SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

SOLARCOOLING® SUNBELT REGIONS TASK65

Solar Cooling for the Sunbelt Regions

SHC Task 65

Task Status Report

92nd ExCo Meeting, Cape Town

Uli Jakob, JER / Green Chiller, Germany

Task Duration: 1 July 2020 – 30 June 2024

Significant Developments & Results
Since Last ExCo Meeting

- Fifth Expert Meeting, Sept. 29th, 2022 in Kassel, Germany
- **21 experts from 11 countries**
- Joint Subtask/activity online meeting held in November as well
- Work is progressing with minor changes of the time planning (some Deliverables are delayed)

Subtask A: Adaptation

Lead: Salvatore Vasta, CNR-ITAE, Italy

Progress & results since last ExCo meeting

A1 Climatic conditions & applications:

- **Geographic Information System (GIS) has been used to process climatic conditions and typical applications data such as**
  - Geographic areas between 40°N and 40°S latitude
  - Solar direct normal irradiance
  - Population density/Built-up areas/ Settlement levels (SMOD)
  - Climate zones (Köppen–Geiger climate classification system)
- **SunBeltChiller project Relevance and market potential estimation (draft)**
  (DNI > 1,500 kWh/m²a, SMOD 13…30, potentially suitable climate zones)

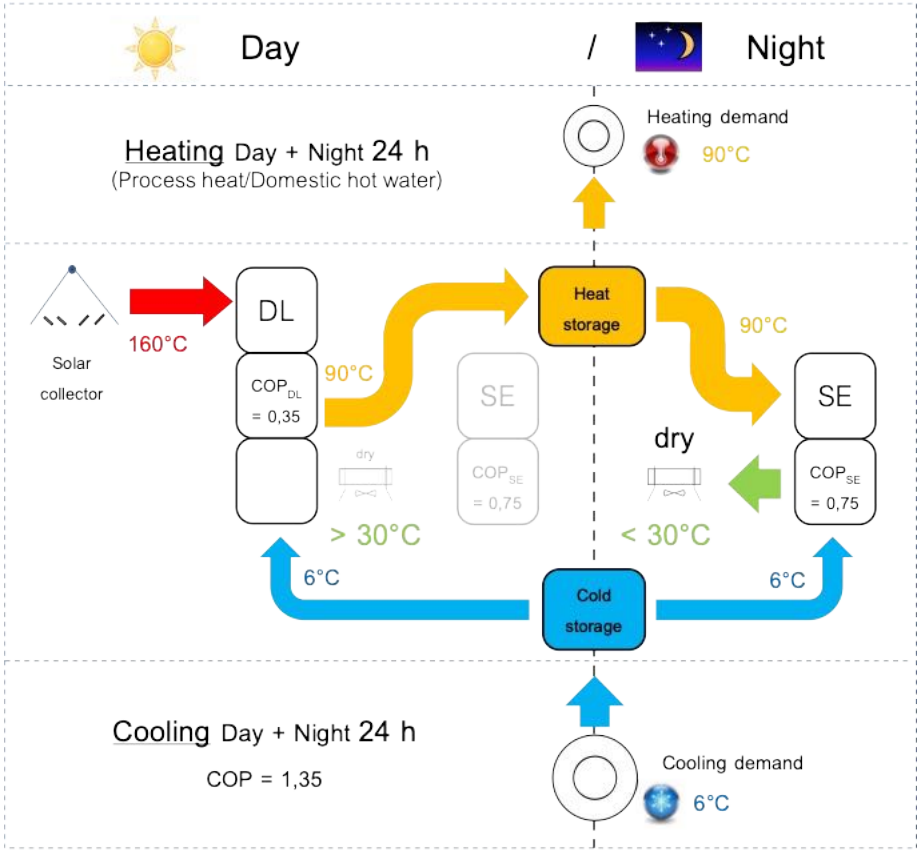
SunBeltChiller – The Project

- **Partners:** ZAE Bayern (R&D), Industrial Solar GmbH (commercialization)
- Funded by the German Federal Ministry for Economic Affairs and Climate Action (BMWK)
- Project duration: 2020 – 2025

1. Developing technical design tool
2. **Study about SunBeltChiller for the sunbelt region:**

   Where it can be used with what advantages ?
3. Building Demo-SunBeltChiller with a cooling capacity of ≈ 50 kW
4. Testing the Demo-SunBeltChiller at the ZAE Bayern in Garching
5. Demo-SunBeltChiller in a real solar thermal plant in the sunbelt region

SunBeltChiller – How it works



Source: ZAE Bayern

Day / Ambient temperature > 30° C:

- DL mode driven by heat from solar collector
- DL heat storage @ ≈ 90° C
- COP_{DL} ≈ 0.35
- Cooling demand supplied by DL and storage

Night / Ambient temperature < 30° C:

- SE mode driven by heat from storage
- SE recooling by **dry air cooler**
- Cooling demand supplied by SE
- Charging cold storage by SE
- COP_{SE} ≈ 0.75

Day + Night :

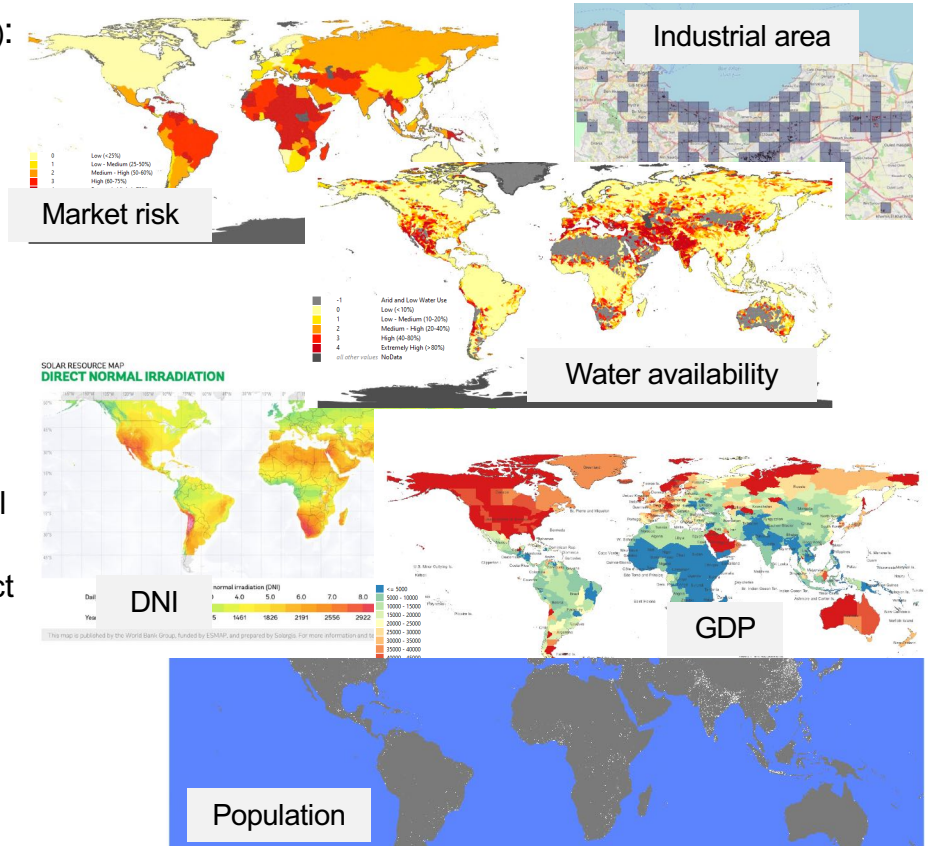
- Solar thermal cooling with dry air cooler
- $COP_{DL/SE}$ ≈ 1.35
- + covering heat demand @ ≈ 90° C

Use of a GIS to determine boundary conditions

Method (using Geographic Information System Software QGIS):

1. Collecting solar cooling specific geographic data from different sources
   - Climate zones (Köppen–Geiger climate classification system)
   - Various solar irradiances (DNI, GHI, DIF) and photovoltaic power potential (PVOUT)
   - Population density/Settlement levels
   - Industrial area
   - Water availability
   - Market risk (RRI) covered by Environmental Social Governance (ESG)
   - Purchasing Power Parity / Gross Domestic Product (GDP)

2. Adaptation of the data to a uniform grid structure



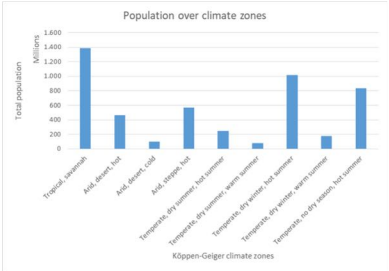
Source: ZAE Bayern

Use of a GIS to determine boundary conditions

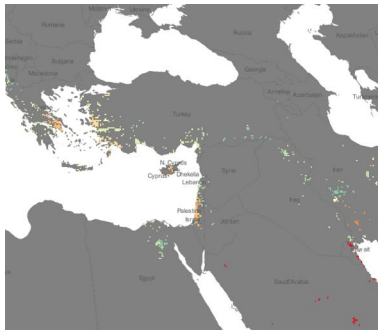
Method:

3. Defining data filter
4. Combining data based on data filter
5. Using population density and industrial area to identify potential cooling demand
6. Using Gross Domestic Product (GDP) to identify market potentials
7. Numerical und graphical presentation of the results

Data source	Filtered range	
Köppen-Geiger climate classes	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 …	Filter
Direct Normal Irradiance [kWh/m²/year] (Global Horizontal Irradiation (GHI), Photovoltaic power potential (PVOUT))	0 1000 1500 2000 2500 3000 …	
Industrial area per building [m²]	0 …	
Baseline Water Stress	-1 0 1 2 3 4	
Reputational Risk Index	0 1 2 3 4 5	
Gross Domestic Product (Map representation)	Results	
Industrial area over Gross Domestic Product (Statistics representation)		



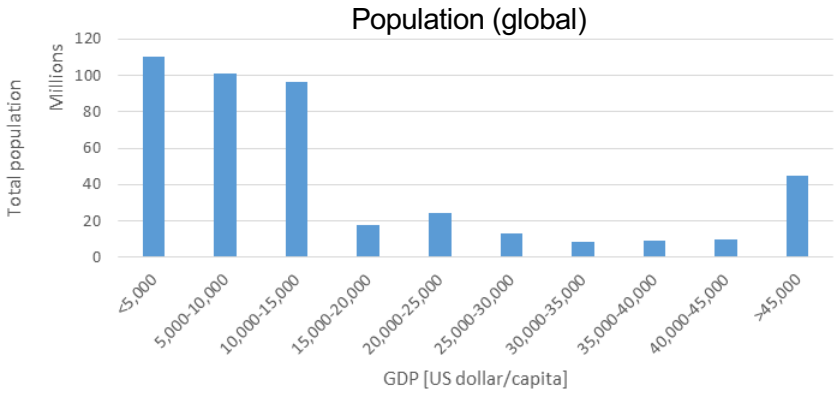
KG class description	Total population [million]	Relative Population
Tropical, savannah	1.385,2	28,5%
Arid, desert, hot	466,5	9,6%
Arid, desert, cold	96,5	2,0%
Arid, steppe, hot	567,3	11,7%
Temperate, dry summer, hot summer	244,9	5,0%
Temperate, dry summer, warm summer	80,6	1,7%
Temperate, dry winter, hot summer	1.013,9	20,8%
Temperate, dry winter, warm summer	176,4	3,6%
Temperate, no dry season, hot summer	836,5	17,2%
Total population	4.867,8	100,0%

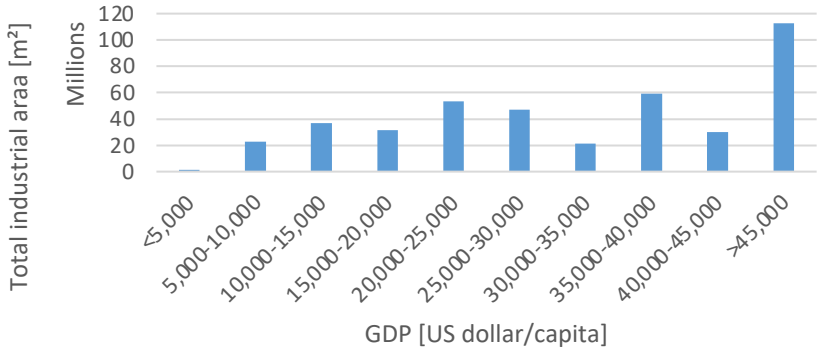


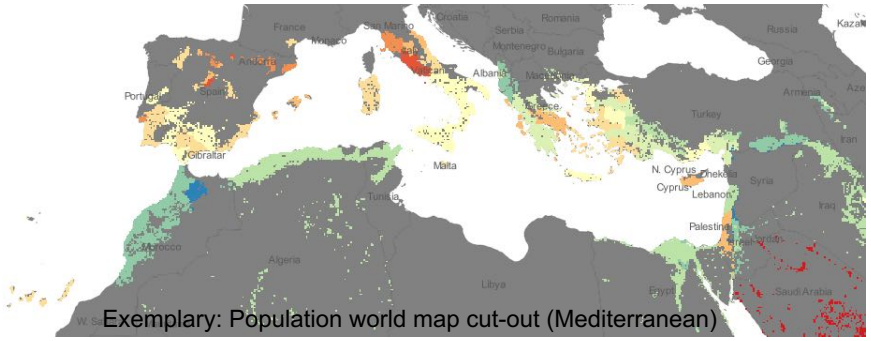
The method can be used to analyze general boundary conditions for cooling systems and to **analyze cooling system specific potentials by choosing/defining appropriate filter**

Source: ZAE Bayern

Results of the system specific potential analysis for the SunBeltChiller





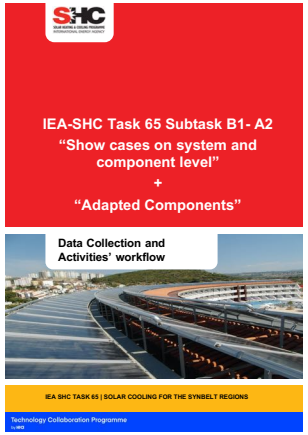


Exemplary: Population world map cut-out (Mediterranean)

Source: ZAE Bayern

Subtask B: Demonstration

Lead: Wolfgang Weiss, ergSol, USA

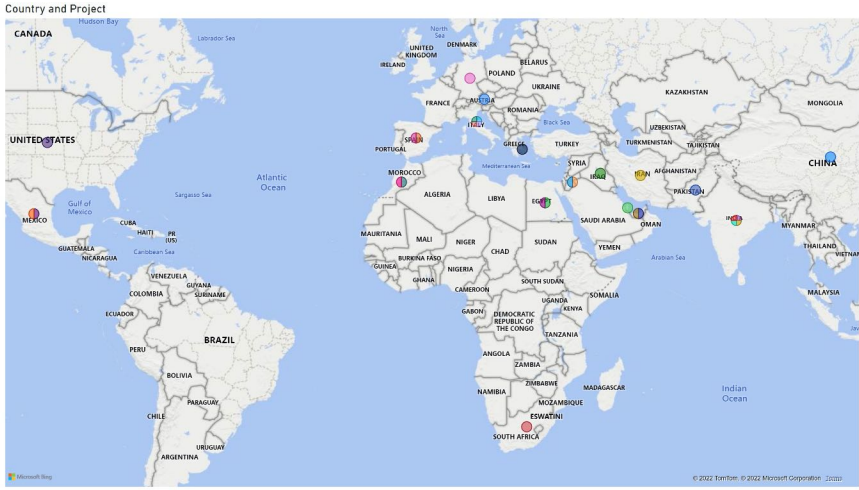


Progress & results since last ExCo meeting

B1/A2 Show cases on system and component level & Adapted components:

32 projects across 18 countries with **17.1 MW of cooling** are studied.

- Most of the projects reported are from BWh (**Hot desert**) (23%), and BSh (**Hot semi-arid**) & Csa (**Hot summer-Mediterranean**) (both 20%) **climate regions**.
- **30%** of cases studied **use evacuated tube**, flat plate (17%), Fresnel (17%), parabolic trough collectors (10%) and **PV panels (10%)**.
- Of the available ST cooling technologies, **71%** of them **use absorption chillers** whereas 19% use adsorption chillers and other technologies such as ejector cooling, PV assisted cooling (3% each).



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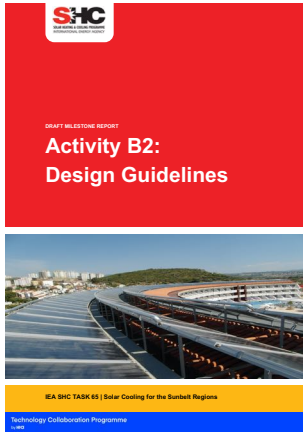
Subtask B: Demonstration

Lead: Wolfgang Weiss, ergSol, USA



Progress & results since last ExCo meeting

B2 Design Guidelines:

- **Collection of design and system integration guidelines** for the specific boundary conditions on solar cooling projects was performed. The key focus was put on:
  - Hybrid cooling system (Solar Thermal + HP + PV/PVT + Boiler, etc.)
  - Systems with high solar fractions
  - Standard modular packages for solar cooling solutions
- The **scope was expanded** to include not only case studies, but also innovations in the **simulation/preliminary design stage** and additional cases of identified solar cooling projects outside the Task

Outreach and Response

- FAHRENHEIT: SUNHORIZON ✓
- Solarinvert: Catania, Italy – 2.5 kW ✓
- Solarwall : Chiloeches, Spain ✓
- Sole: Athens, Greece ✓
- FRIENDSHIP: ✓
- ASTEP: ✓
- SHIP2FAIR: Winery ,Spain ✓
- Pink: ✓
- SolCoolDry: Food Production, Kenya ✓

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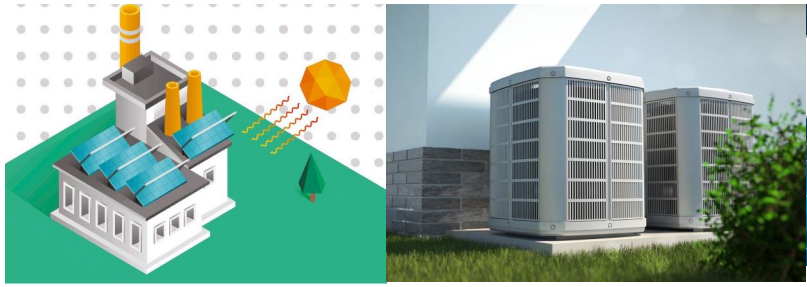
Subtask B: Demonstration

Lead: Wolfgang Weiss, ergSol, USA

Progress & results since last ExCo meeting

B4 Standardisation / Solar cooling kits:

- **Collection of standardization and solar cooling kits in all capacity ranges and different technologies. Research has been started on the following topics of KPIs.**
  - Background on **renewable energy standards**
  - Specific standards for solar cooling
  - Technologies covered by **Australian Standards include solar desiccant cooling** systems, solar air space heating systems, solar water space heating systems, building ventilation systems, evaporative cooling systems.
- **Pre-standard (CWA) "Experimental characterization of the hybrid heat pump module"**, publication expected end of 2022 (HyCool EU H2020 project)



CEN WORKSHOP AGREEMENT (CWA)
Characterization of a hybrid heat pump module

Kick-off Meeting
2022/04/29

Subtask C: Assessment and tools

Lead: Daniel Neyer, Neyer Brainworks, Austria

Progress & results since last ExCo meeting

C3/B3 Assessment mechanism / Key Performance Indicators:

- **Review of existing tools and methods** for technical (SPF, PER, fsav, etc.) and economic (LCC/CAPEX/OPEX, LCOH/LCOE, LCCBA etc.) hast started to provide the bases to select the necessary KPIs for different project phases and stakeholders.
- **Adaptation of method and KPIs** was collected in various expert meetings, workshops and bilateral meetings/interviews. The structure and first findings will be presented in a draft milestone report in December 2022.
- **Activity C3 will be merged with Activity B3**.

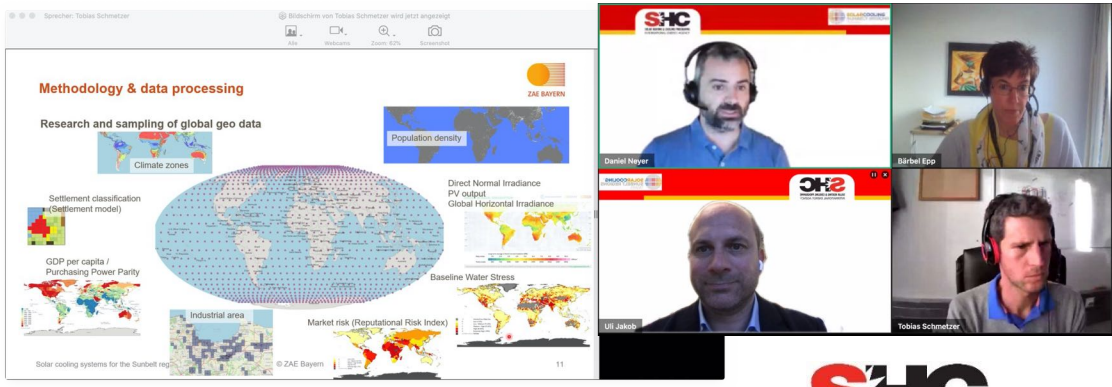
Subtask D: Dissemination

Lead: Paul Kohlenbach, Berlin Hochschule für Technik, DE

Progress & results since last ExCo meeting

D2 policy advise & financing models & D5 workshops:

- **COOLING-DOWN EU LIFE project:** roadmap to unlock the potential of renewable cooling for a decarbonised cooling sector
- **Collecting and compiling information on business models** and benefits of solar cooling applications has started. The next step will be the **development of new financing schemes** suitable for solar cooling considering the LCOE/LCC results of Subtask C.
- **ISES SHC Solar Academy Webinar Task 65,** (online) with 155 part. (25.10.2022) and 42 part. (27.10.2022)



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Subtask D: Dissemination

Lead: Paul Kohlenbach, Berlin Hochschule für Technik, DE

https://en.wikipedia.org/wiki/Solar_air_conditioning

Solar air conditioning

From Wikipedia, the free encyclopedia
(Redirected from Solar cooling)

Solar air conditioning refers to any air conditioning (cooling) system that uses solar power.

This can be done through passive solar, solar thermal energy conversion and photovoltaic conversion (sunlight to elec
2012 funding for a new solar air conditioning research and development program, which should develop and demonst

Contents [hide]

Missing information:

1. Solid sorption air conditioning systems
2. Any reference to SHC Task 65
3. Issue for operation in SUNBELT Regions

Participating Countries / Sponsors

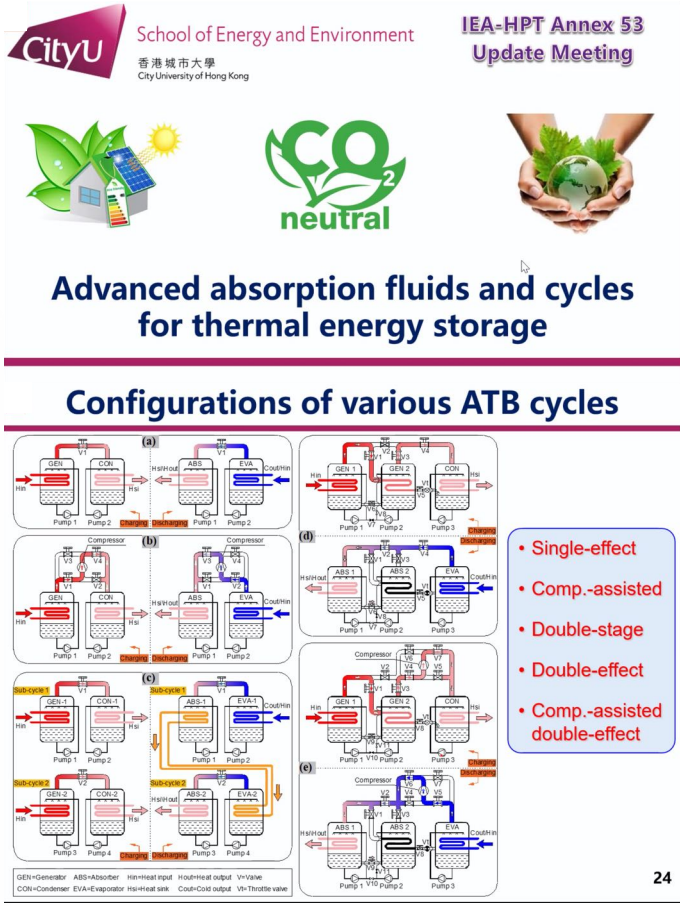
Country / Sponsors	National Participation Letter (Y/N)	Number of Research Institutes	Number of Universities	Number of Companies
Australia	Y	1		
Austria	Y		2	7
China	Y		4	
Denmark	Y			1
France	Y	1	1	
Germany	Y	3		6
Italy	Y	1	2	1
Slovakia	Y		1	
South Africa				
Spain	Y		2	1
Sweden	Y			1
Switzerland	Y			1
The Netherlands	Y			1
Turkey				
UK	Y		1	1
USA (Limited Sponsor)	Y			1
CCREEE (Caribbean)				
EACREEE (East African)	Y		1	
ECREEE (West African)				
EC (MI IC7)				
RCREEE (Arab region)	Y		1	1
SACREEE (Southern African)	Y		2	
Total	**17**	**6**	**18**	**23**

82 experts

Other **NPLs are still in progress** or have been requested from SACREEE (Botswana, Lesotho), ECREEE (Nigeria) and South Africa

Collaboration with other SHC Tasks, IEA TCPs, outside organizations/institutions

- **Mission Innovation, IC7**
- **IEA HPT Annex 53 on Advanced Cooling/ Refrigeration Technologies Development**
- **IEA SHC Task 64 on Solar Process Heat**



Issues for the ExCo

- **Participating ExCo members**
  - Please sign NPLs and help the experts with funding if possible
  - Expert from Canada may join

- **Full ExCo**
  - None

Task Meetings

Meeting #	Date	Location	Number of participants & countries/sponsors
1	28.-29.10.2020	Virtual meeting	50 participants 16 countries + 1 Sponsor
2	24.-25.03.2021	Virtual meeting + Industry Workshop	35-45 participants 19 countries + 1 Sponsor
3	10.11.2021	Virtual meeting	30 participants 10 countries + 1 Sponsor
4	23.03.2022	Virtual meeting	25 participants registered 8 countries + 1 Sponsor
5	29.09.2022	Uni Kassel, Germany	21 participants 11 countries + 1 Sponsor
6	23.-24.03.2023	Uni Innsbruck, Austria + Industry Workshop	
7			
8			

Follow up Task

1. **Preparation of task concept paper** until next ExCo meeting (June 2023)

2. **Potential topics / focus**:
   a) Solar Cooling for Africa or
   b) Solar Industrial Cooling or
   c) Solar District Cooling
   d) other

Mentimeter:

https://www.menti.com

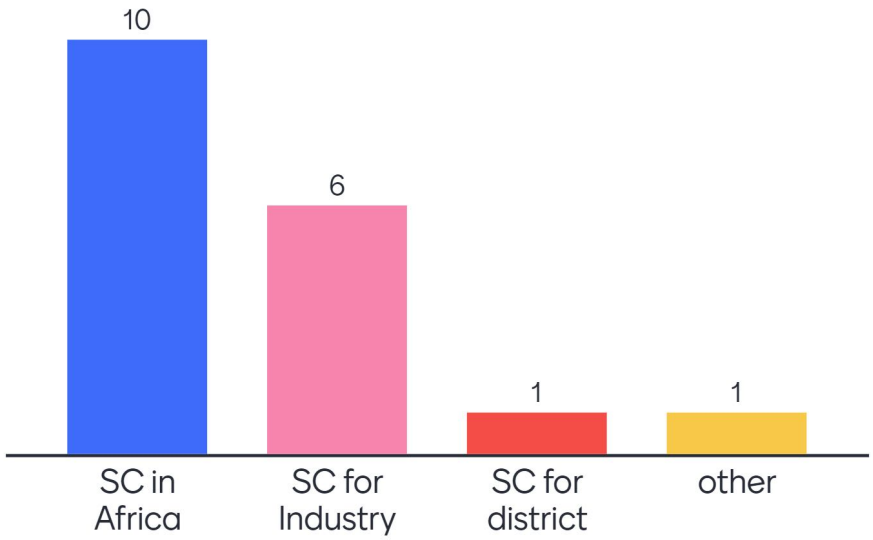
Code: 3598 2200

Follow up Task – Mentimeter results

Go to **www.menti.com** and use the code **3598 2200**

Mentimeter

Topic for a Task 65 follow up



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- Other: Latin America

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