solarcombi+

WP4 – Determination of standard system applications and most promising markets detailed work programme

Solar Combi+ Project meeting
Athens 17.-18.11.2008

Alexandra Troi / Patrizia Melograno, EURAC

Identification of most promising markets and promotion of standardised system configurations for the market entry of small scale combined solar heating & cooling applications
EIE/07/158/SI2.466793 09/2007 – 02/2010

Objective

- Evaluation of the results of the virtual case studies and the ecological and economic assessments and
- Determination of most promising applications and areas

→ **Standard system configurations**, independent of specific product, to be communicated and promoted towards a wide audience

→ **Package solutions**, to be marketed by the single chiller producers

→ Illustration of **most promising applications**

→ An **online tool**, which helps assess the best configuration in the users specific case

→ **Key data** and “**libraries**” for calculation codes and **short info** for feasibility toolboxes (EPBD)

Deliverables

4.1 **Report** on the identification of **standard system configurations** (month 16 – 12/2008)

4.2 **Description of package solution**(s) – Rotartica (month 20 – 4/2009)

4.3 Description of package solution(s) – CW (month 20 – 4/2009)

4.4 Description of package solution(s) – SorTech (month 20 – 4/2009)

4.5 Description of package solution(s) – SOLution (month 20 – 4/2009)

4.6 Description of package solution(s) – SK (month 20 – 4/2009)

4.7 **Description** and **visual representation** (e.g. maps) of **most promising regions** for different applications (Poster and PDF in partner languages) (month – 4/2009)

4-8 **Online tool** to make the results of virtual case studies online available: e.g. query based on an easy to handle form (where e.g. climate, kind of application etc. can be chosen, economic conditions can be changed) (month 20 – 4/2009)

4.9 **Key data and "libraries"** for calculation codes (**EPBD**) (month 20 – 4/2009)

4.10**Short info for feasibility studies** (§ 5 EPBD, IEE project SENTRO) (month 20 – 4/2009)

Time schedule

	2007		…	2008											2009					
	9	10		2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
	1	*2*		*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*	*21*	*22*
WP1																				
WP2													today							
WP3																				
WP4									7 months											
WP5																				
WP6																				
Wp7																				
M	x				x						x							x		
Rep								PR									IR			
Del					D2.1 D2.2 D2.3 D2.4	D2.5 D6.5			D6.2		D3.1 D3.2 D3.3			D4.1		D2.6 D2.7		D4.2 D4.3 D4.4 D4.5 D4.6 D4.7 D4.8 D4.9 D4.10 D6.2		D5.1 D5.2 D5.3 D5.4 D5.5 D5.6 D6.3 D6.5 D6.9

Role & contribution of each partner

	Task 1	Task 2	Task 3	Task 4	Task 5	∑ hours
EURAC	contribution	with CW	X	X	X	860
CRES	contribution			X		110
ISE	contribution	with SorTech		X		220
AEE INTEC	contribution	with SOLution				200
UNIBG	coordination					200
TECSOL	product indepen-dent solutions	with EURAC				220
IKERLAN	contribution	with ROTARTICA				150
ROTARTICA		with IKERLAN				160
CW		with EURAC				160
SorTech		with ISE				160
SOLution		with AEE INTEC				50
SK		with TECSOL				50
estimated ∑hrs.	470	1200	320	470	80	2540

Task 1 – Standard system configurations

Project proposal states as

→ Objective

Standard system configurations, independent of specific product, to be communicated and promoted towards a **wide audience**

→ Task

Definition of a reduced number of "standard system configurations" which can be promoted and applied **similarly to the standard systems for DHW** with **reasonably good results** in **typical/average cases** (mostly technology independent)

→ Outcome

Standard system configurations (3 to 5), which are independent of specific product and work best under different circumstances

Task 1 – Standard system configurations

Methods to be applied:

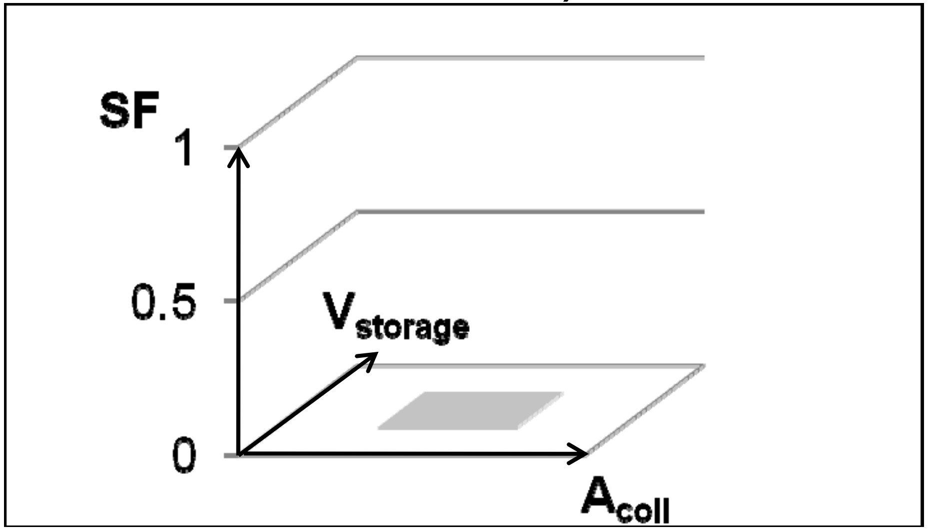
- → Graphical representation
- → Optimisation functions
- → Series of sensitivity analyses

Task 1 – Standard system configurations

Performance illustration in 3D graph, over A_{coll} and $V_{storage}$ to get an idea on range of obtainable values for different parameters (climate, application, chiller, C1/E1, ...)

- → Solar Fraction
- → Primary Energy Ratio
- → Cost/Benefit Ratio
- → ...

- → A and V rated with $Q_{chiller}$?



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Task 1 – Standard system configurations

Proposed optimisation function 1:

→ Solar Fraction

Solar fraction Sf

Sf_{total}	=	Q_{coll} / $Q_{heat,demand,total}$ (heating + driving heat for chiller + DHW)	[%]

The single solar fractions for heating, cooling and DHW are calculated as follows in system C1.

$Sf_{cooling}$	=	$1\text{-}Q_{aux,cool} / Q_{chiller,tot}$	[%]
$Sf_{heating}$	=	$1\text{-}Q_{aux,heat} / Q_{heat\ demand}$	[%]
$Sf_{DHW,total}$	=	$1\text{-}Q_{aux,DHW} / Q_{DHW,demand}$	[%]

Task 1 – Standard system configurations

Proposed optimisation function 2

→ Cost Benefit ratio (according Haberl et.al. 2008

(Cost/Benefit Ratio Analysis of a Maximum Lean Solar Combisystem)

$$\text{objective} = \min \frac{\text{additional costs}}{\text{primary energy savings}} = \min \frac{a * I_0 + B_{MaxLean} - B_{ref}}{E_{prim,sav}}$$

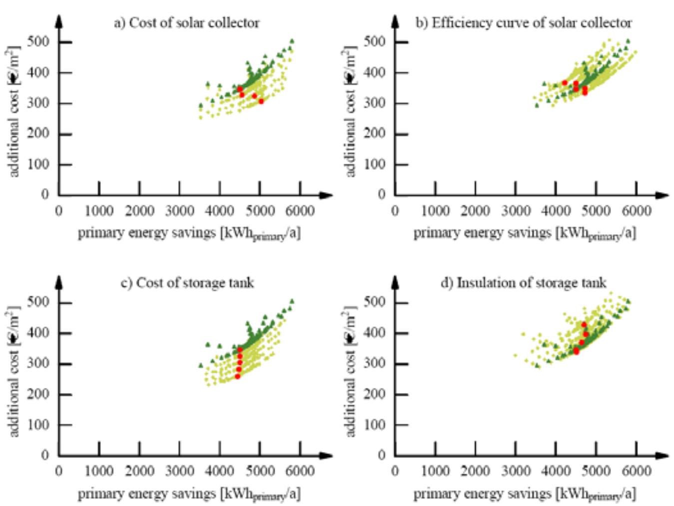
a	annuity factor
I_0	total investment costs of the solar thermal system
$B_{MaxLean}$	annual operation costs of the MaxLean system concept (including the heating circuit)
B_{ref}	annual operation costs of the conventional reference system
$E_{prim,sav}$	primary energy savings

Task 1 – Standard system configurations

Optimisation functions & sensitivity analysis

→ following the concept of Haberl et.al. 2008

(Cost/Benefit Ratio Analysis of a Maximum Lean Solar Combisystem)



Variation		cost/benefit ratio [€/kWh$_{primary}$]	additional cost [€/a]	primary energy savings [kWh$_{primary}$/a]	V_{store} [m^3]	$A_{collecotr}$ [m^2]
Base Case		0.077	347	4502	0.67	8.9
cost of solar collector [% of initial cost]	95	0.075	340	4552	0.67	9.2
	90	0.072	328	4552	0.67	9.2
	85	0.069	322	4653	0.65	10
	80	0.067	325	4863	0.69	11
	75	0.064	312	4876	0.67	11.3
	70	0.061	307	5032	0.67	12.4
efficiency curve of solar collector	I	0.071	335	4722	0.63	9.3
	II	0.074	349	4724	0.65	9.7
	III	0.081	366	4499	0.71	9.4
	IV	0.087	368	4222	0.63	9.4
cost of storage tank	95	0.075	336	4502	0.67	8.9
	90	0.072	326	4502	0.67	8.9
	85	0.07	316	4502	0.67	8.9
	80	0.068	306	4502	0.67	8.9

Task 1 – Standard system configurations

Optimisation functions & sensitivity analysis

→ following the concept of Haberl et.al. 2008
(Cost/Benefit Ratio Analysis of a Maximum Lean Solar Combisystem)

For each parameter variation

→ determination of achievable new cost/benefit ratio

→ determination of associated A_{coll} and $V_{storage}$

Task 1 – Standard system configurations

Optimisation functions & sensitivity analysis

→ following the concept of Haberl et.al. 2008

(Cost/Benefit Ratio Analysis of a Maximum Lean Solar Combisystem)

		collector cost		efficiency curve		storage cost		insulation		rise in energy prices	
cost / benefit	(1)	++ (-21%)	-11%	+ (± 10%)	± 9%	++ (-24%)	-25%	+(*) (-10%)	+13%	++ -280%	-280%
	(2)		+11%		∓ 11%		-1%		+2%		–
dim.	(3)	+	+3.5 m^2	○	–	○	-0.5 m^2	++	-3.1 m^2	○	+0.6 m^2
	(4)		–		–		+0.04 m^3		-0.12 m^3		–

Task 1 – Standard system configurations

Proposed variation parameters for Solar Combi+

- → Climate
- → Application
- → Chiller

If, hopefully, not all of them behave completely different, we will be able to define a reduced number of cases to be analysed with the second set of variation parameters

- → Collector efficiency (vacuum/flat plate)
- → Installation cost (collector, storage, chiller)
- → Energy prices (fuel electricity)
- → ...

→ Robust Standard System Configurations

Task 1 – Standard system configurations

- In the previous work package a number of promising system configurations have been defined and their performance analysed. Those who have shown up the highest energetic and economical efficiency for a broad range of applications will serve as model for the definition of the standard system configurations.
- Definition of a reduced number of "standard system configurations" which can be promoted and applied similarly to the standard systems for DHW with reasonably good results in typical/average cases (mostly technology independent)
- standard system configurations (3 to 5), which are independent of specific product and work best under

Task 2 – Package solution

Development of "Package solution" by each chiller partner (for each device) and/or preparation of technology specific design-concepts based on the virtual case studies and standard system configurations

5 teams: Rotartica & IKERLAN

Climatewell	&	EURAC
SorTech	&	ISE
SOLution	&	AEE INTEC
Sonnenklima	&	TECSOL

Task 3 – Most promising applications

The analysis of the virtual case studies will at the same time reveal the **most promising markets** for early market access

These are in particular **climatic regions** and **applications**, where Solar Combi+ systems have particular high economical efficiency, due to

- High workload of each component, leading to low specific costs
- Favourable economic circumstances (high fuel/electricity cost, subsidy schemes, etc.)

Task 3 – Most promising applications

Virtual study cases are analysed, combining their

→ performance information with
→ economic circumstances,
→ current solar thermal and
→ chiller market information

Methods to be applied: statistics, matrix analysis, GIS

Elaboration of visual representations as e.g. maps etc.

Responsible: EURAC

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Task 3 – Most promising applications

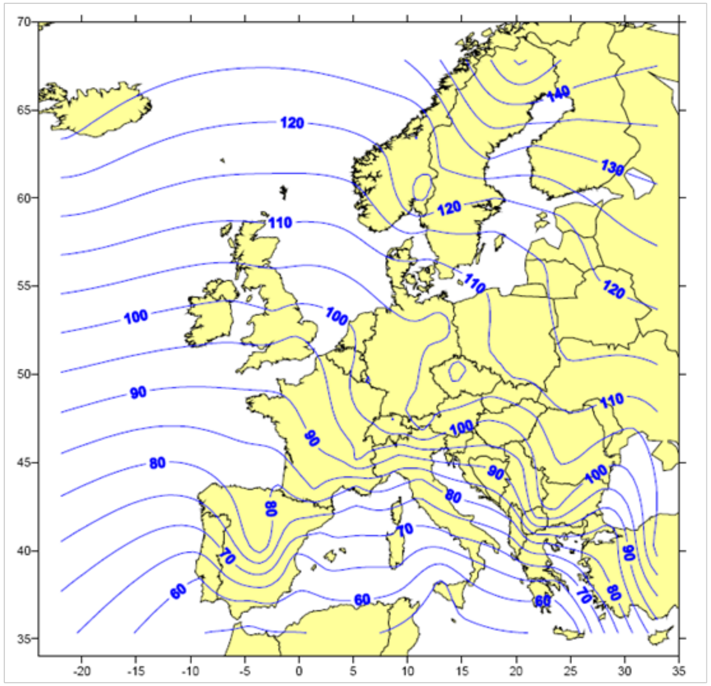
GIS – Geographical Information System

→Analysis and correlation of information with different geographical distribution

- climatic information
- economic information on country or regional level

Other information to be included could be

- solar thermal market figures
- chiller market figures
- ...



Task 3 – Most promising applications

Most promising markets are mainly addressing industry partners, but **also more general geographical analyses** can be performed.

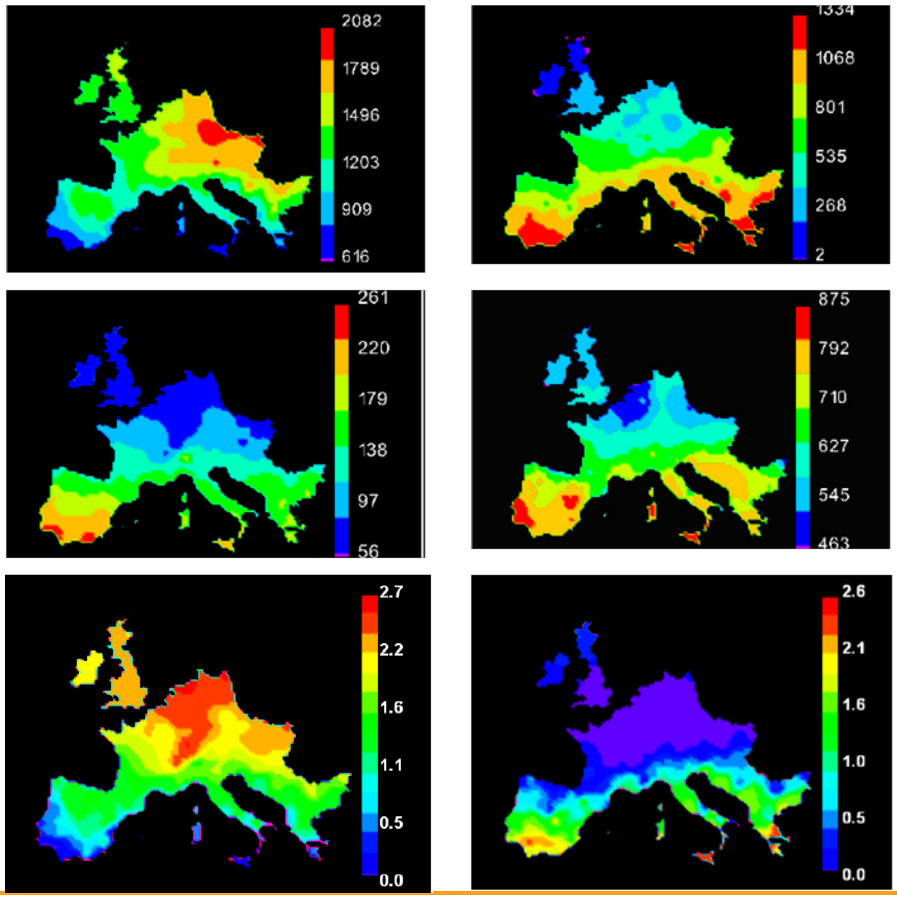
e.g. Passiv-ON

winter summer

HDD / CDD

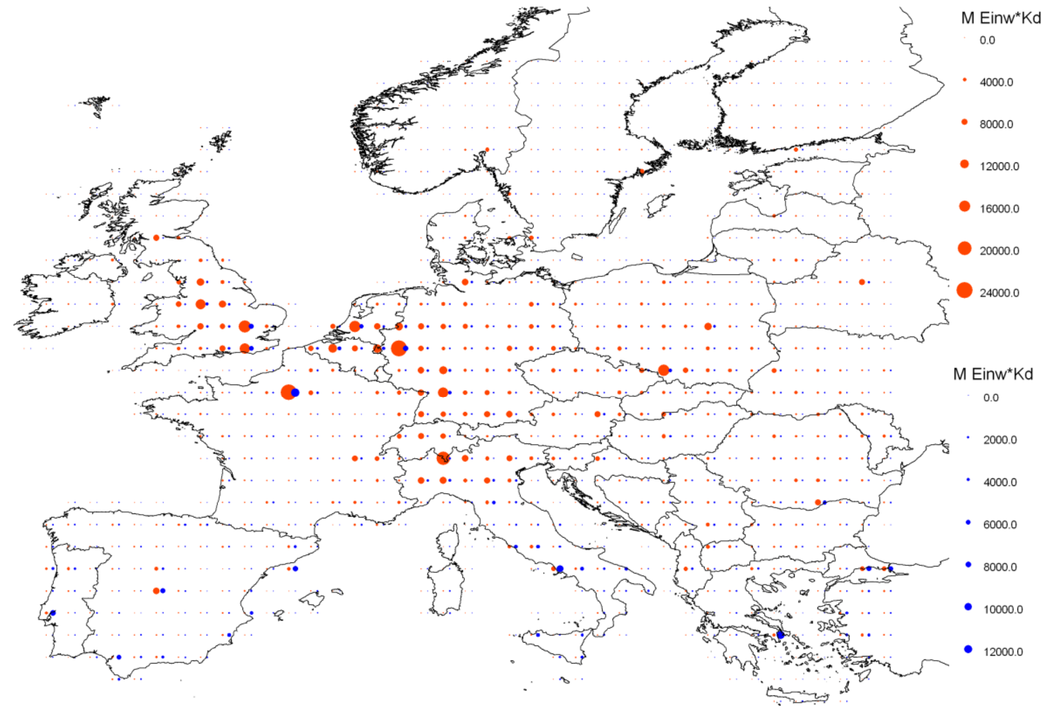
Irradiat.

Climate severity index



Task 3 – Most promising applications

Most promising markets are mainly addressing industry partners, but **also more general geographical analyses** can be performed.



Task 4 – Online tool

Tasks 1 and 2 determine standard system configurations and "Package solutions". Nevertheless, planners and architects might need **information about the performance of other configurations for specific cases**.

For this purpose, an online tool will make the results of virtual case studies online available and allow to:

- query all virtual case studies (or only those which make sense from PE point of view?)
- change energy related inputs (conversion factors)
- change economic parameters (financial incentives, fuel cost)

Task 4 – Online tool "case summary"

- Input values

Simulation parameters:
- Climate
- Application
- Specific chiller (?)
  C1/E1, chilling power, ...

Dimensioning:
- A
- V

Changed by user

Environment related parameters:
- η_{Boiler}
- PE conv. factor
- CO_2 conv. factor

Cost related parameters:
- Installation costs
  (incentives, ...)
- Planning costs
- Maintenance costs
- Operation Costs (Fuel, electricity)
- i, n

- Output values

Energy related outputs
- q_{coll}, η_{coll}
- Solar fractions
- COPs (thermal, electrical)
- (solar) cooling time
- ...

Environment related outputs
- Saved PE
- COP_{PE}
- PE ratio
- Saved CO_2
- ...

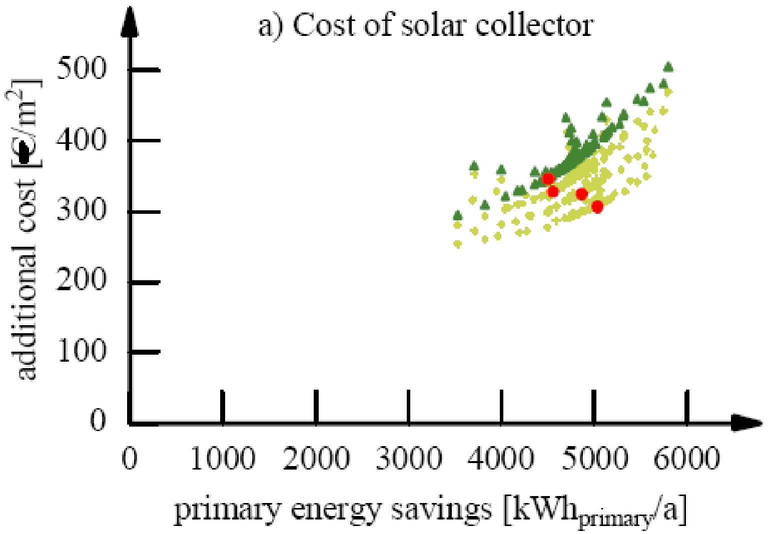
Cost related outputs
- Cost for subsystems
- Operating costs
- Annual costs
- Costs for saved PE

Task 4 – Online tool “adapted optimisation”

With the user-defined energetic and financial parameters,

→ the achievable result in terms of PE ratio, cost/benefit ratio, etc. might change

→ the optimum dimensioning in sense of A_{coll} and $V_{storage}$ might change.



Task 4 – Online tool

Open questions:

- Should the user be guided in choosing “his” climate, application, chiller capacity?
- How should the specific chillers be dealt with in the online tool?
- How should the difference between C1 and E1 scheme be dealt with
- ...

Task 5 – Key data, libraries & short info

Main objective: tools helping in the implementation of the EPBD:

a)Regarding § 3:

Provide key data and "libraries" to **calculation tools** (§ 3 of EPBD). Contact to the IEE projects EPA ED and EPA NR has been established: the results from "Solar Combi+" could be implemented into their method, specifically in the software tool for calculating of energy performance of the building(s) and quantification of the **effect of energy saving measures**.

→key data and "libraries" for calculation codes (EPBD)

b)Regarding § 5:

Provide easy to use information to evaluate the technical, environmental and economical feasibility of solar heating and cooling systems (obligatory for new buildings with useful floor area of 1000 m² - which are at the upper limit of the considered small scale applications). EURAC is responsible for the contact with IEE project SENTRO and integration in their toolbox

→integration in the IEE project SENTRO's EPBD feasibility study toolbox

Responsibility: EURAC

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