IEA SHC Task 53
on New Generation Solar Cooling

Main presentation and first results

Daniel MUGNIER – Karsltad, 09/10/2014

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Task 53

www.tecsol.fr

Context : Status of **Solar cooling** in 2014

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 as **SUNCOOL**

How to find a solution for small / medium size ?

* A very **important priority** : solar for cooling,
especially for small to medium size

Example : 10% of the entire Saudi Arabia oil production for national cooling

* **New context on economics** for PV and trend towards selfconsumption

* A real **growing market**...

... but **strong need** of:

* standards
* thermal management optimum
* monitoring & best practice

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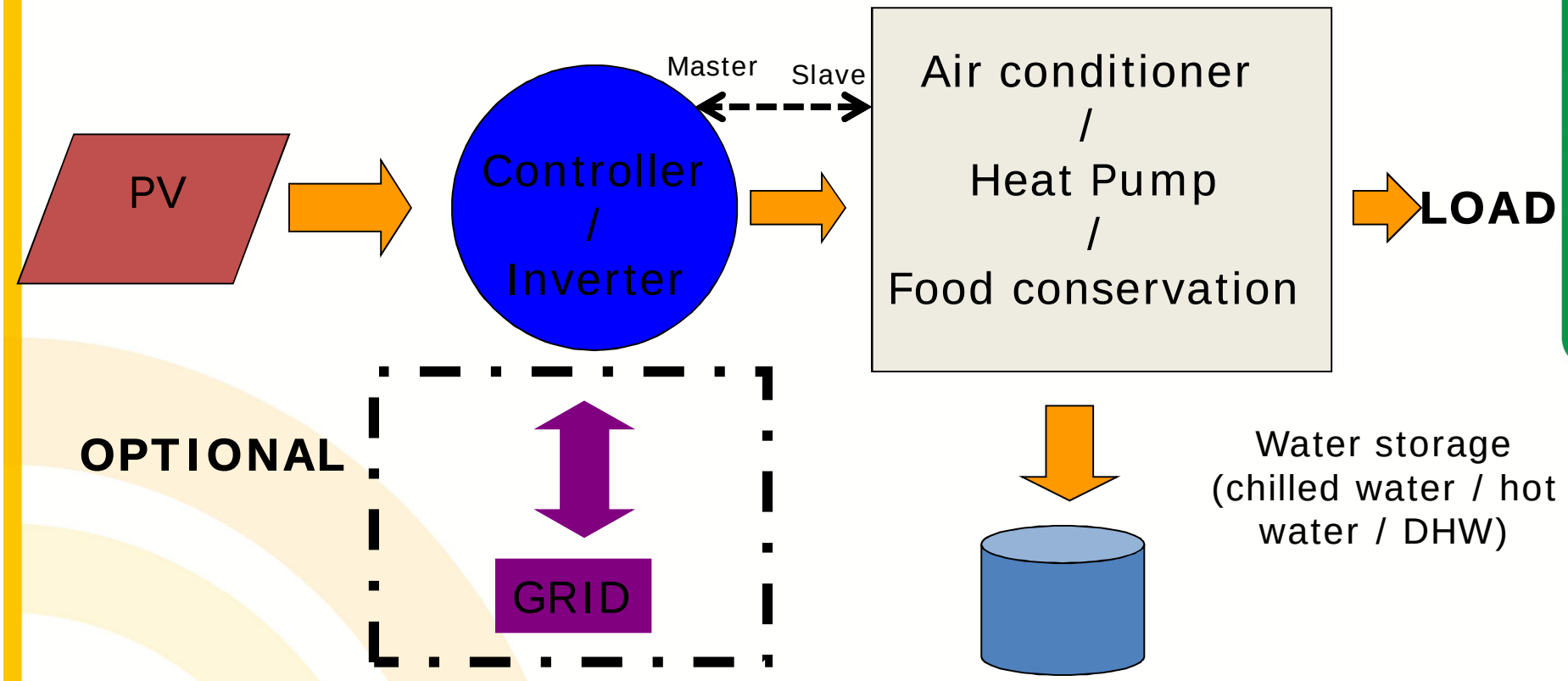
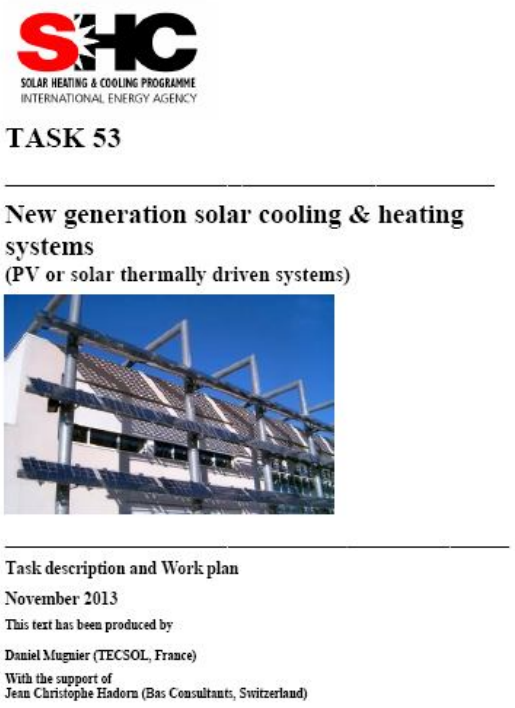
Example of Basic concept for the PV approach



IEA SHC Task 53 Goals

(1) **to analyze the interest of new generation solar cooling & heating concepts systems for bulidings in all climates and select best solutions** which lead to highly reliable, durable, efficient and robust solar cooling and heating (ambient + DHW) systems

(2) **to contribute to market entry of the technology** and identify most promising market areas in terms of cost competitiveness and value of electricity.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New generation solar cooling & heating systems
(PV or solar thermally driven systems)

Task description and Work plan

November 2013

This text has been produced by

Daniel Mugnier (TECSOL, France)

With the support of
Jean Christophe Hadorn (Bas Consultants, Switzerland)

Scope of the Task

System : solar driven systems for cooling and heating

* Solar thermal driven innovative compact cooling+heating systems

* **Photovoltaïc + air conditioning system** (Compression air conditioning / heat pump (if heating as well) ; **food conservation included**)

Applications : **Off grid & grid connected buildings**

(houses, small multi-family buildings, offices, shops, commercial center, hotels)

Power range : **from 1 kW cooling to several tens kW cooling / heating**

Limit : Need to have **a possible direct coupling between solar and cold production machine**

Partial or total coupling

Outcome

- **Investigation on new small to medium size solar cooling systems** (thermal and PV) and develop best suited cooling & heating systems technology focusing on reliability, adaptability and quality
- **Proof of cost effectiveness** of new solar cooling & heating systems
- **Investigation on life cycle performances** on energy & environmental terms (LCA) of different options
- **Assistance for market deployment** of new solar cooling & heating systems for buildings worldwide
- **Increase of energy supply safety and influence the virtuous demand side management behaviors**

Time Schedule

- **40 months**
- **From March 2014 to June 2017**

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Participating countries

.. at least 8 countries

France

Austria

Spain

Italy

Sweden

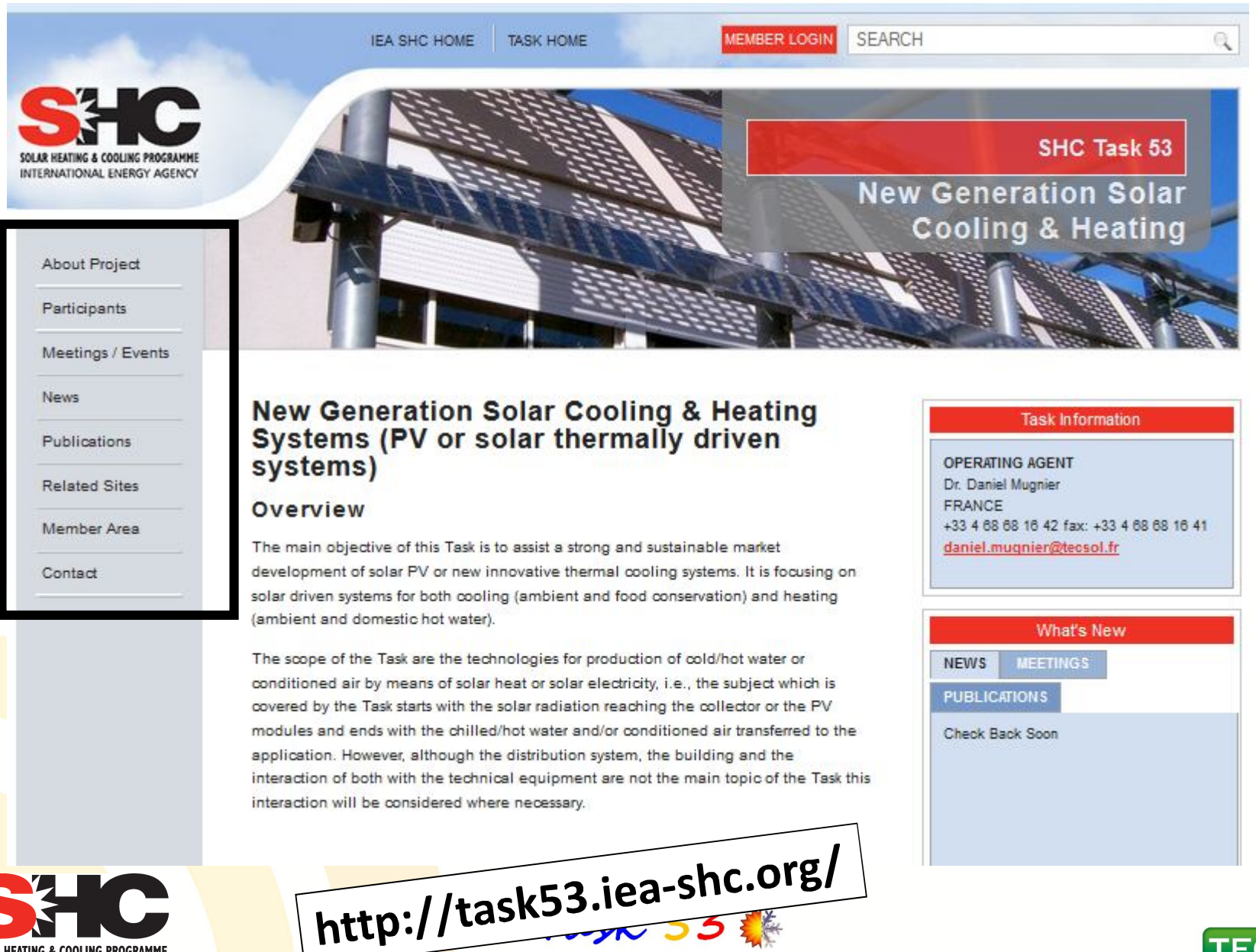
Australia

Switzerland

China

Probable newcomers :
Turkey, Germany

IEA SHC Task 53 Website



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

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IEA SHC Task 53 meetings and workshops

* Mälardalen University, Sweden :
  7-8/10/2014

MÄLARDALEN UNIVERSITY
SWEDEN

+ SUNCOOL Workshop

* Shanghai Jiao Tong University, China : March 2015

...for the **Solar Cooling Week !**

上海交通大學
SHANGHAI JIAO TONG UNIVERSITY

(workshop & expert meeting on solar thermal and solar PV cooling with Chinese and worldwide expert)

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Task 53 Structure

Subtask A

Components, Systems & Quality

Subtask B

Control, Simulation & Design

Subtask C

Testing and demonstration projects

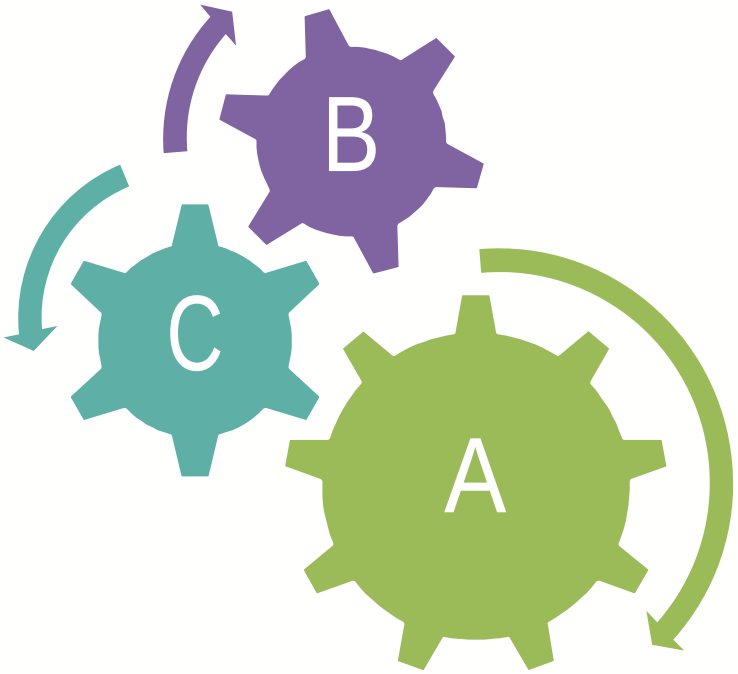
Subtask D

Dissemination & market deployment

IEA SHC Task 53 Subtask A

Interaction between SUBTASKs B,C and D

Basis work for subsequent activities in the other subtasks



IEA SHC Task 53 Subtask A

What is it about?

- What is the state-of-the-art market available products and upcoming R&D?
- What reference systems are competitors?
- What system configuration do exist und fit for what application?
- What storage concepts exist and how to manage store strategies?
- What system integration options do exist?
- What are the benefits of NG SCH Systems (eco ... LCA ... electrical grid)

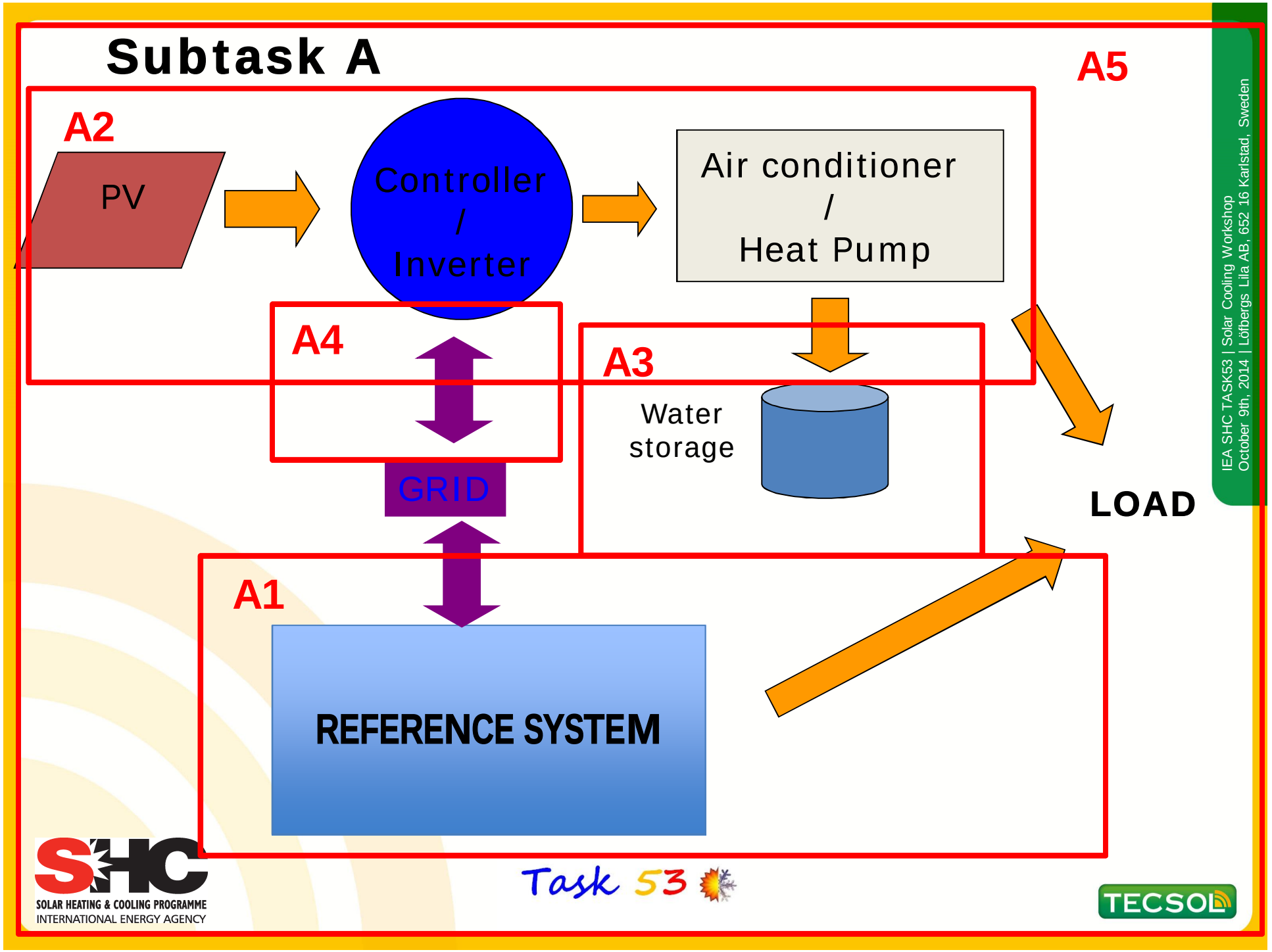
Quelle www.oew.org

IEA SHC Task 53 Subtask A

What is it about?

The general objectives of this subtask are:

- to know the commercially available equipment for NG SHC systems
- to know the R&D entities and its activities on the topic
- to investigate the different technical storage solution and its system integration
- to easily classify the ST/PV HC products/ system (schematic square view method)
- to conduct LCA of the main components and systems and to value the impact on the electric grid


Subtask A
A5
A2
PV
Controller
/
Inverter
Air conditioner
/
Heat Pump
A4
A3
Water
storage
GRID
LOAD
A1
REFERENCE SYSTEM
IEA SHC TASK53 | Solar Cooling Workshop
October 9th, 2014 | Löfbergs Lila AB, 652 16 Karlstad, Sweden
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IEA SHC Task 53 Subtask A

Status of activity leadership

- **Activity A1** Reference
  Leader AIT
- **Activity A2** New Generation Systems
  Leader Tecsol
- **Activity A3** Storages
  Leader HEFR
- **Activity A4** System Integration
  Leader AIT
- **Activity A5** LCA and Techno-ECO Analysis
  Leader Uni Palermo

IEA SHC Task 53 Subtask A

What do we deliver ?

- D-A1: Definition of the existing cooling reference systems (A1)
- D-A2-1: **State of the art of new generation commercially available products** (costs, efficiency criteria ranking and performance figures)
- D-A2-2: Technical report on recent R&D work on the topic (A2)
- D-A3 : **Technical report on best practices for energy storage** ..
- D-A4-1: Report on **a new and universal classification method** "new generation solar cooling square view" for generic systems
- D-A4-2: State of the art on the **management of the interface solar cooling (e.g. AC unit / PV modules) and distribution system /gri**d
- D-A5-1: **Techno-economic analysis report on comparison between thermal and PV existing solar cooling systems** including as well LCA approach and Eco label sensibility

IEA SHC Task 53 Subtask A

Which systems do we have?

NG systems close to market **R&D Systems close to Market**

PV CH (Cooling/ Heating) on the Market

STDCH

- SolabCOOL (NL)

- **SUNCOOL**/Climatewell (SE)

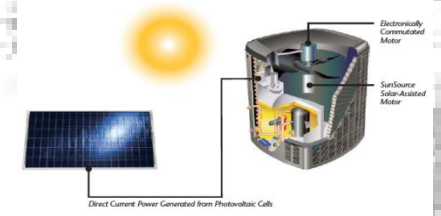
PV CH (Cooling/ Heating)

- BIG HEATING company (GER)
- Helioherm

STDCH

- FREESCOO (IT)
- Climatewell (SE)

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



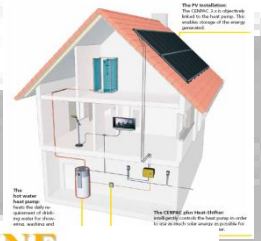
SUNSOURCE™
Solar by day. Electric by night. Savings all year.

LENNOX
Innovation never felt so good.™

HOTSPOT ENERGY

Sud Concept
ACCELERATEUR D'INNOVATION

CENTROSOLAR
CENPAC plus



SOLAR LINE

FREECOLD

tocal 222-S

CLIMATISATION SPLIT SOLAIRE DIRECTE

Panneaux solaires photovoltaïques

COSSECO

VIESSMANN
climate of innovation

Heizen und Kühlen mit Solarstrom –
Eigenstromnutzung mit Split-Wärmepumpe Vitocal 222-S

SOLAR AIR
COOLING HEATING

IEA SHC TASK53 | Solar Cooling Workshop
October 9th, 2014 | Löfbergs Lila AB, 652 16 Karlstad, Sweden

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(no claim for completeness)

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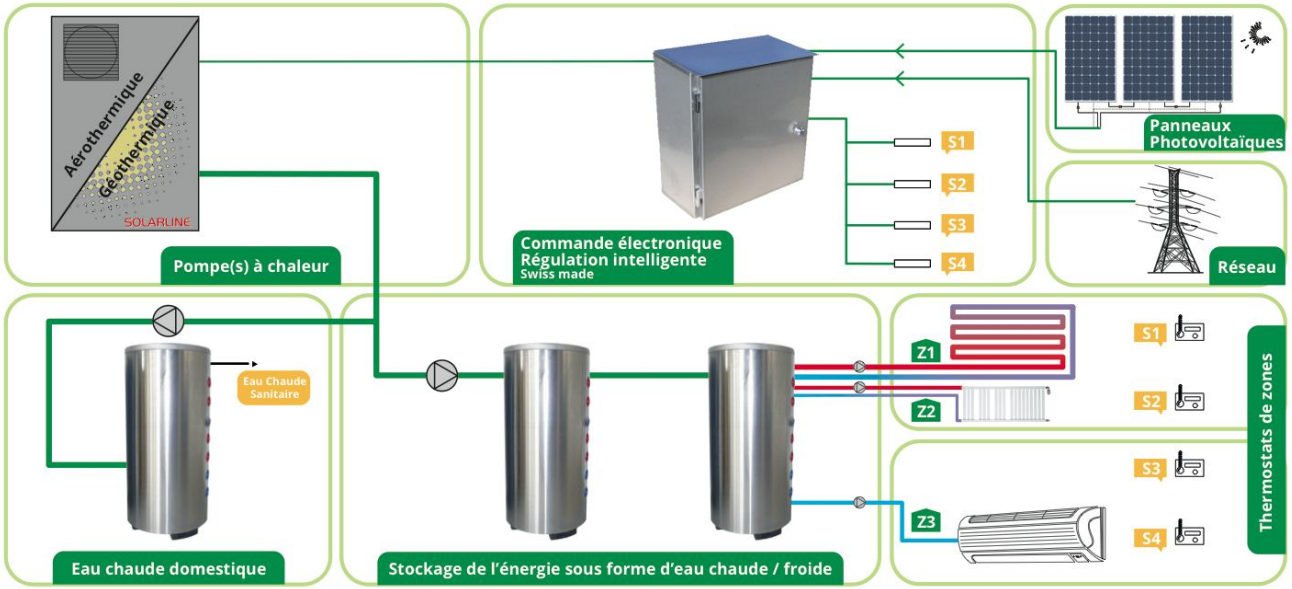
Typical **ALREADY** EU market available solution

Efficient Geothermal Heat Pump : COP of 5,3
Field test since 2011 in Switzerland



PV booster => **overall yearly COP of 6,9**

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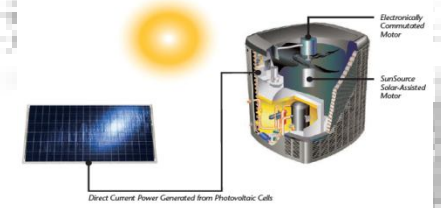
General State of the art



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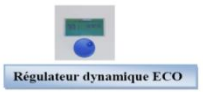

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climate of innovation

CLIMATISATION SPLIT SOLAIRE DIRECTE

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Main categories

Solar air conditioners : Splits

PV+ HP coupling for Office/Commercial

hotspot energy

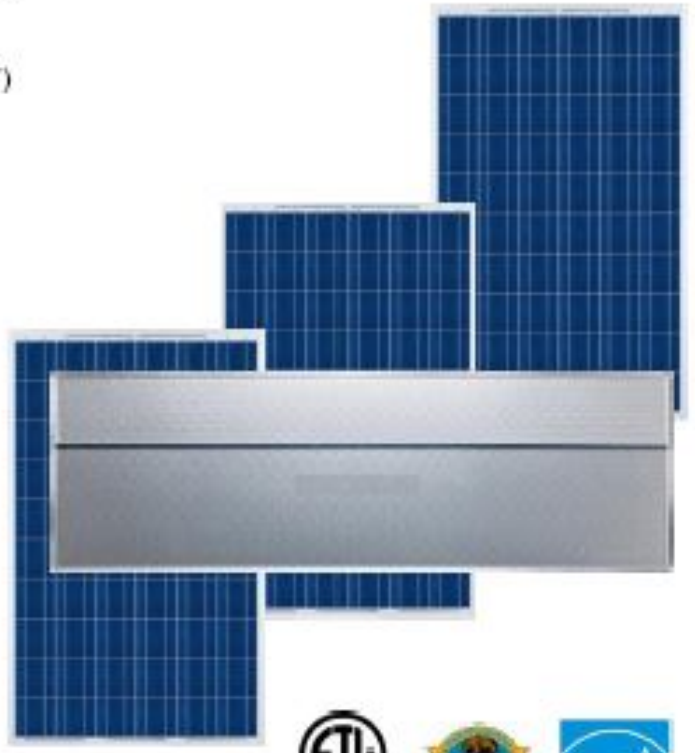
HotSpot Energy LLC
(757) 410-8640

Solar Air Conditioner

SEER 35 • Solar Hybrid Heat Pump

Model ACDC12

Connect Up To Three Panels (Max 840W)
Runs On Solar Power & AC Power
11,000 BTU Cooling/12,000 BTU Heat
Plug-And-Play Solar Connection
No Batteries Required



Home

Keep the inside cool all day for next to nothing in energy costs. Preventing daytime heat build-up also cuts evening cooling costs.

Office

Keep the work area comfortable during business hours for pennies per day. Cool or heat up to 750 Sq. Ft. (69m²).

International

Compatible with 50hz and 60hz power, use it anywhere in the world.

Intertek

Simple To Install

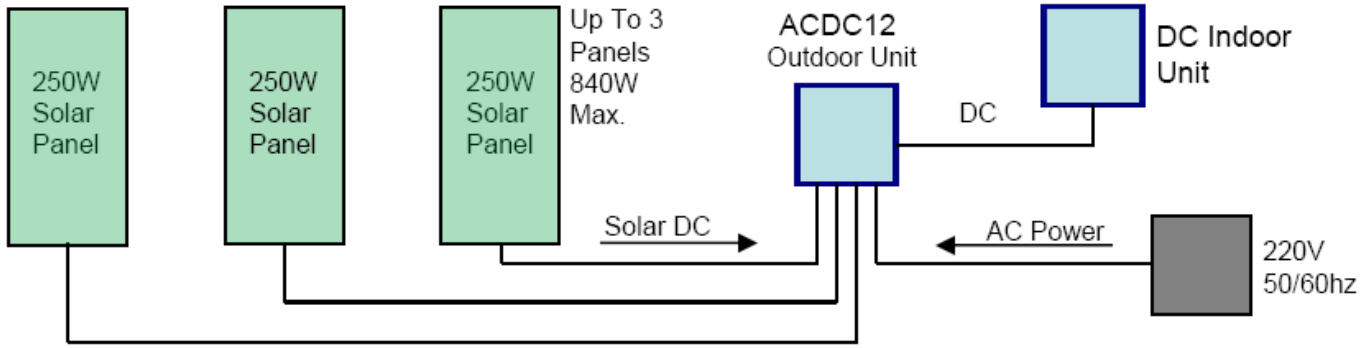
This unit installs exactly like a normal mini-split air conditioner. Standard MC4 solar connectors and cabling can be used to connect the solar panels directly to the AC unit.

Ultra-High SEER
Solar Air Conditioner

Your air conditioner needs the most power when the sun is shining, a coincidence you can take advantage of with our ACDC12 solar air conditioner. It can keep an indoor area cool during the day for pennies. Literally, pennies, operating above **SEER 35** with only two solar panels connected. Use this system to cool a small area or to augment a larger system.

The unit uses solar energy up to 720w, and adds in utility power, with no need for batteries. Even when the sun is not shining at all, this ultra high-efficiency (SEER >19 without solar) heat pump will keep you comfortable and save you money using far less electricity than a normal AC or heat pump unit of the same capacity.

Connects Directly To Solar Panels



ACDC12-Hybrid
Retail/List-$1695ea FOB Factory
Dealer Price: 4-49 units $1290ea FOB Factory
Distributor Price: 50+ units $891ea FOB China
***Unit includes 3m lineset**

DC4812VRF

Solar/DC Air Conditioner

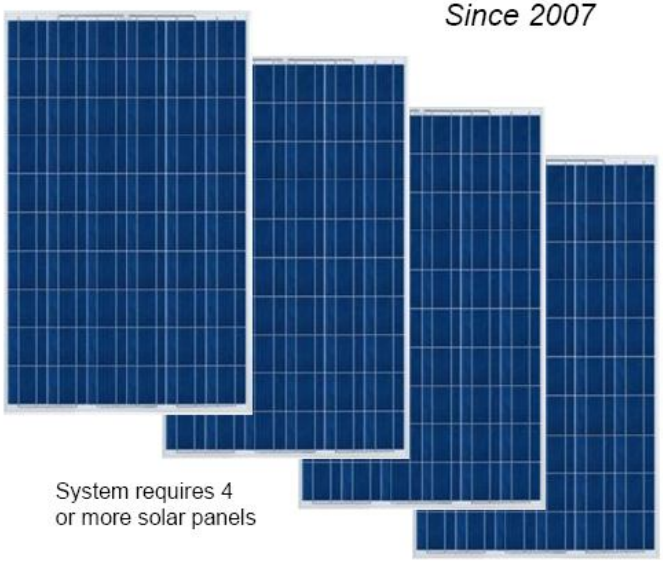
hotspot energy

Specialty HVAC Manufacturing Since 2007

12,000 BTU 48V DC Heat Pump
VRF Dynamic Capacity Compressor
100% DC - No Inverter

Wall Mount Indoor Unit (IDU)

The DC4812VRF is designed from the ground up to operate on DC power. There is no AC power used inside or needed externally to operate the unit. DC power is connected to the outdoor unit. The indoor unit receives DC power from the outdoor unit.



System requires 4 or more solar panels

- **48v Solar/Battery Power**
- **12,000 BTU Heat Pump**
- **Cool or Heat up to 700 ft^2**
- **Eligible For US Tax Credits**
- **Variable Capacity**
- **Anti-Corrosion Technology**
- **Eco-Friendly R410a Refrigerant**
- **Washable Filters**
- **Digital Wireless Remote**
- **Quiet Indoor Unit**
  (As Low As 26dB)

User Friendly Remote w/ sleep mode, timer, & follow-me (C or F)

Complete Kits

48v DC Air Conditioner
4, 6 or 8 x 250w PV Panels
PV Mounting Hardware
Charge Controller
Deep Cycle Batteries
Refrigerant Line-set
*Customer Supplied Wiring

Starting at $3995

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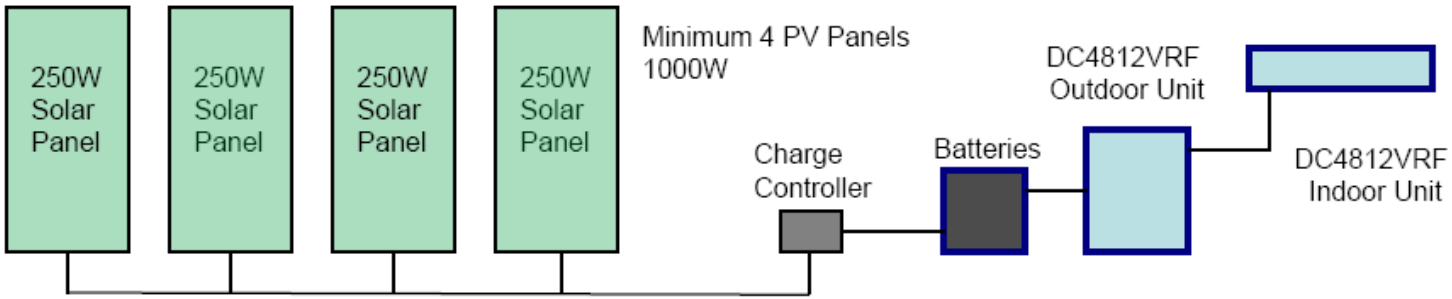
Powered By Batteries & Solar Panels



DC4812VRF-100% DC

Retail: $1795ea FOB Factory

Dealer Price: 4-49 units $1490ea FOB Factory

Distributor Price: 50+ units $1185ea FOB China

***NO LINESET**

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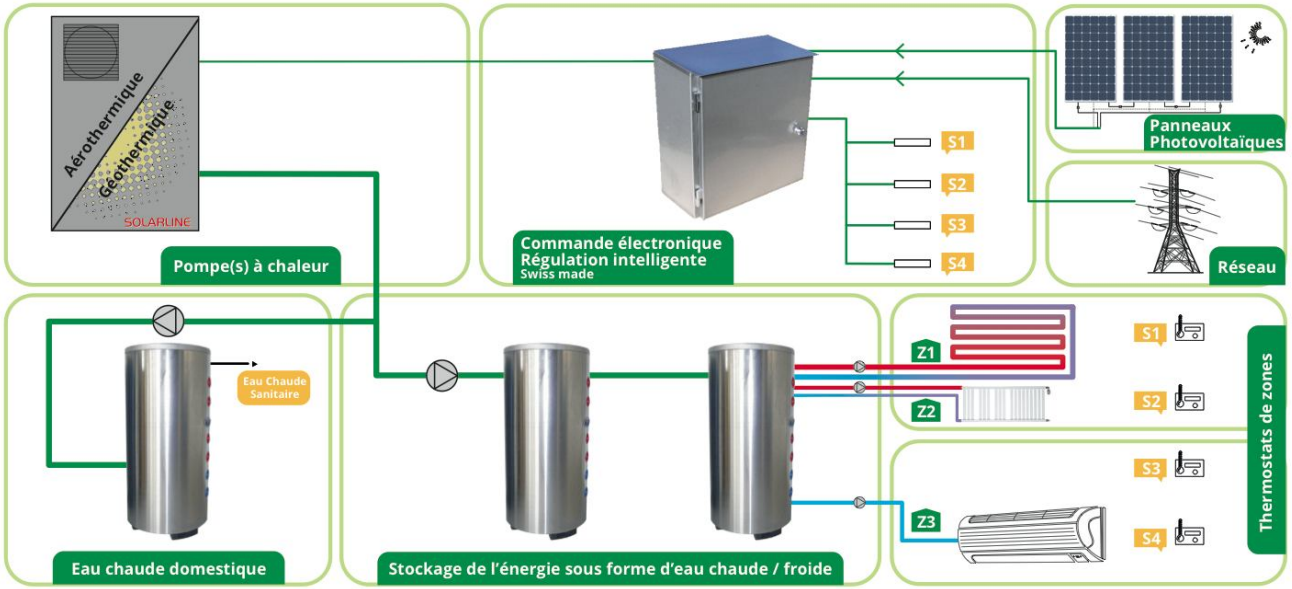
Typical **ALREADY** EU market available solution

Efficient Geothermal Heat Pump : COP of 5,3
Field test since 2011 in Switzerland



PV booster => **overall yearly COP of 6,9**

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New R&D discovered during EUROSUN

EuroSun 2014, International Conference on Solar Energy and Buildings.
September 16-19, 2014 . Aix-les-Bains, France

Solar PV-driven Air Conditioner

Bin-Juine Huang, Tse-Han Lin, Yan-Tze Chen, Po-Chien Hsu, Kang Li

New Energy Center, Department of Mechanical Engineering,
National Taiwan University, Taipei, Taiwan

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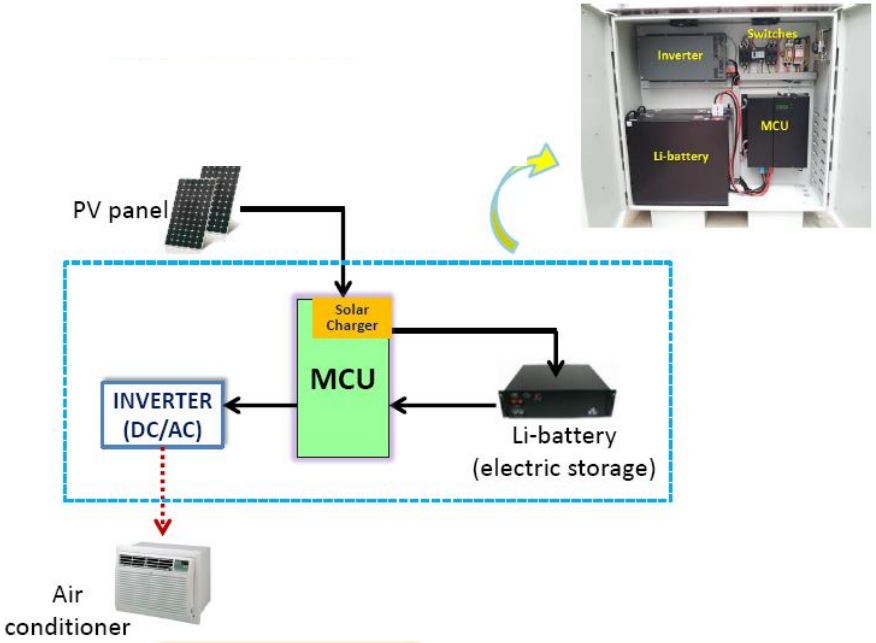
State of the art of the future new **Market**

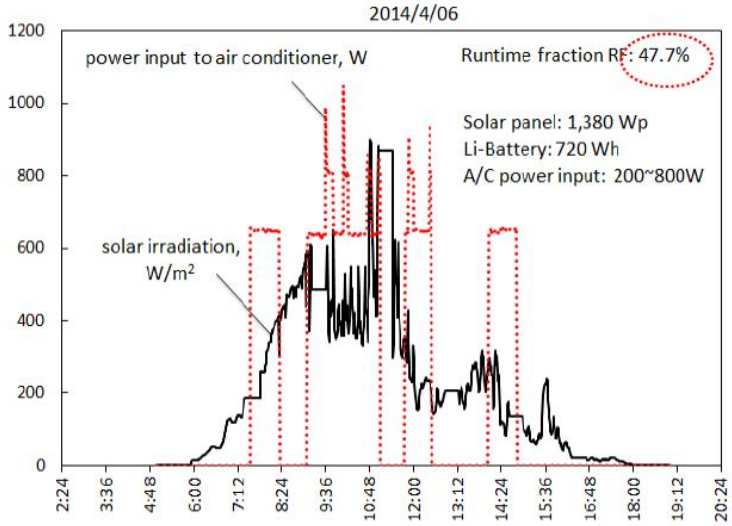
Ongoing R&D in Taïwan



Operation probability (*OPB*)

- 100% at solar irradiation >550W/m2 (full solar cooling)
- around 80% at solar irradiation 400W/m2 (partly solar cooling) at cloudy condition

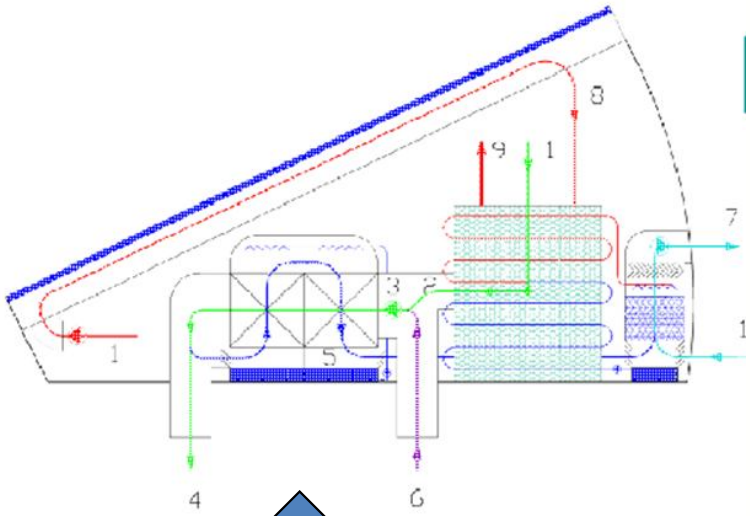
Battery use to run a AC on/off air conditioner



Source: EUROSUN conference, Prof Huang, National Taiwan University, Taipei, Taiwan

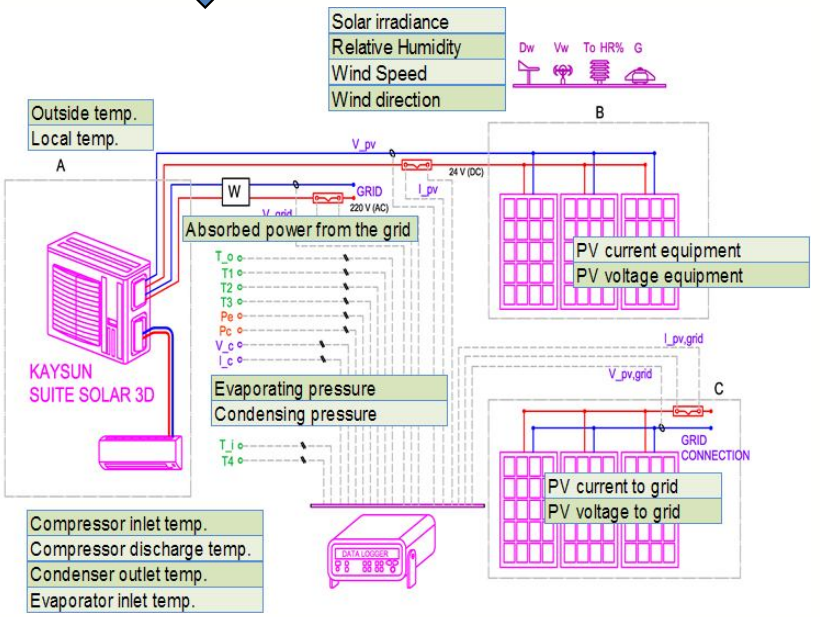
State of the art of the future new **Market**

Active R&D participants in Task 53



Concept for compact solar thermal air conditioner based on fixed & cooled adsorption beds (Source: Solarinvent)

Testing principle for a Chinese PV split unit (Source: Universidad Miguel Hernández de Elche)



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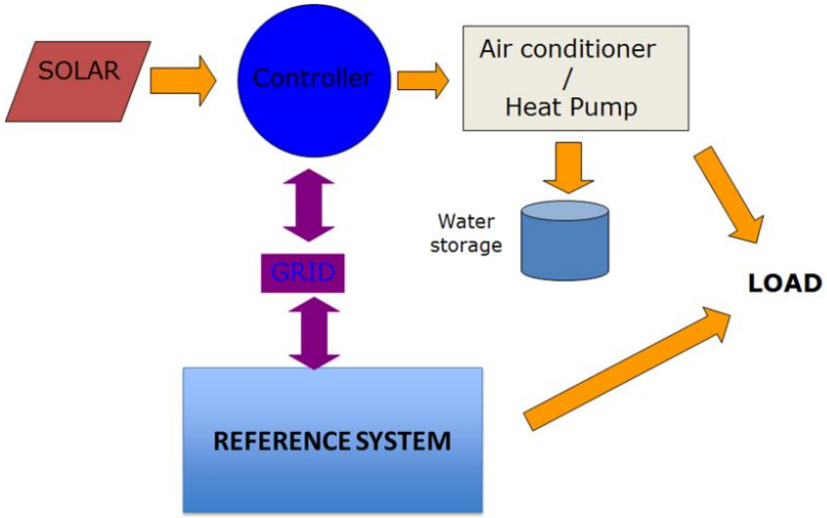


Source : Cosseco

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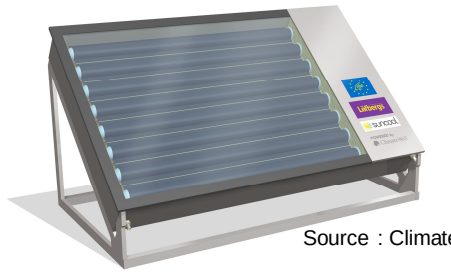
Thanks for your attention !

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


Source : Climatewell

Contact : Daniel Mugnier, TECSOL

daniel.mugnier@tecsol.fr

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