

IEA SHC Tasks presentation

Task 53 : Solar Cooling



Daniel MUGNIER – 12/10/2016 – Palma de Mallorca

Task 53



11th ISES
EuroSun
Conference

www.tecsol.fr

Energy challenges for sunny countries

Commitment of the countries to reach ambitious objectives and scale up RE and EE

Very important share of the energy consumption due to air conditioning



One huge advantage in the sunny regions :

Infinite resource with the SUN !

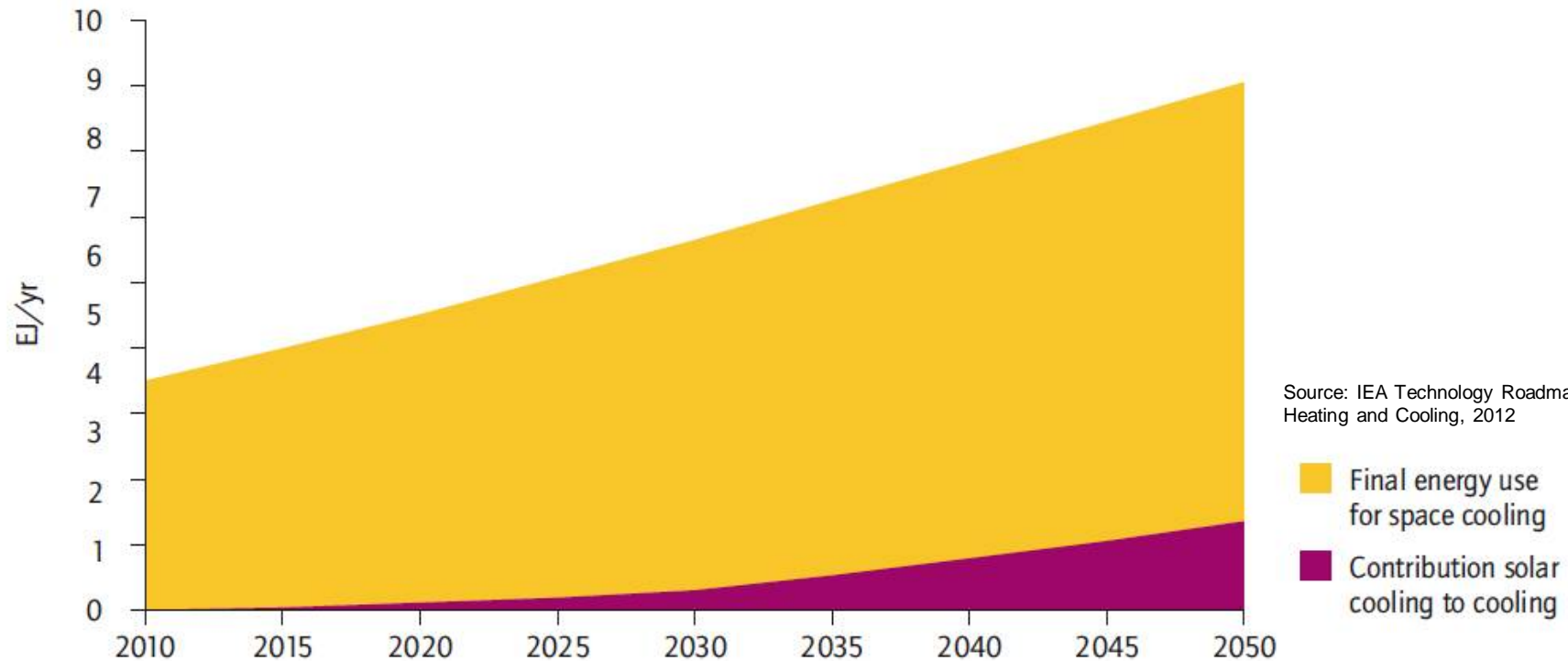


How to go and spread cost competitive solar cooling ?

IEA Technology Roadmap SHC

Share of solar cooling by 2050

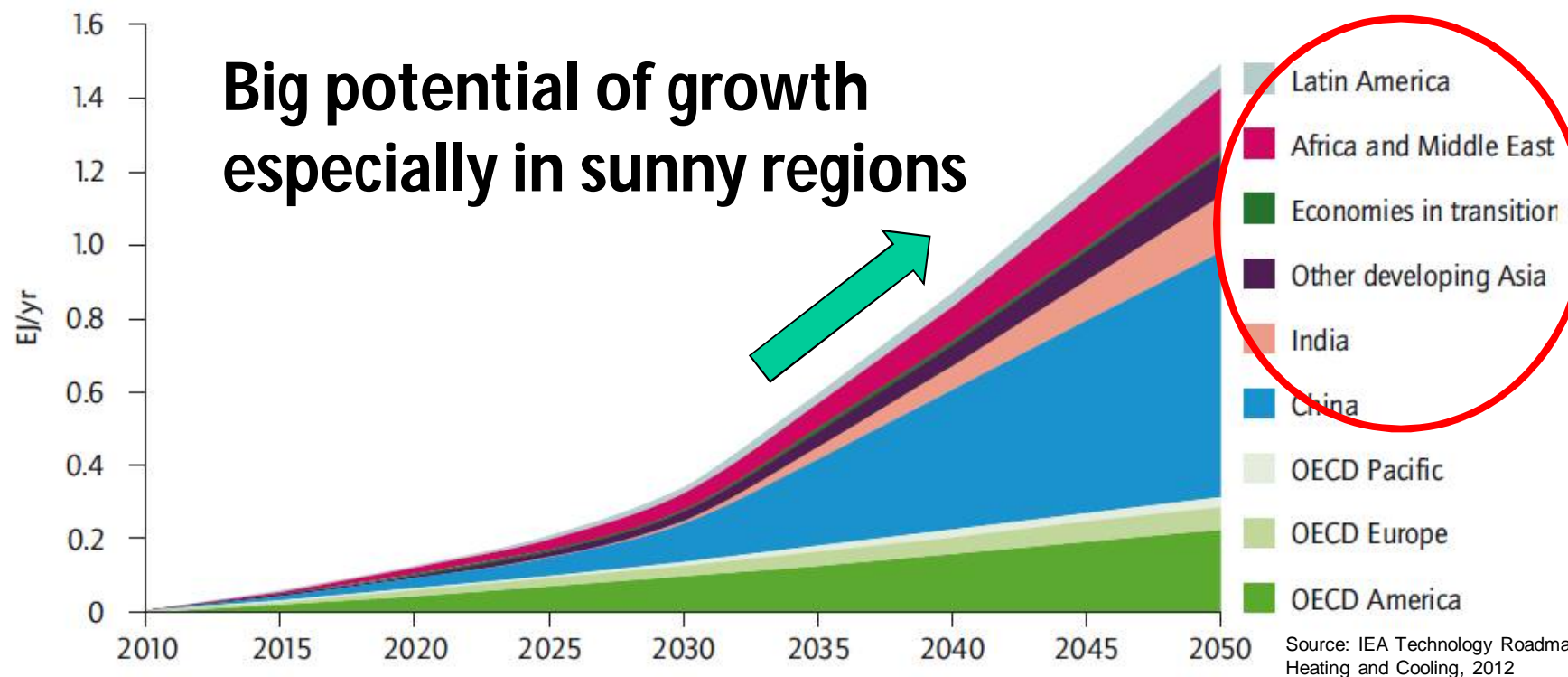
Roadmap vision for solar cooling in relation to total final energy use for cooling (Exajoule/yr)



Solar Cooling nearly 17% of total energy use for cooling!

IEA Technology Roadmap SHC – *Market potential by 2050*

Figure 16: Roadmap vision for solar cooling (Exajoule/yr)



1.5×10^{18} J/a = 416.7 TWh/a Solar Cooling by 2050

Systems could enter the market between 2015 and 2020

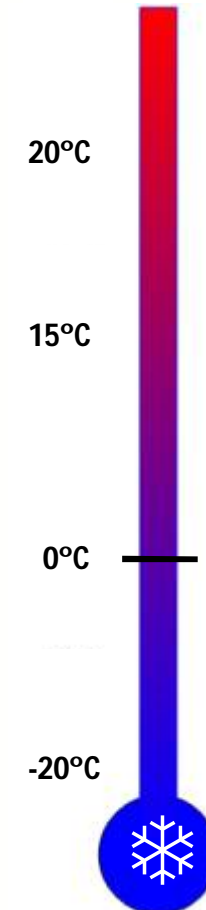
2 main channels in 2016 for Solar Cooling



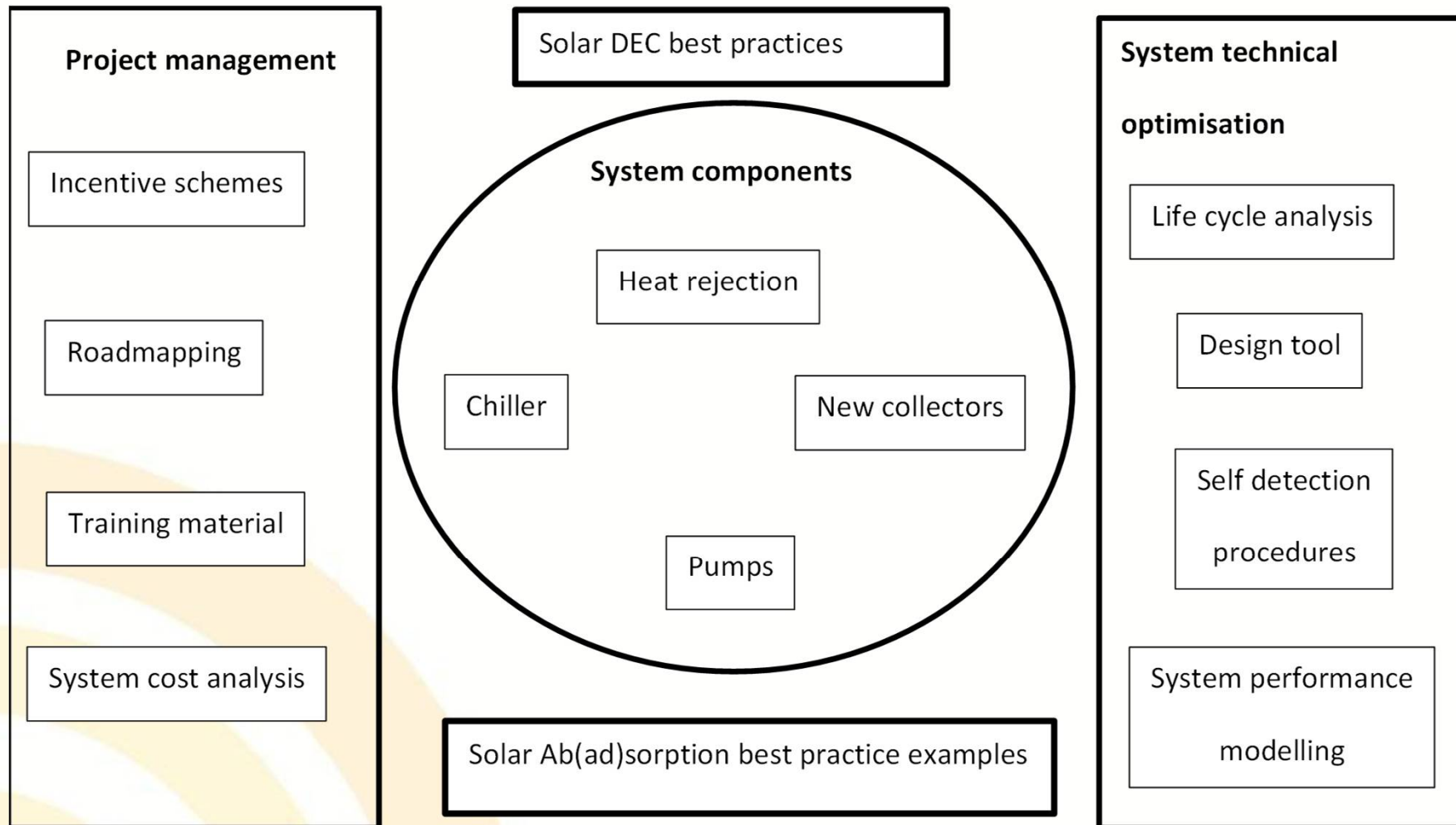
CHILLER / AIR CONDITIONER

Solar thermal collector technologies versus Application for solar cooling

Solar thermal collector	Heat transfer medium	Collector temperature	Application for cooling
Air collector 	Air	40-60°C	Air-conditioning
Flat plate collector 	Water, Water-Glycol	70-90°C	Air-conditioning, slab cooling
Evacuated tube collector 	Water, Water-Glycol	90-120°C	Air-conditioning, slab cooling
Parabolic trough / Fresnel collector 	Thermal oil, Water	120-250°C	Refrigeration, air-conditioning, slab cooling



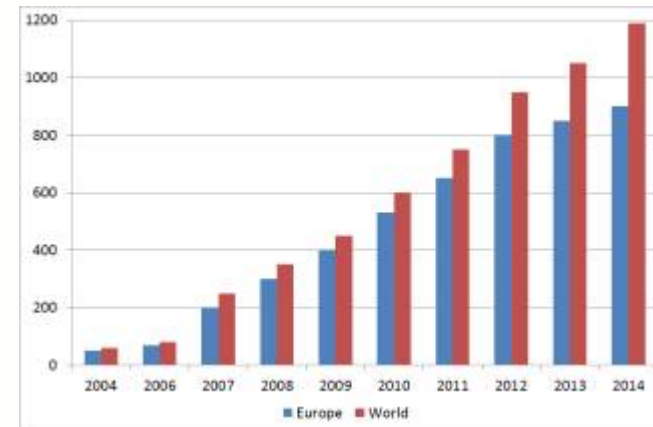
Task 48 investigation results :



Solar cooling market trends in the World

Still a niche market :
≈ **1,200 systems** installed
worldwide (2015)

A High level of innovation
still present :



Source: Solem Consulting / TECSOL

- * Heat rejection
- * Electric consumption reduction
- * kWh cooling cost decrease

Already very accurate concepts for Arabic countries

- * low & medium temperature solar thermal absorption
- * small size PV air-conditioning



TASK 53

New generation solar cooling & heating
systems
(PV or solar thermally driven systems)



Title description and Work plan
November 2013
Report for the participants
David Miguez (TECSOL, France)
With the support of
The European Behavioural Research Institute

IEA SHC
Task 53



Task 53 

Need of a new Generation solar cooling systems

Solar thermal « traditionnal » cooling has **difficulty to emerge as a economically competitive solution**

Main reasons :

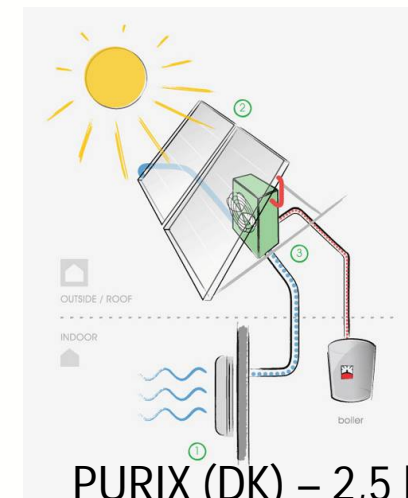
- **Technical** : Limit on adaptability due to hydraulics, complexity
- **Economical** : High upfront cost, especially for small systems

⇒ Still need **intensive R&D** for quality improvment and best solution selection (ongoing IEA SHC Task 53)

⇒ Very innovative concepts such...

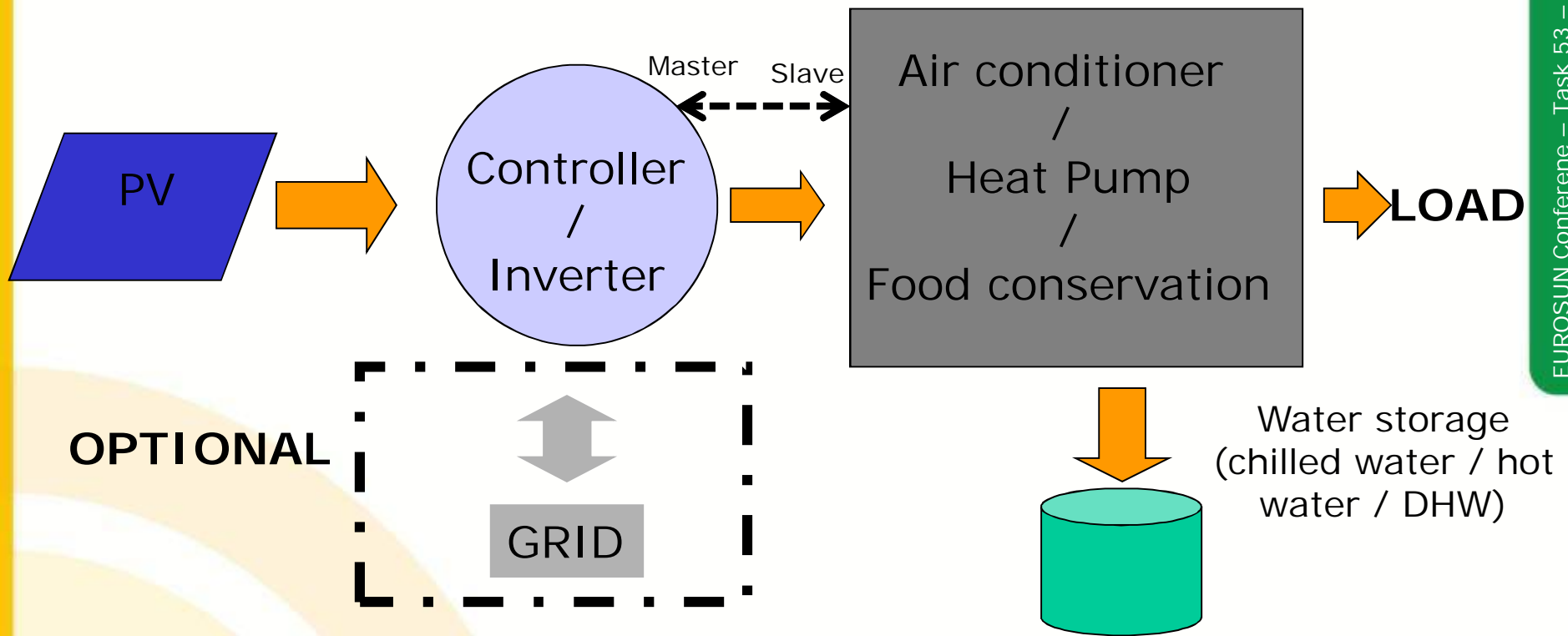


SOLABCOOL (NL)
4,5 kWc



PURIX (DK) – 2,5 kWc
5m² solar panels

Example of Basic concept for the PV approach



Main categories

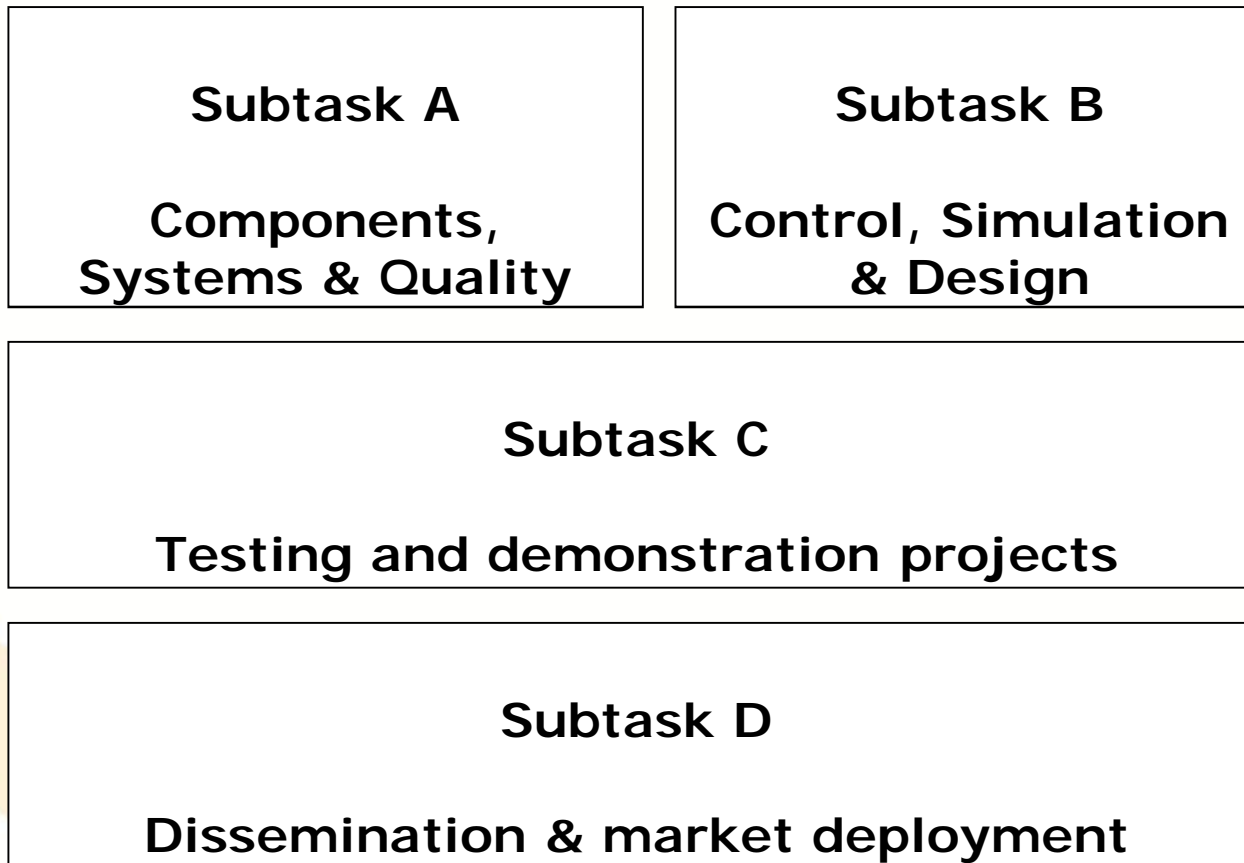


Solar air conditioners : Splits

PV+ HP coupling for Office/Commercial



Task 53 Structure













4 Subtasks & 19 activities

Time Schedule : 4,5 years

From March 2014 to June 2018

Task 53 new developments & progress

Subtask A: Components, Systems & Quality

Manufacturer	Market status	Service	Solar input type	Nominal cooling capacity (kW or m3/h)	Nominal heating capacity (kW)	Nominal solar input (Wp for PV and m² for ST)	Cooling Storage	Target market area	Heat rejection	Back up	Other
 ATISYS	R&D	Cooling/heating	PV	4	5,1	4600	Sensible tank	France, Northern Africa	Air	Grid	R290 chiller, short term elec. battery
 CLIMATEWELL	R&D	Cooling/heating/DHW	ST	40	108	180	Sensible tank	Europe, sunny countries	Air	Elec chiller (390 kW)	Adsorption (LiCl/H2O)
 COSSECO	Commercial	Cooling/heating/DHW	PV	48	58,5	4800	Sensible tank	Switzerland, Europe	Geothermal	Grid	Scroll, no battery
 FREECOLD	Commercial	Cooling	PV	2,5	-	1500	-	Africa, developping countries	Air	Grid	solar input 24VDC, elec. battery possible
 FREESCOO	R&D	Cooling/heating	ST/PV	500	1,44	2,4	-	Italy	Air		Desiccant technology
 GREE	R&D	Cooling/heating	PV	33,5	37,5	12190	None	China	Air	Grid	VRF
 KAYSUN	Commercial	Cooling/heating	PV	3,5	3,5	705	None	Spain, Europe	Air	Grid	Scroll, no battery
 PURIX	Commercial	Cooling/heating	ST	2,5	3,6	4,8	None	Europe, sunny countries	Air	Boiler	Absorption (LiBr/H2O)
 SOLABCOOL	R&D	Cooling/heating	ST	4,5	8	13,3	None	Europe, sunny countries	Air	District heating	Silicagel-water adsorption cooling machine
 YAZAKI	R&D	Cooling/heating	ST	35		100	Sensible tank	China	Air	Elec chiller (29,3 kW)	Absorption (LiBr/H2O)

Overall presentation of the data collection on innovative solar cooling and heating systems among IEA SHC Task 53



State of the art of new generation commercially available



Subtask A: Components, Systems & Quality

Manufacturer	Market status	Service	Total Investment price (€*)	Solar production investment (€*)	Cold/heating production investment (€*)	Storage investment (€*)	Other (€*)	Specific invest. Cost (€*/kW _{cooling})	Annual maintenance cost (€*)
ATISYS	R&D	Cooling/heating	-	-	-	-	-	-	-
CLIMATEWELL	R&D	Cooling/heating/DHW	-	-	-	-	-	-	-
COSSECO	Commercial	Cooling/heating/DHW	64300	9300	32600	14200	8200	1 340	-
FREECOLD	Commercial	Cooling	3600	1500	2100	-	-	1 440	100
FREESCOO	R&D	Cooling/heating	7500	1500	3500	-	2500	2 500	50
GREE	R&D	Cooling/heating	24600	12400	11800	-	400	734	300
KAYSUN	Commercial	Cooling/heating	2500	700	1800	-	-	714	30
PURIX	Commercial	Cooling/heating	4425	-	-	-	-	1 770	20
SOLABCOOL	R&D	Cooling/heating	-	-	-	-	-	-	-
YAZAKI	R&D	Cooling/heating	-	-	-	-	-	-	-

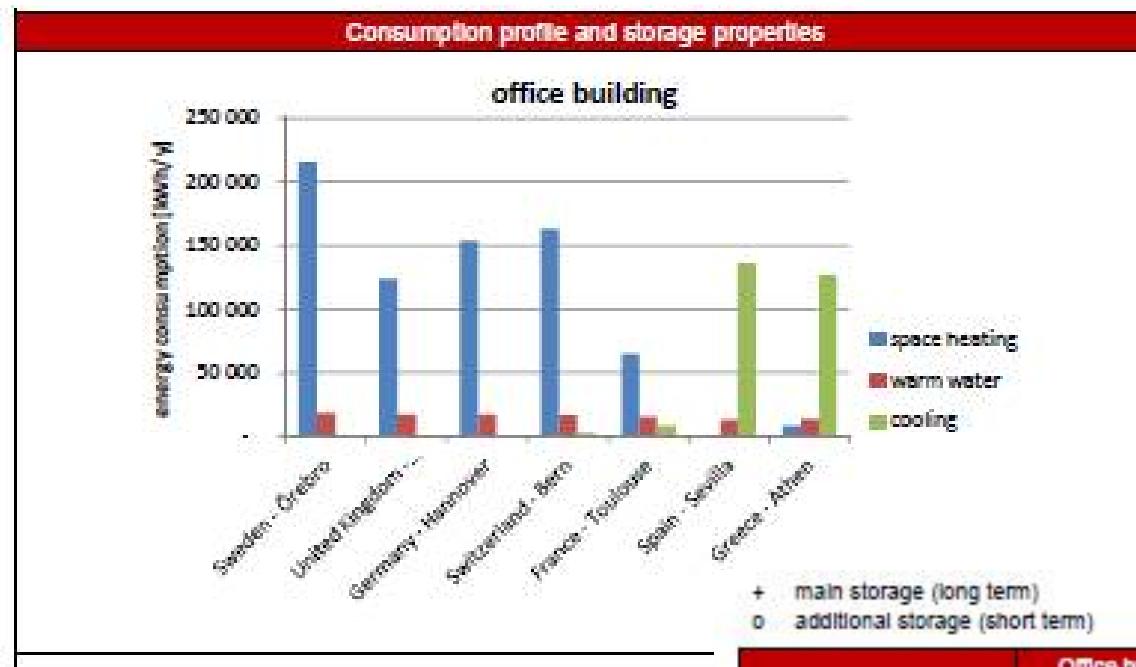
*: end user price excluding VAT

Economical data on innovative solar cooling and heating systems among IEA SHC Task 53

**Draft state of the art of new generation
Commercially available**



Subtask A: Components, Systems & Quality



Consumption profile and storage properties for office buildings in European cities

Estimation of the most economical storage technology for an office building depending on its location.

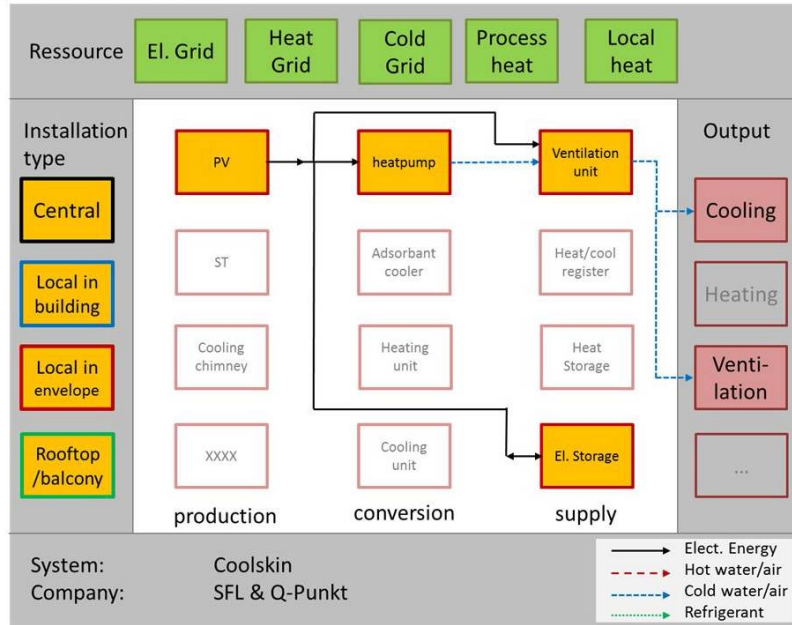
+ main storage (long term)
o additional storage (short term)

	Office building – northern climate zone	Office building – middle climate zone	Office building – southern climate zone
UTES	+	+	++
ATES	+	+	+
Pit storage	+	+	+
Solid media	o	o	o
PCM	o	o	o
Ice storage	o	++ / o	++ / o
Hot and cold water tank	++	+ / o	o

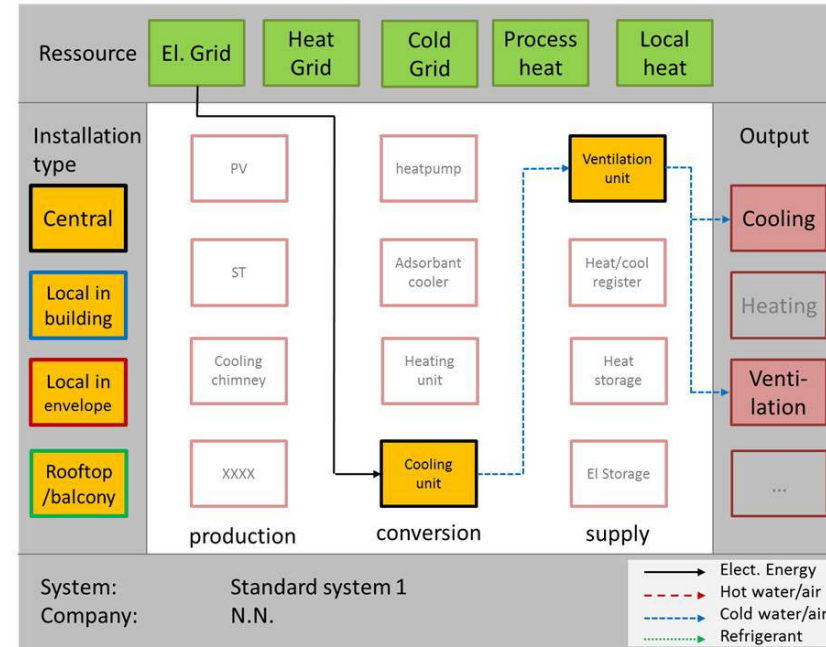
Technical report on best practices for energy storage including both efficiency and adaptability in solar cooling systems

Subtask A: Components, Systems & Quality

Schematic Draft 2: Example 1



Schematic Draft 2: Example 2

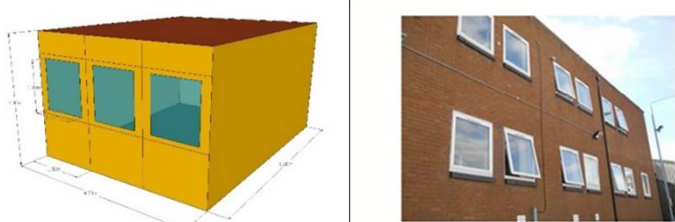
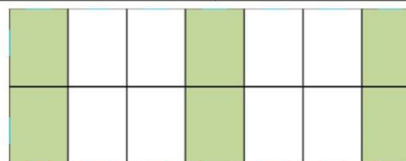


Report on a new and universal classification method “new generation solar cooling square view” for generic systems (A4 : System integration)

Subtask B: Control, Simulation and Design

Ongoing set up work of building TRNSYS models for simulating reference systems

Warning : so far, no climatic conditions out of Europe (research of new contributors)...

OFF	
Sketch and picture	
Zoning	
Zone height/width/depth	3.0 / 4.5 / 6.0 m Ceiling height 2.8 m
Zone floor area / volume	27 m ² / 81 m ³
Office area per floor	6 to 12 offices per floor
Number of floors	3 to 7
Roof type	Flat concrete roof
Glazing ratio	30 % to 60%

Definition for reference conditions
(B1 : Reference conditions)

Subtask C: Testing and demonstration projects



Task 53



Final draft report (including ST & PV)

Deliverable D-C1.2 – Adapted Monitoring Procedure for New Generation Solar Heating & Cooling Systems
Final Draft

Date: 17.05.2016

By Bettina Nocke¹, Daniel Neyer², Alexander Thür³, Karl Berger⁴

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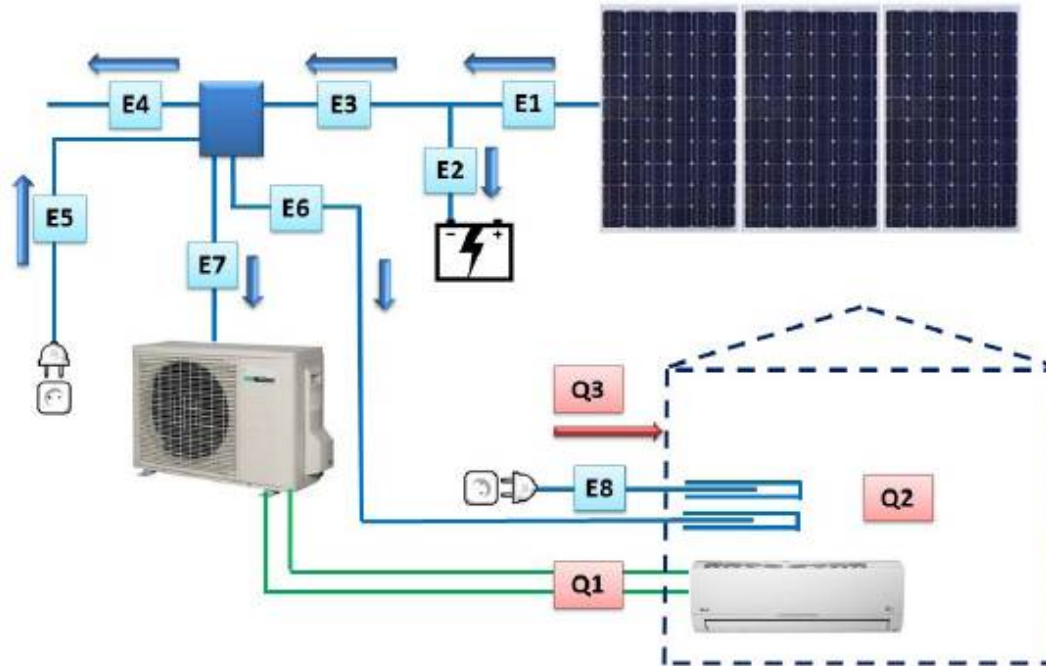


Figure 2 PV driven solar heating and cooling system of a HVAC installation.

Monitoring procedure
KPI's
Reference conditions
Example

Monitoring procedure for field test & demo systems (C1 : Monitoring procedure & monitoring system selection criteria)

Task 53

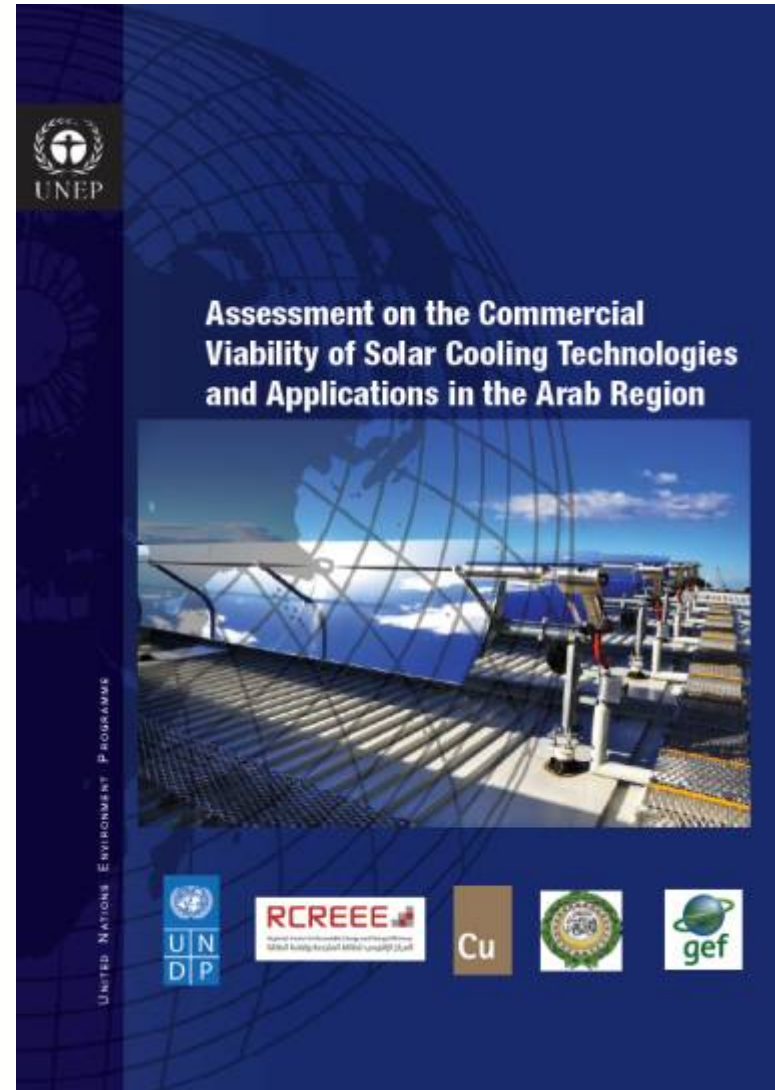


Study on solar cooling potential

Clients :

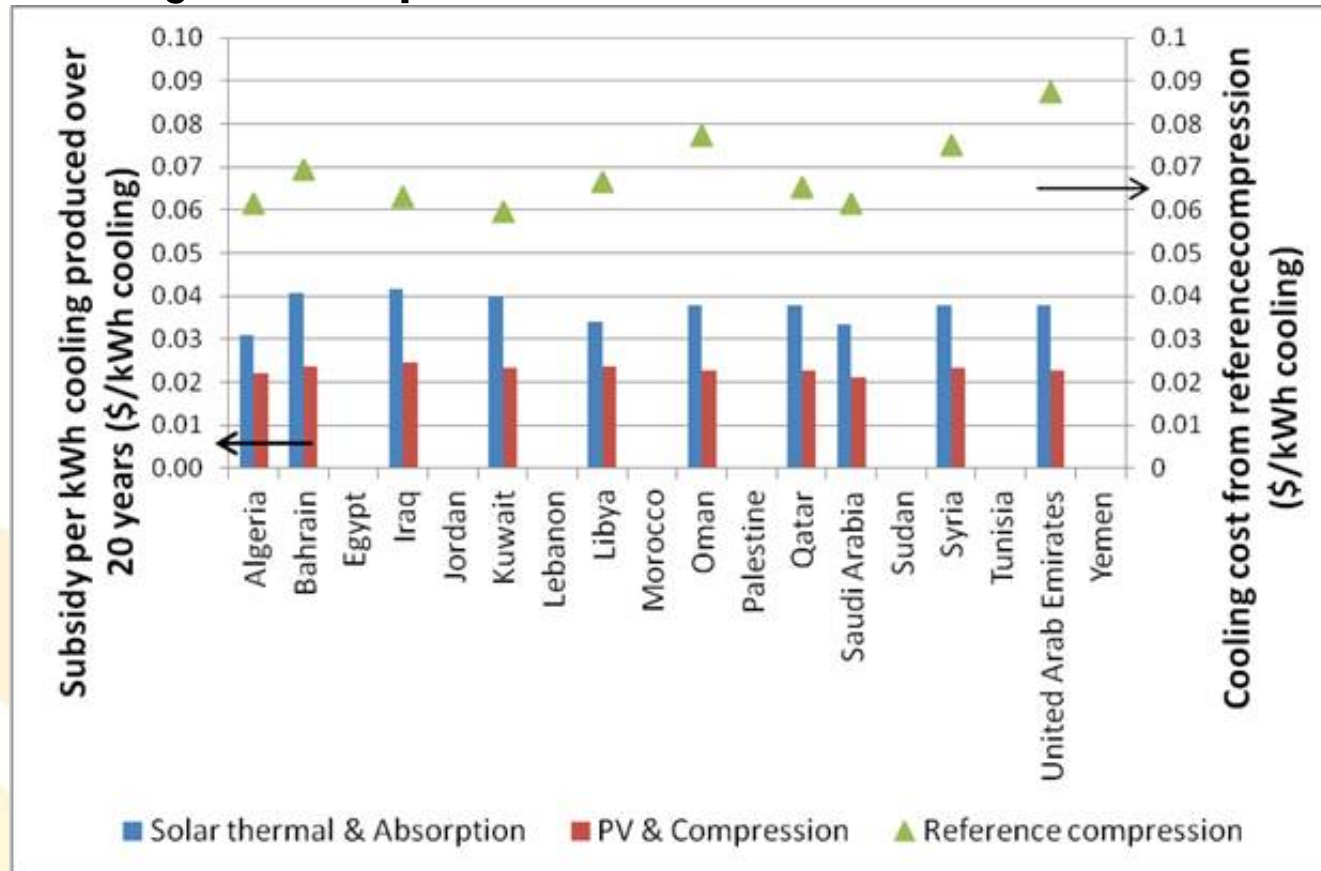


Consultants :



Economical analysis of the 100 kW cooling segment :

Level of subsidy per unit of cooling production over 20 years
& reference cooling cost for specific 12 countries



It is far cheaper to subsidized solar cooling than oil or gas cooling !

Cost reduction potentials on solar cooling

(by 2020-2025)

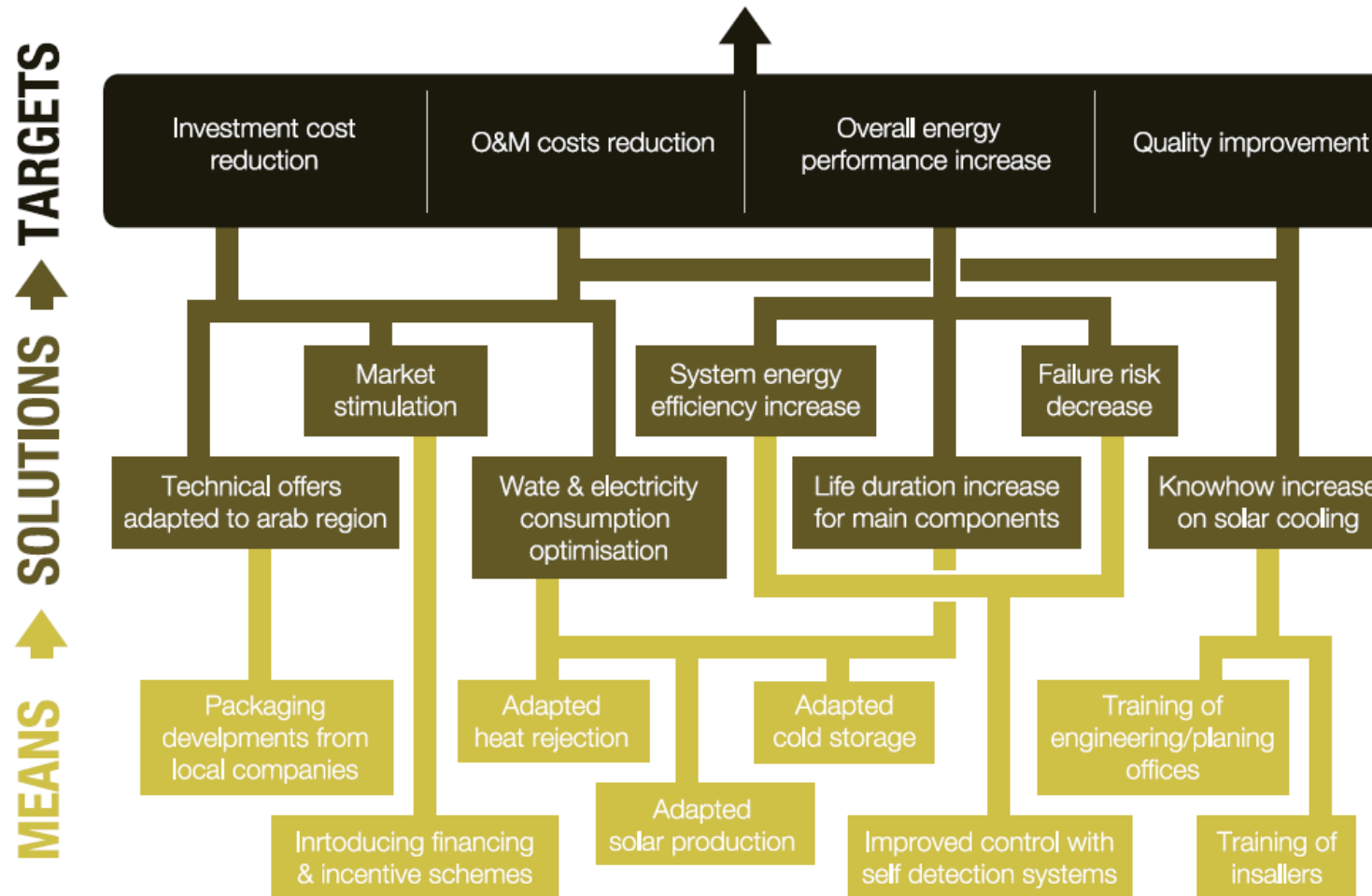
Factor	Key indicator evolution <i>(difference between initial situation and new one)</i>	Cost reduction ratio <i>(reference : 2015, on investment)</i>
Sales scaling factor	x10 sales volume	15 to 30%
Size scaling factor	x10 system size from 100 kW _c to 1 MW _c	50 to 70%
Packaging factor	Solar cooling prefabrication (kits of less than 30 kW _c)	30 to 40%
Local company manufacturing factor	Manufacturing of the main components locally	5 to 10%
Technical innovations factor	Arab region adapted solar production	10 to 30%
	Heat rejection	on
	Cooling storage	Net Present Cost

Significant cost reduction potential thanks to R&D !



Solar Cooling Roadmap proposal

Global cost reduction and competitiveness



Task 53 communication

Workshops / conferences dealing with Task 53

Workshop/Conference /Seminar (include type: Task organized, keynote, presentation, poster, etc.)	Activity & Presenter (keynote, presentation, poster, etc.)	Date & Location	Number of Participants	If Hosted by Task # Industry, Government, Research, Countries
6 th OTTI SAC conference	keynote	Roma, 24/09/2015	80	OTTI 6 th SAC conference
SHC 2015 conference – Keynote on solar cooling	keynote	02/12/2015 - Istanbul	100	IEA SHC Programme
SHC Task53 / PVPS Task1 Join Workshop	presentations	Madrid 11/04/2016	35	IEA SHC /PVPS Programme
IEA SHC Task 53 Industry Workshop	presentations	Madrid 11/04/2016	50	IEA SHC Programme

≈ 260 persons «reached by Task 53 commnication during 4 events



Task 53 is better known in Spain !



Task 53 Website

The screenshot displays the website for SHC Task 53. At the top, there are navigation links for 'IEA SHC HOME' and 'TASK HOME', a 'MEMBER LOGIN' button, and a search bar. The main banner features the SHC logo and the text 'SHC Task 53 New Generation Solar Cooling & Heating' over a background image of solar panels on a roof. A left-hand navigation menu is highlighted with a black border, listing: 'About Project', 'Participants', 'Meetings / Events', 'News', 'Publications', 'Related Sites', 'Member Area', and 'Contact'. The main content area has a section titled 'New Generation Solar Cooling & Heating Systems (PV or solar thermally driven systems)' with an 'Overview' sub-section. The overview text states: 'The main objective of this Task is to assist a strong and sustainable market development of solar PV or new innovative thermal cooling systems. It is focusing on solar driven systems for both cooling (ambient and food conservation) and heating (ambient and domestic hot water). The scope of the Task are the technologies for production of cold/hot water or conditioned air by means of solar heat or solar electricity, i.e., the subject which is covered by the Task starts with the solar radiation reaching the collector or the PV modules and ends with the chilled/hot water and/or conditioned air transferred to the application. However, although the distribution system, the building and the interaction of both with the technical equipment are not the main topic of the Task this interaction will be considered where necessary.' To the right, there are two sidebars: 'Task Information' listing the operating agent as Dr. Daniel Mugnier in France with contact details, and 'What's New' with tabs for 'NEWS', 'MEETINGS', and 'PUBLICATIONS', currently showing 'Check Back Soon'.



<http://task53.iea-shc.org/>



Very recent communications...

AFREE : Arab Forum for Renewable Energy and Energy Efficiency (ARFREE)

01-02 June 2016

Location: Cairo

Event Type:



Task 53 is better known in MENA Region !

EUROSUN 2016 : 6 communications on behalf of Task 53

(CNR ITAE, CSIRO, University of Innsbruck (2), UNIPA, UMH)

Seminar in Madrid (Jornada sobre” Sistemas solares de calor y frío aplicados a la edificación. La participación Española en la AIE y Smart Cities” organized by CIEMAT) – 05/05/2016



Thanks for your attention !

Contact : *Daniel Mugnier*, TECSOL

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