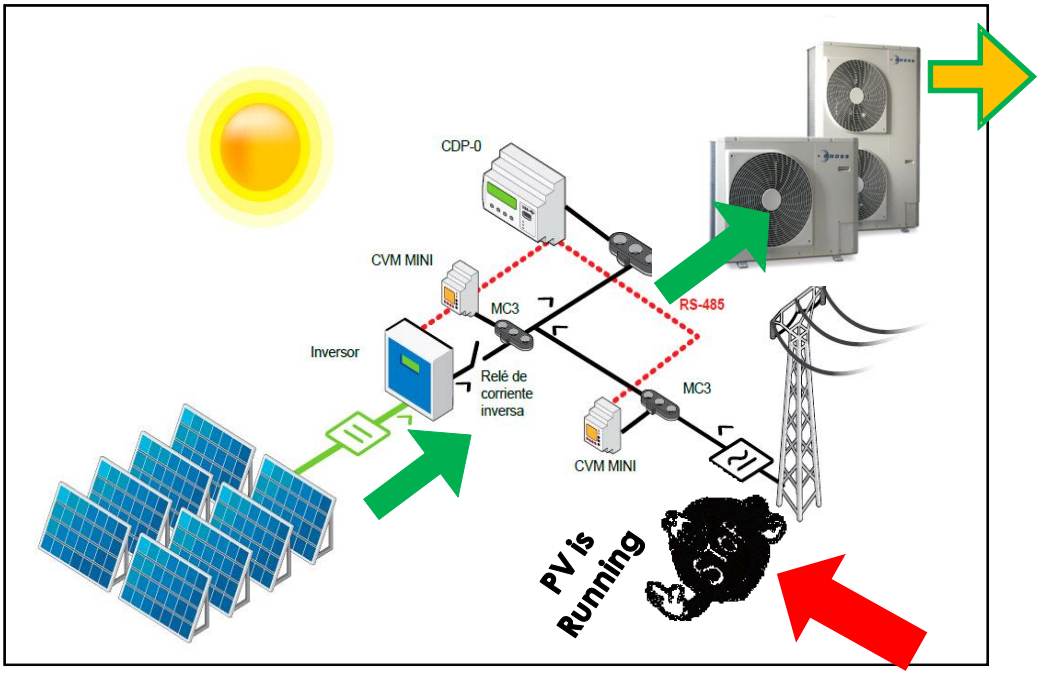
4.5 Alternative to PT-SCH : PV + heat pump

•To be explored for Matrouh Governorate project

•Electrical energy Production



•To be explored for Matrouh Governorate project



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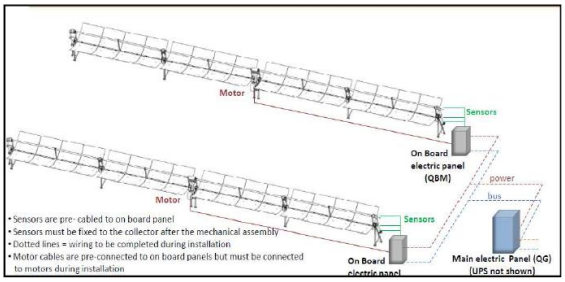
Stowing procedure in case of bad weather

Electric panel at 230 VAC



SCADA System	Main Features

Remote parameterization of equipment

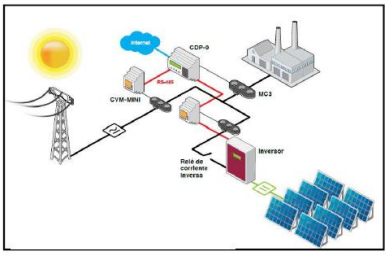
Viewing parameters real time

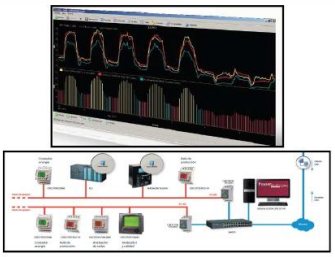
Multi Software (Embedded Web Server)

Integrated XML Server

In a charge distribution (or remote installations)

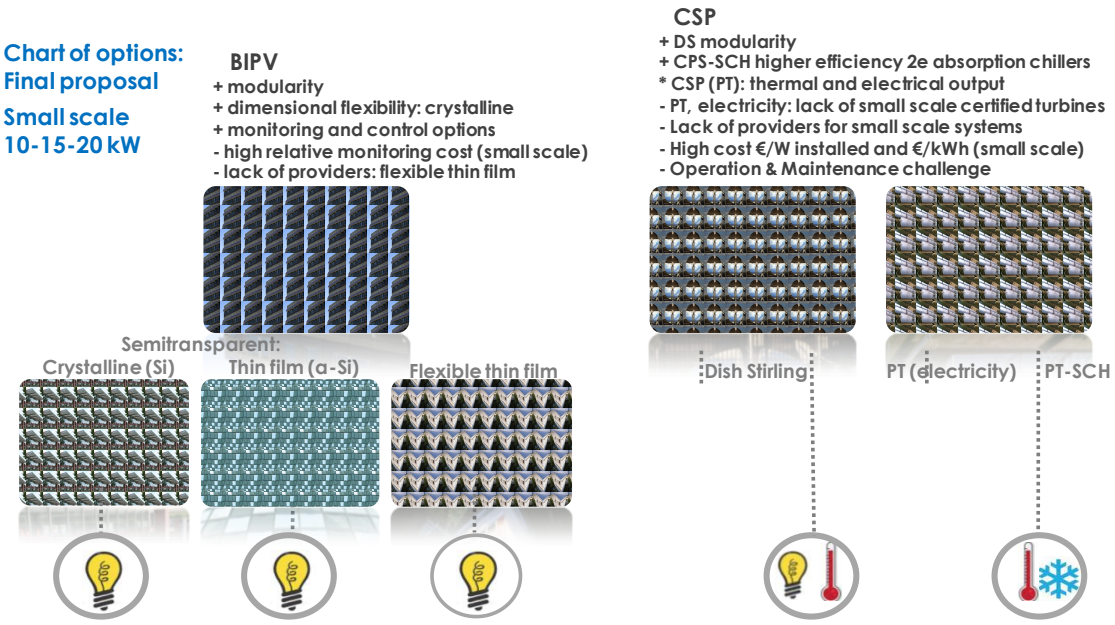
Energy management system. Subsistence Solutions.





5 CONCLUSION : « CHART OF OPTIONS/MODELS » ESTABLISHED, FOR BEING APPLIED WITHIN THE PROJECT

The final evaluation by the Project Technical Team concluded as available best options the following ones:



That is, the Chart of solar-systems to be installed in the selected buildings could be one o more of these five pre-defined systems:

- **BIPV-1: Glass-laminated, crystalline semi-transparent (30-40%)**
- **BIPV-2: Glass-laminated, crystalline thin-film (semitransparent: 10-20%)**
- **BIPV-3: Thin-film, flexible (EFTE laminated)**
- **Dish Stirling 'Innova' type, for electricity and hot water: 1 kWe-3kWt**
- **Parabolic Trough (oil) 'Soltigua' type, feeding a Solar Colling & Heating: 8,55 kWc**

And so it was then approved by the Project Management Board in its 3rd. Meeting at Patras.

General statement on the European Union

The European Union is made up of 27 Member States who have decided to gradually link together their know-how, resources and destinies. Together, during a period of enlargement of 50 years, they have built a zone of stability, democracy and sustainable development whilst maintaining cultural diversity, tolerance and individual freedoms. The European Union is committed to sharing its achievements and its values with countries and peoples beyond its borders.

بيان عام عن الاتحاد الأوروبي

يتكوّن الإتحاد الاوروبي من ال 27 الدول الأعضاء الذين قرروا معاً ربط خبراتهم والموارد ومصائرها. معاً، وخلال فترة 50 عاماً من التوسع، تم بناء منطقة من الإستقرار، الديمقراطية والتنمية المستدامة مع الحفاظ على التنوع الثقافي، التسامح والحريات الفردية. يلتزم الإتحاد الأوروبي في تقاسم إنجازاته وقيمه مع الدول والشعوب خارج حدوده.

General statement on the European Union (Greek)

Η Ευρωπαϊκή Ένωση αποτελείται από 27 Κράτη Μέλη που έχουν αποφασίσει να συνδέσουν σταδιακά την τεχνογνωσία, τους πόρους και το μέλλον τους. Κατά τη διάρκεια μιας περιόδου διεύρυνσης 50 ετών, έχουν δημιουργήσει μαζί μια ζώνη σταθερότητας, δημοκρατίας και αειφόρου ανάπτυξης διατηρώντας παράλληλα την πολιτιστική πολυμορφία, τη διαφορετικότητα και τις ατομικές τους ελευθερίες. Η Ευρωπαϊκή Ένωση έχει δεσμευθεί να μοιράζεται τα επιτεύγματα και τις αξίες της με χώρες και λαούς που βρίσκονται εκτός των συνόρων της.

Statement about the Programme

The 2007-2013 ENPI CBC Mediterranean Sea Basin Programme is a multilateral Cross-Border Cooperation initiative funded by the European Neighbourhood and Partnership Instrument (ENPI). The Programme objective is to promote the sustainable and harmonious cooperation process at the Mediterranean Basin level by dealing with the common challenges and enhancing its endogenous potential. It finances cooperation projects as a contribution to the economic, social, environmental and cultural development of the Mediterranean region. The following 14 countries participate in the Programme: Cyprus, Egypt, France, Greece, Israel, Italy, Jordan, Lebanon, Malta, Palestinian Authority, Portugal, Spain, Syria, Tunisia. The Joint Managing Authority (JMA) is the Autonomous Region of Sardinia (Italy). Official Programme languages are Arabic, English and French.

بيان حول البرنامج

إن برنامج NPI CBC MedE 2007 – 2013 هو جزء من سياسة الجوار والشراكة الأوروبية ومن آلياتها التمويلية. يهدف هذا البرنامج إلى تعزيز ودعم عملية التعاون المستدام والمنسجم على مستوى حوض البحر الأبيض المتوسط وذلك من خلال معالجة التحديات المشتركة وتعزيز الإمكانات الذاتية. يموّل البرنامج مشاريع التعاون كمساهمة في التنمية الإقتصادية، الإجتماعية، البيئية والثقافية لمنطقة البحر الأبيض المتوسط. إن الدول قبرص، مصر، فرنسا، اليونان، إسرائيل، إيطاليا، الأردن، لبنان، مالطا، السلطة الفلسطينية، البرتغال، إسبانيا، سوريّا، ال 14 التالية هي الدول المشاركة في البرنامج: هي منطقة الحكم الذاتي لمقاطعة سردينيا (إيطاليا). إن اللغات الرسمية للبرنامج هي : العربية ، الإنجليزية والفرنسية. JMAتونس. إن سلطة الإدارة المشتركة

Statement about the Programme

Το Πρόγραμμα Διασυνοριακής Συνεργασίας Μεσογειακής Λεκάνης (ENPI CBC Mediterranean Sea Basin) 2007-2013 είναι μια πολυμερής πρωτοβουλία Διασυνοριακής Συνεργασίας η οποία χρηματοδοτείται από το Ευρωπαϊκό Μέσο Γειτονίας και Εταιρικής Σχέσης (ENPI). Το Πρόγραμμα έχει σαν στόχο να συμβάλει στην προώθηση της βιώσιμης και αρμονικής συνεργασίας στην περιοχή της Μεσογειακής Λεκάνης αξιοποιώντας πλήρως τις ενδογενείς δυνατότητες της περιοχής και αντιμετωπίζοντας τις κοινές προκλήσεις. Χρηματοδοτεί έργα συνεργασίας τα οποία συμβάλλουν στην οικονομική, κοινωνική, περιβαλλοντική και πολιτιστική ανάπτυξης της Μεσογείου. Στο Πρόγραμμα συμμετέχουν οι ακόλουθες 14 χώρες: Κύπρος, Αίγυπτος, Γαλλία, Ελλάδα, Ισραήλ, Ιταλία, Ιορδανία, Λίβανος, Μάλτα, Παλαιστινιακή Αρχή, Πορτογαλία, Ισπανία, Συρία, Τυνησία. Η Κοινή Διαχειριστική Αρχή (ΚΔΑ) του Προγράμματος, είναι η Αυτόνομη Περιφέρεια της Σαρδηνίας (Ιταλία). Επίσημες γλώσσες του Προγράμματος είναι τα Αραβικά, Αγγλικά και Γαλλικά.

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تنبيه

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European Union web links
http://ec.europa.eu/world/.
Europe Aid Development and Cooperation Office http://ec.europa.eu/europeaid/index_en.htm
ENPI CBC Med Programme http://www.enpicbcmed.eu

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