Worldwide overview on Solar Cooling and SHC Tasks 48 and 53

Task 48

Task 53

TECSOL

Daniel MUGNIER – 27/03/2015

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

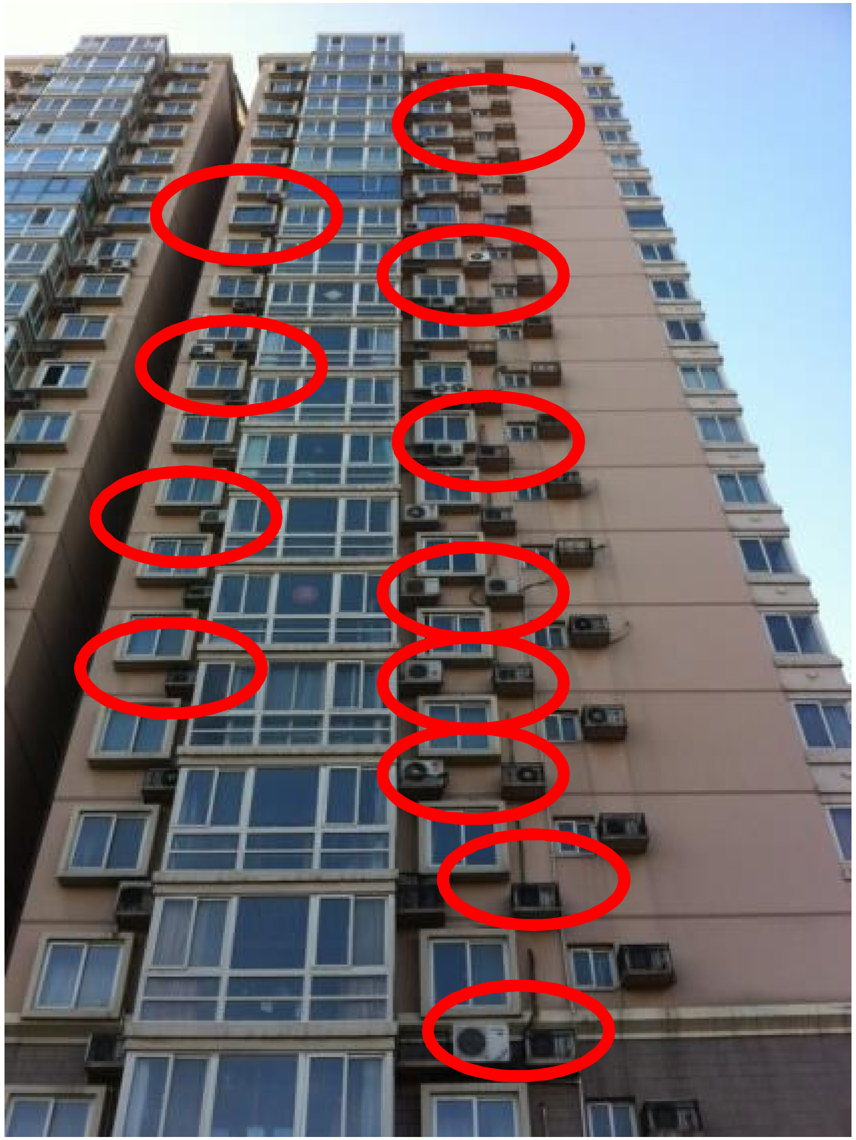
Shanghai (China)

www.tecsol.fr

To Introduce the importance of...

SOLAR COOLING for China...

...one picture taken in China in October 2015



Task 48

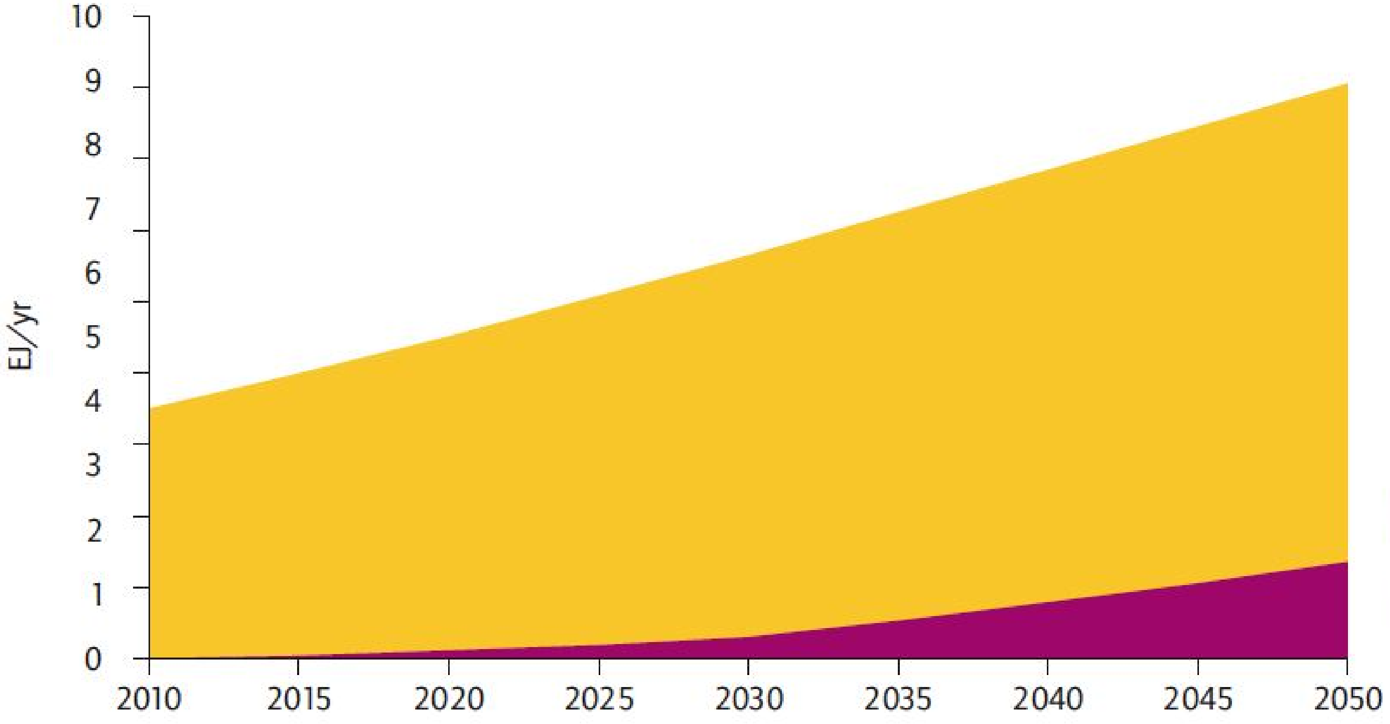
Task 53

TECSOL

SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY

IEA Technology Roadmap SHC
Share of solar cooling by 2050

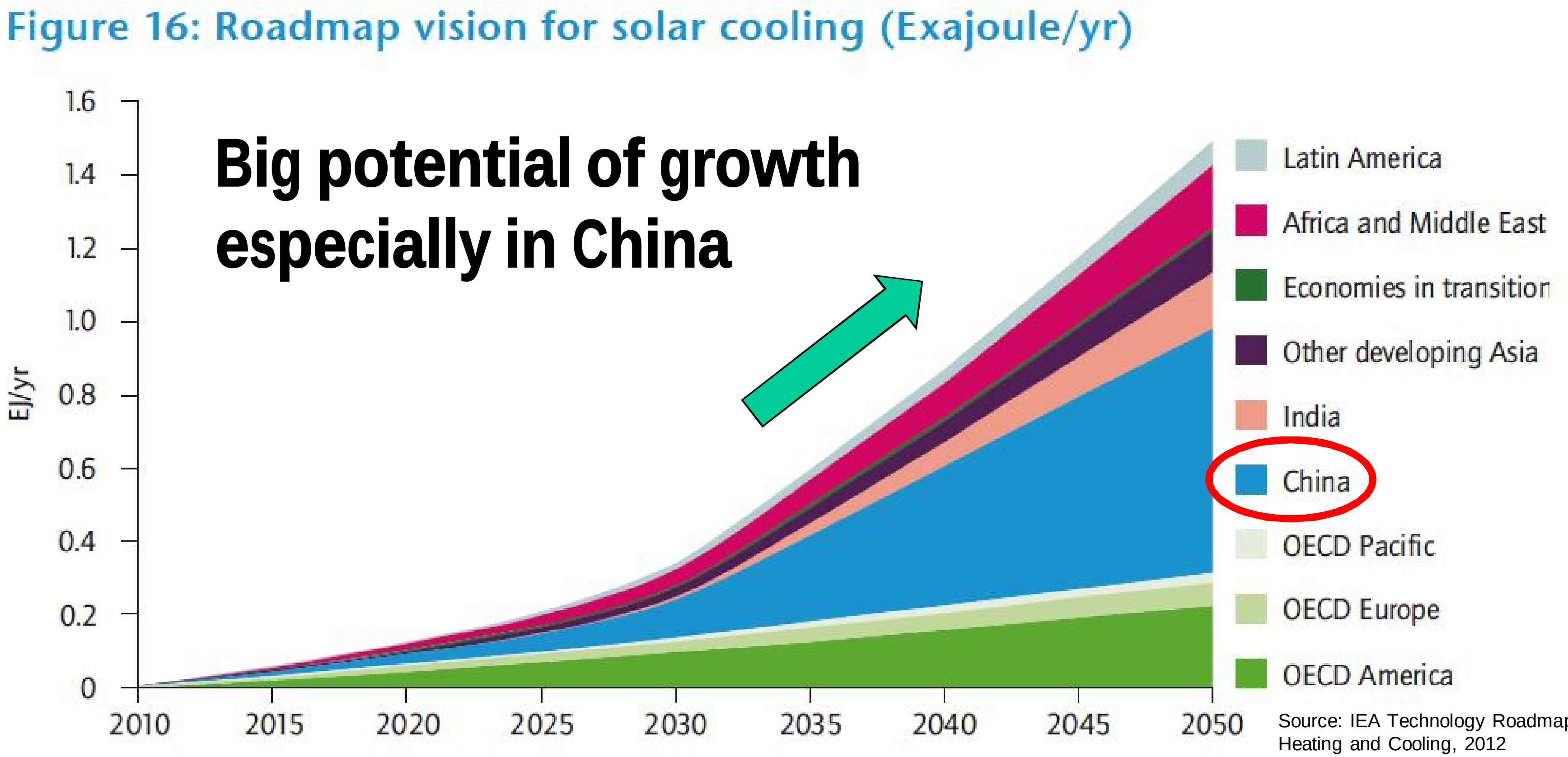
Figure 17: Roadmap vision for solar cooling in relation to total final energy use for cooling (Exajoule/yr)



Source: IEA Technology Roadmap Solar Heating and Cooling, 2012

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

IEA Technology Roadmap SHC – *Market potential by 2050*



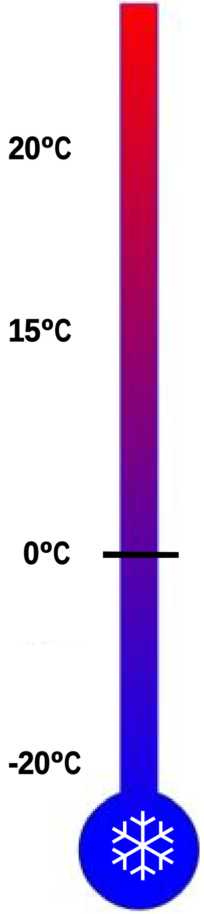
Source: IEA Technology Roadmap Solar Heating and Cooling, 2012

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

Systems could enter the market between 2015 and 2020

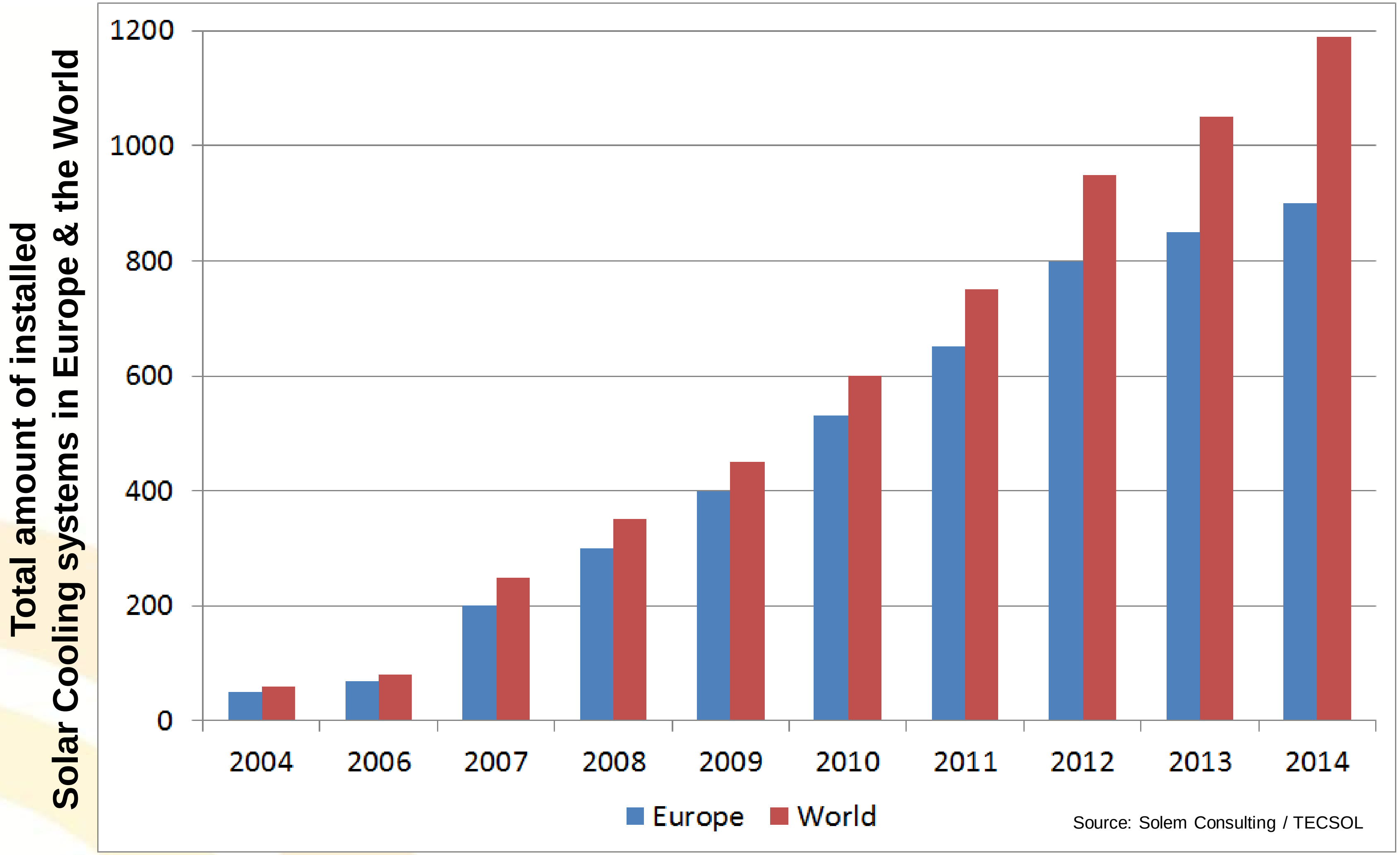
Solar thermal collector technologies versus Application for solar cooling

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



Source : JER

Market development of solar thermal cooling



About > 1,200 systems installed worldwide (2014)

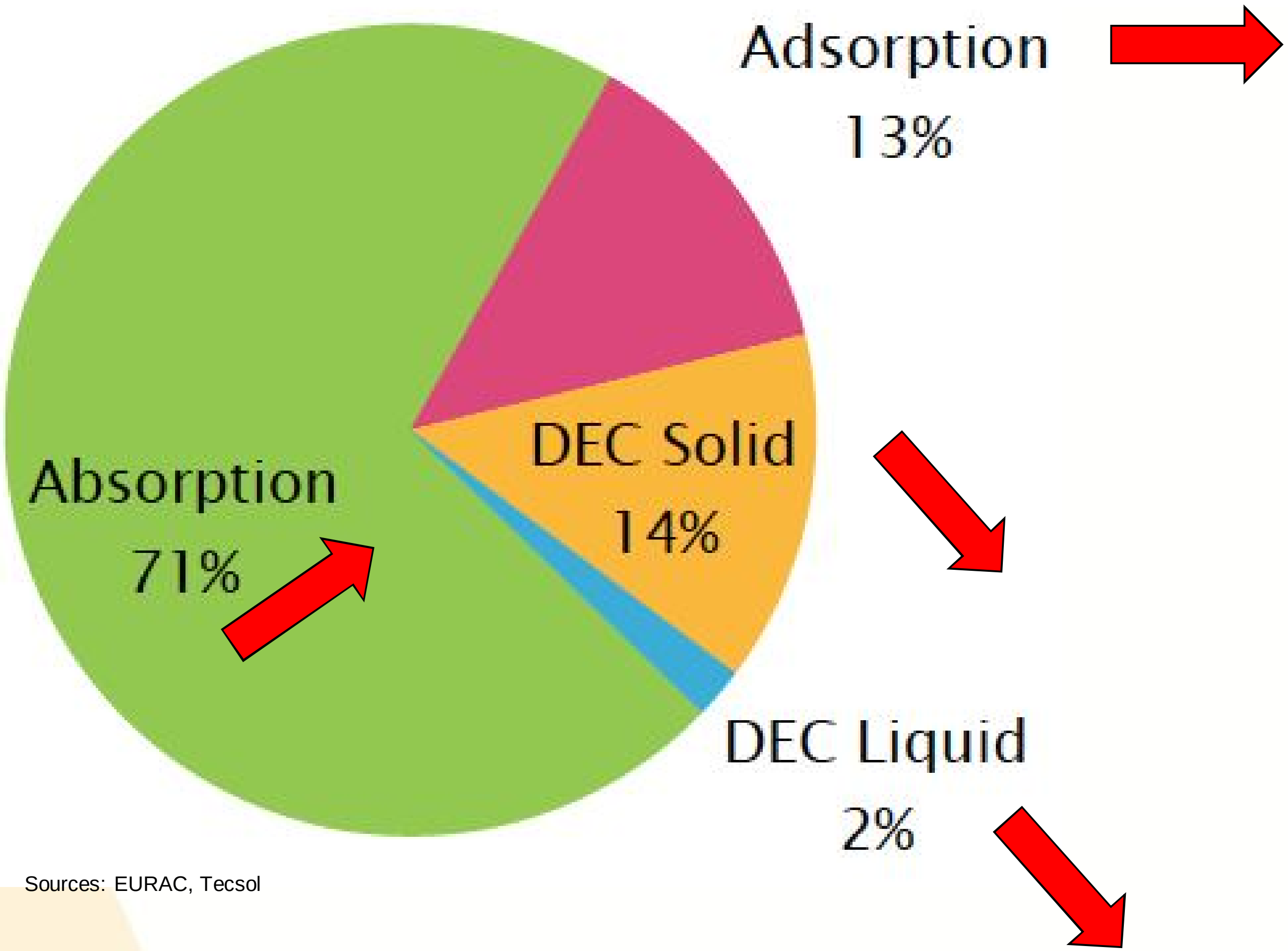
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Task 48

TECSOL

Market share of solar driven sorption chillers (IEA SHC Task 38 / 2009)

Trend in 2014



Sources: EURAC, Tecsol

Desert Mountain High School, USA

SOLID solarinstallation+design

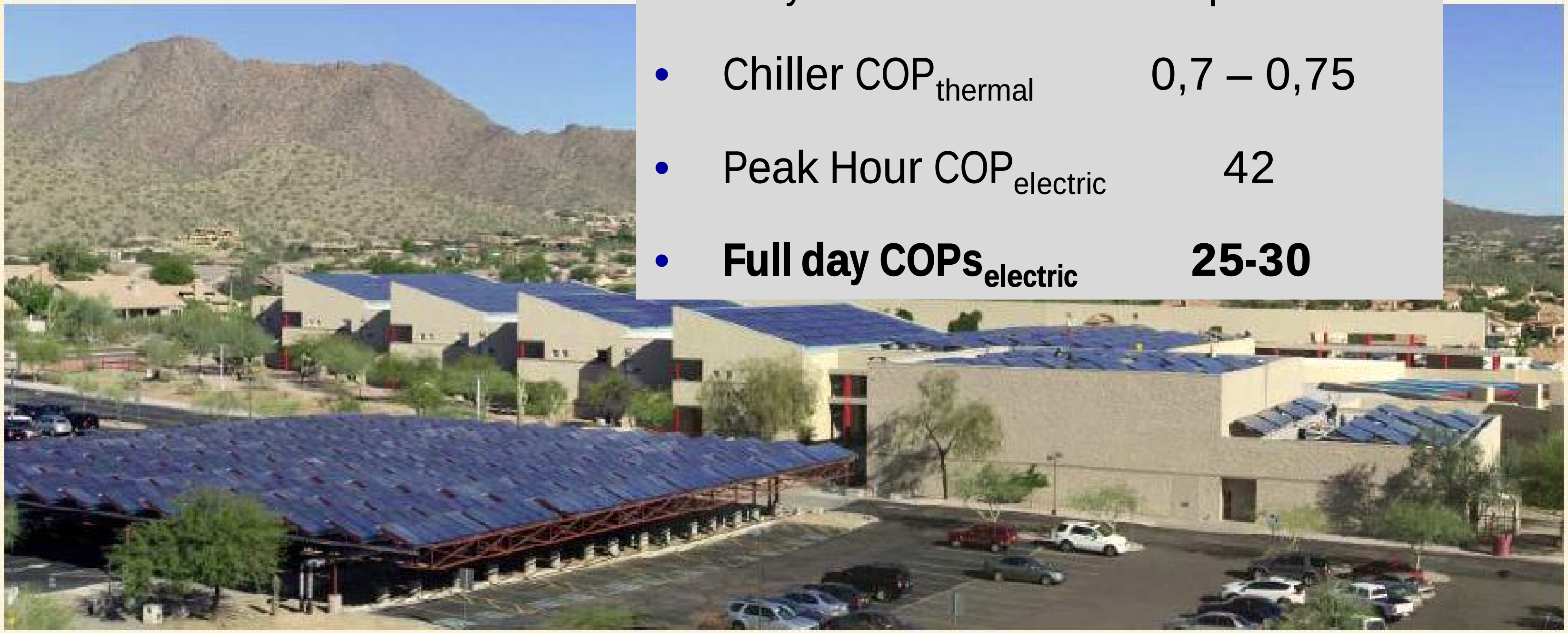
Solar Panels: 5,000 m² → 3.5 MW

Cooling load: 500 tons / 1750 kW

In operation since 2014

<u>Preliminary results after 6 months of operation:</u>

- Very stable and reliable operations
- Chiller $COP_{thermal}$ 0,7 – 0,75
- Peak Hour $COP_{electric}$ 42
- **Full day $COPs_{electric}$ 25-30**



SERM Montpellier SAC/DHW system

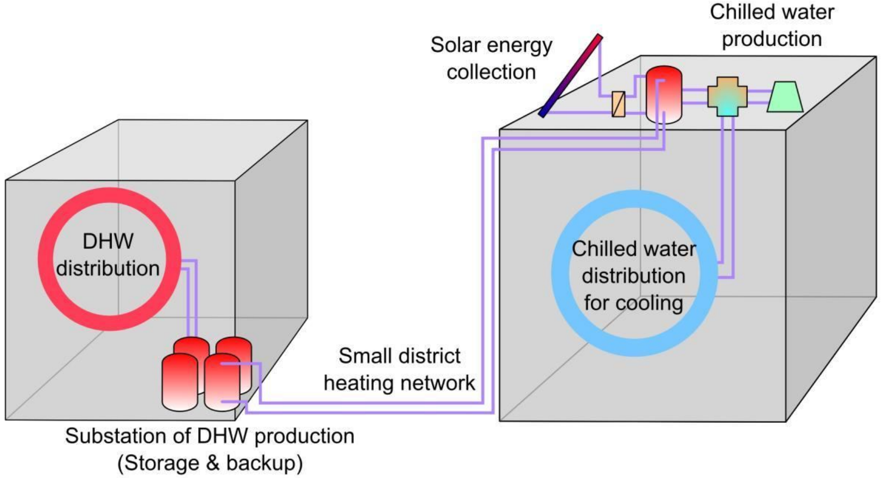
Montpellier Heating and System net utilities
=> System owner

TECSOL : engineering company

AXIMA GDF SUEZ : Company in charge of the works

Building A view

Picture of the collector field



240 m² DG FP collectors + 35 kW absorption chiller
solar circuit in drainback mode

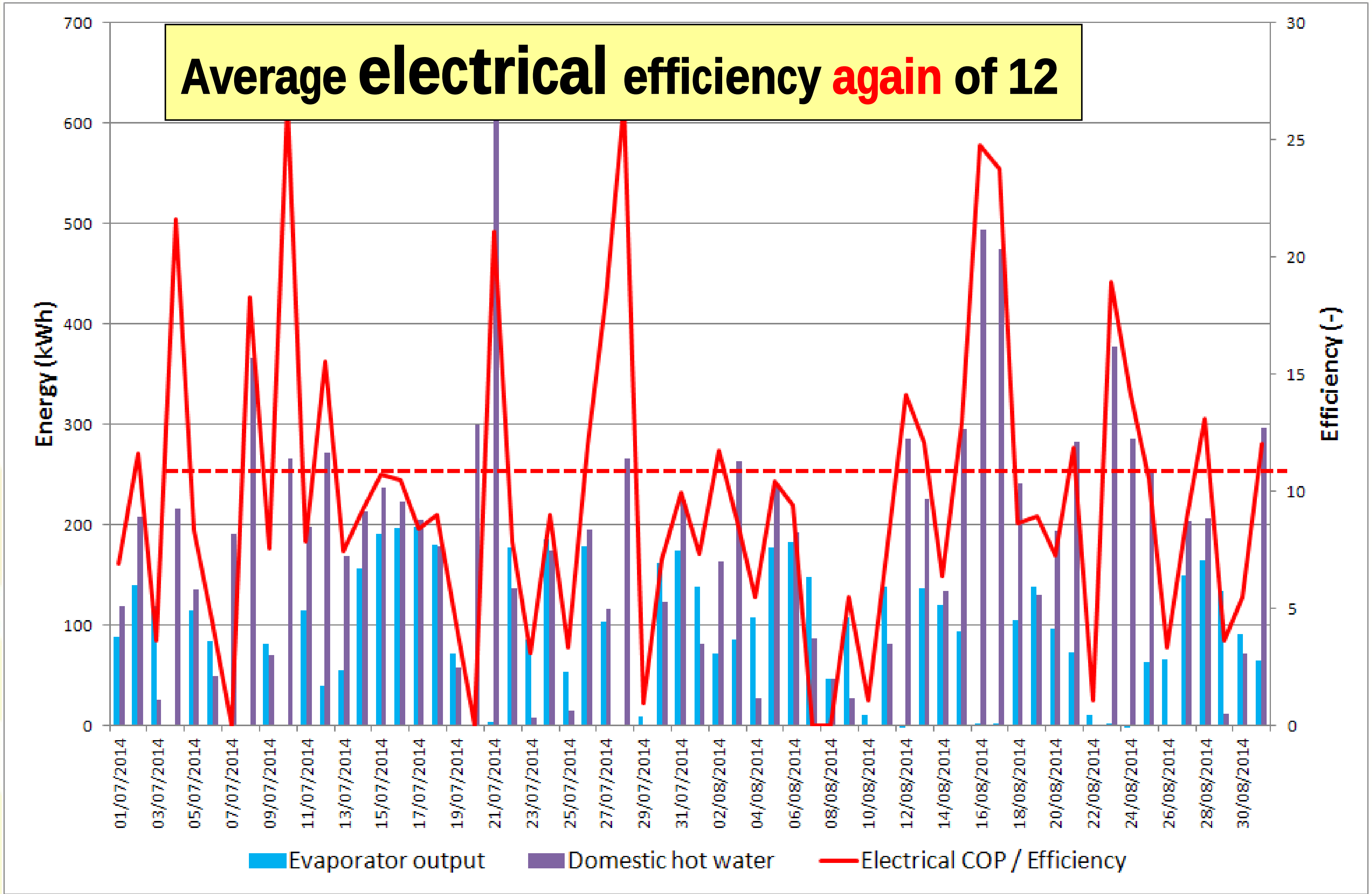
Full year balance (march 2013/ mars 2014)

	DHW Production (kWh)	Cooling Production (kWh)	Parasitic elec. Consumption (kWh)	Useful Solar Yield (kWh/m2)	Overal elec efficiency (-)
from 18/03/2013	4 654	0	110	19.4	42.3
april 2013	11 588	0	290	48.3	40.0
may 2013	16 478	0	380	68.7	43.4
june 2013	7 497	2 765	902	42.8	13.4
july 2013	9 482	3 983	1 190	56.1	13.5
august 2013	8 628	1 970	840	44.2	14.2
september 2013	9 316	676	554	41.6	18.9
october 2013	7 843	0	240	32.7	32.7
november 2013	4 789	0	220	20.0	21.8
december 2013	3 851	0	157	16.0	24.6
january 2014	3 734	0	190	15.6	19.7
february 2014	6 435	0	218	26.8	29.5
march 2014	12 860	0	348	53.6	30.9
april 2014	14 085	0	360	58.7	39.1
may 2014	12 633	281	326	54.0	40.2
june 2014	8 847	944	685	39.7	15.2
july 2014	5 586	2 959	851	26.8	12.4
TOTAL	148 308	13 578	7 861	**674.5**	**20.6**

** elec consumption linked to the solar useful production (pumps solar, DHW, generator, evaporator, condensor circuits) without measuring back up elec consumption.*

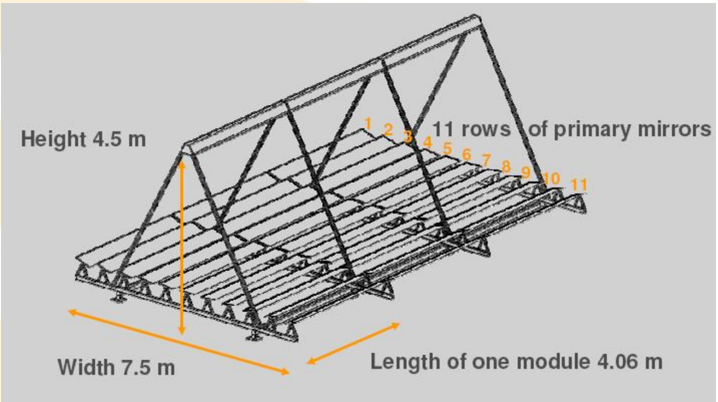
Global Electrical efficiency of **nearly 21** in average for a full year & a **solar yield of 674 kWh/m².y**

Monitoring results for Summer 2014



High-temperature applications

Example : Fresnel Collectors in South Africa



MTN (Mobile TelephoneNetworks) Headquarter

Johannesburg

Absorber type:	SCHOTT PTR 70
Fresnel-Kollektoren:	2 Strings of 11 Modules
Solar cooling capacity:	**275 kW$_{th}$**
Yearly production:	**391 MWh**
Collector area :	**484 m²**
CO_2-savings:	47.000 kg/y

INDUSTRIAL SOLAR thermal solutions

SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY

Task 48

TECSOL

Technical status

- **Mature components available** (both solar and refrigeration, A/C)
- **Main progress made in last decade**
  - *Small scale heat driven chillers*
  - *Increasing number of high efficient double and – recently – triple effect absorption chillers*
  - *Development of systems using single-axis tracking solar collectors*
- **Main technical shortcomings are still on system level**
  - *Energy efficient heat rejection system*
  - *Energy management*
  - *Bottleneck: good trained technical staff almost not available*

Energy performance

- **Many systems lead to measurable energy savings** when compared to a best practice conventional reference solution
- **Best values of overall electric COP range up to 6-8**, which means that
  6-8 kWh of useful cooling are produced with 1 kWh of invested electricity
- **Target value for electric COP > 10**
- **However**: also many systems do not achieve these values in practice due to
  - *Non-optimal design*
  - *Non-optimal operation (e.g. control, part load)*

Structure of Task 48

Subtask A
Quality procedure on component level

Subtask B
Quality procedure on system level

Subtask C
Market support measures

Subtask D
Dissemination and policy advices

4 Subtasks & 25 activities

3,5 years – 20 experts
From October 2011 to March 2015

Task 48 investigation results :

Project management

- Incentive schemes
- Roadmapping
- Training material
- System cost analysis

Solar DEC best practices

System components

- Heat rejection
- Chiller
- New collectors
- Pumps

Solar Ab(ad)sorption best practice examples

System technical optimisation

- Life cycle analysis
- Design tool
- Self detection procedures
- System performance modelling

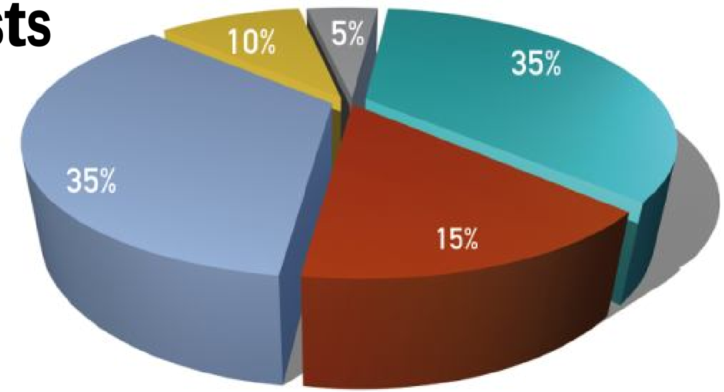
Source : IEA SHC Task 48

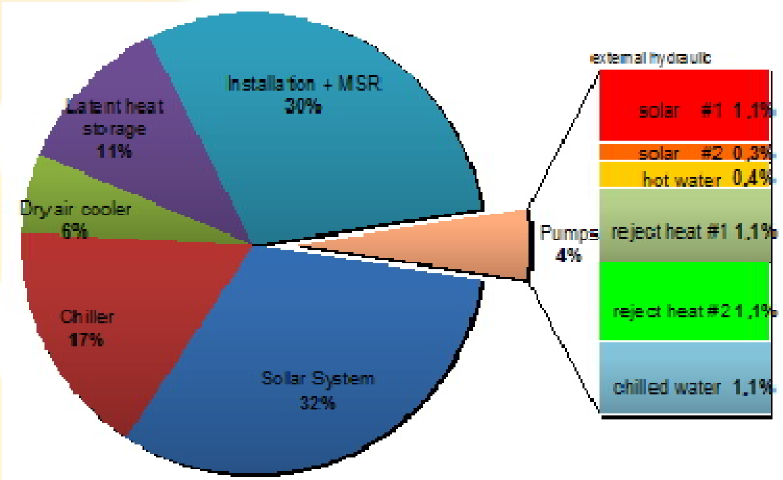
Task 48

Task 48 result (A4) : Pumps
Impact of pump costs on overall system costs

Percentage on overall costs

33% Collector field
33% Piping & installation
20 % chiller
< 5% pumps





⇒Investment costs not completely negligible (even if minor effect on overall system costs)

⇒But bad quality pumps can have a big impact

Source : IEA SHC Task 48 – ZAE Bayern

TECSOL

Bilan été 2014

Task 48 investigation results :

Project management

- Incentive schemes
- Roadmapping
- Training material
- System cost analysis

Solar DEC best practices

System components

- Heat rejection
- Chiller
- New collectors
- Pumps

Solar Ab(ad)sorption best practice examples

System technical optimisation

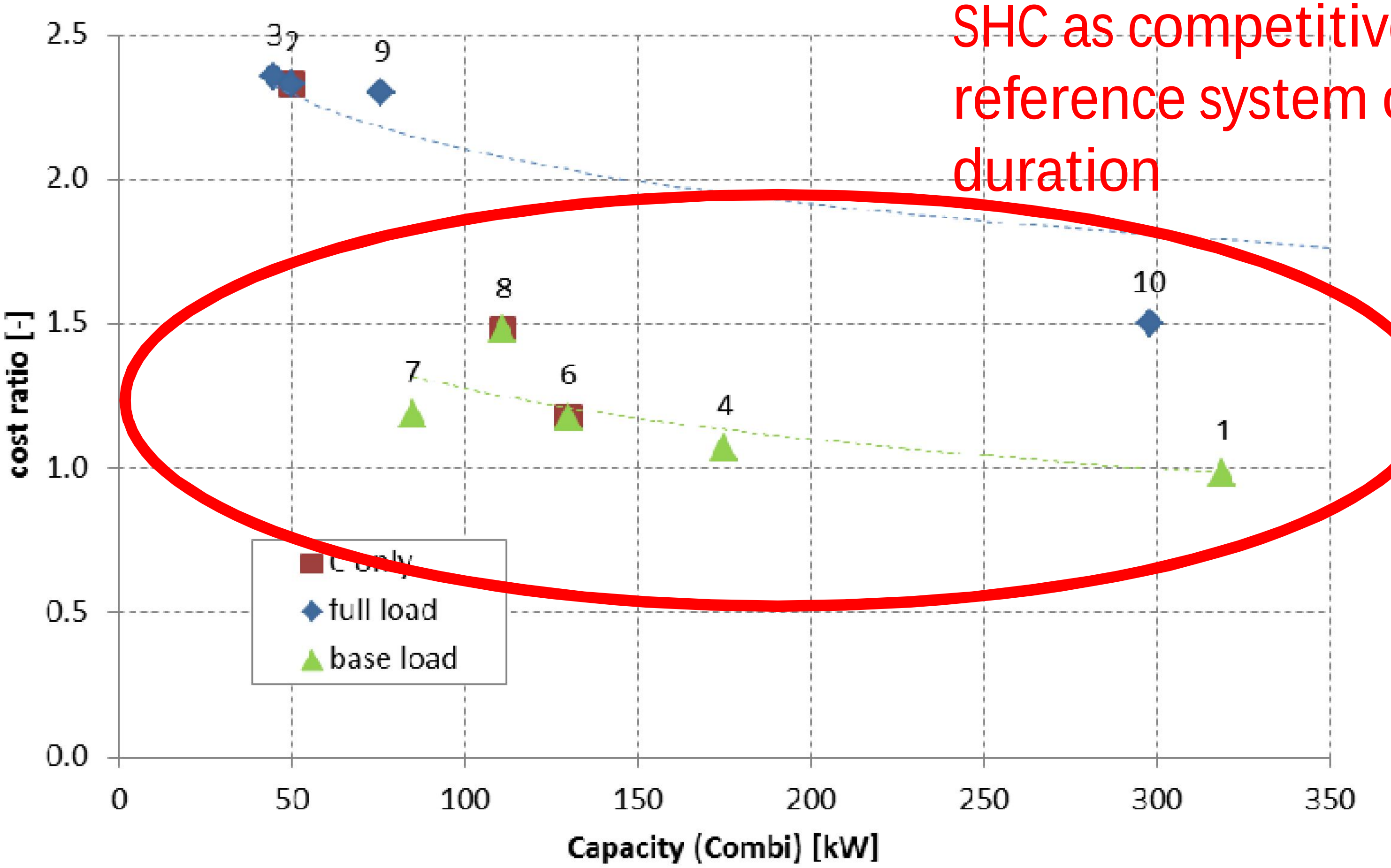
- Life cycle analysis
- Design tool
- Self detection procedures
- System performance modelling

Source : IEA SHC Task 48

Task 48 result (B7):
Technical and economic costs analysis

Results: Cost ratio (SHC/REF)

SHC as competitive as reference system on its life duration



Source : IEA SHC Task 48 – UIBK

Need of a new Generation solar cooling systems

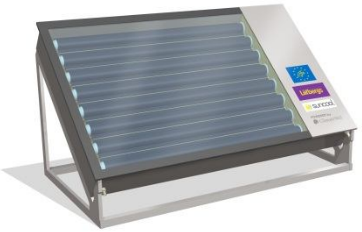
Solar thermal « traditionnal » cooling has **difficulty to emerge as a economically competitive solution**

Main reasons :

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

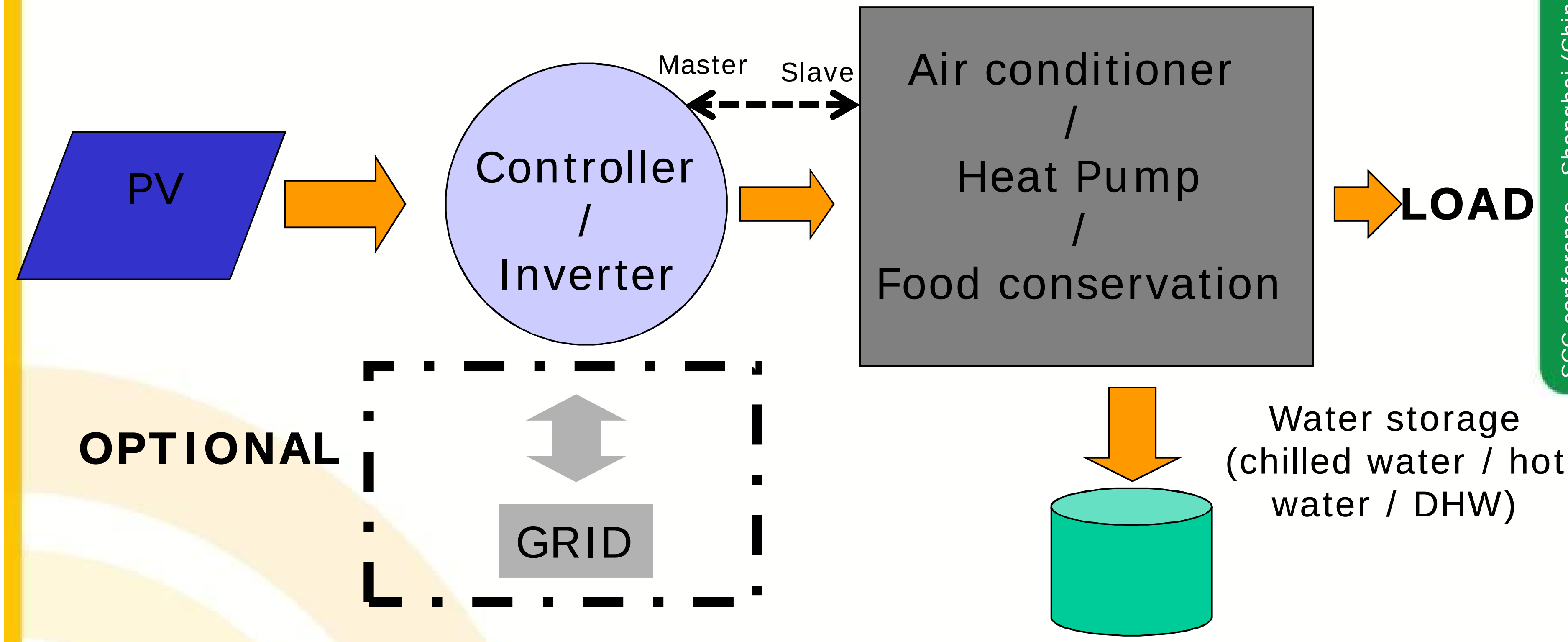
⇒ Still need **intensive R&D** for quality improvment and best solution selection (ongoing IEA SHC Task 48)

⇒ Very innovative concepts such

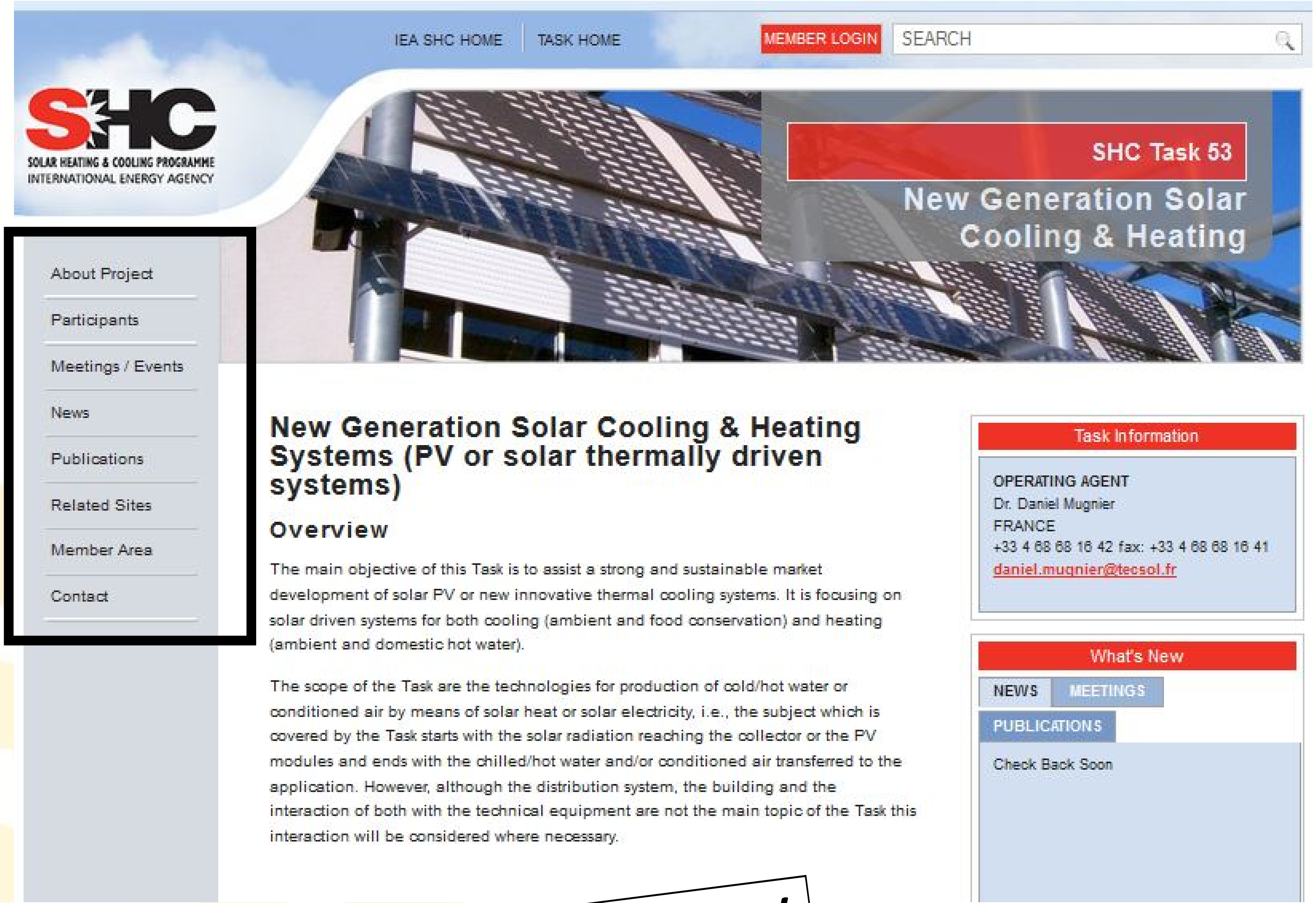


Source : Climatewell

Example of Basic concept for the PV approach



IEA SHC Task 53 Website


IEA SHC HOME | TASK HOME | MEMBER LOGIN | SEARCH

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

SHC Task 53
New Generation Solar Cooling & Heating

- About Project
- Participants
- Meetings / Events
- News
- Publications
- Related Sites
- Member Area
- Contact

New Generation Solar Cooling & Heating Systems (PV or solar thermally driven systems)

Overview

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.

Task Information

OPERATING AGENT
Dr. Daniel Mugnier
FRANCE
+33 4 68 68 16 42 fax: +33 4 68 68 16 41
daniel.mugnier@tecsol.fr

What's New

NEWS | MEETINGS | PUBLICATIONS

Check Back Soon

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

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Task 53

TECSOL

IEA SHC Task 53 Subtask A

Which systems do we have?

NG systems close to market

PV CH (Cooling/ Heating) on the Market

STDCH

– SolabCOOL (NL)

– SUNCOOL/Climatewell (SE)

R&D Systems close to Market

PV CH (Cooling/ Heating)

- BIG HEATING company (GER)
- Helioherm

STDCH

- FREESCOO (IT)
- Climatewell (SE)

State of the art of this new **Market**

(no claim for completeness)

SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY

Task 53

TECSOL

Main categories

Solar air conditioners : Splits

PV+ HP coupling for Office/Commercial

Source : Cosseco

http://task48.iea-shc.org/

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

Source : Solabcool

Thanks for your attention !

Contact : Daniel Mugnier, TECSOL

daniel.mugnier@tecsol.fr