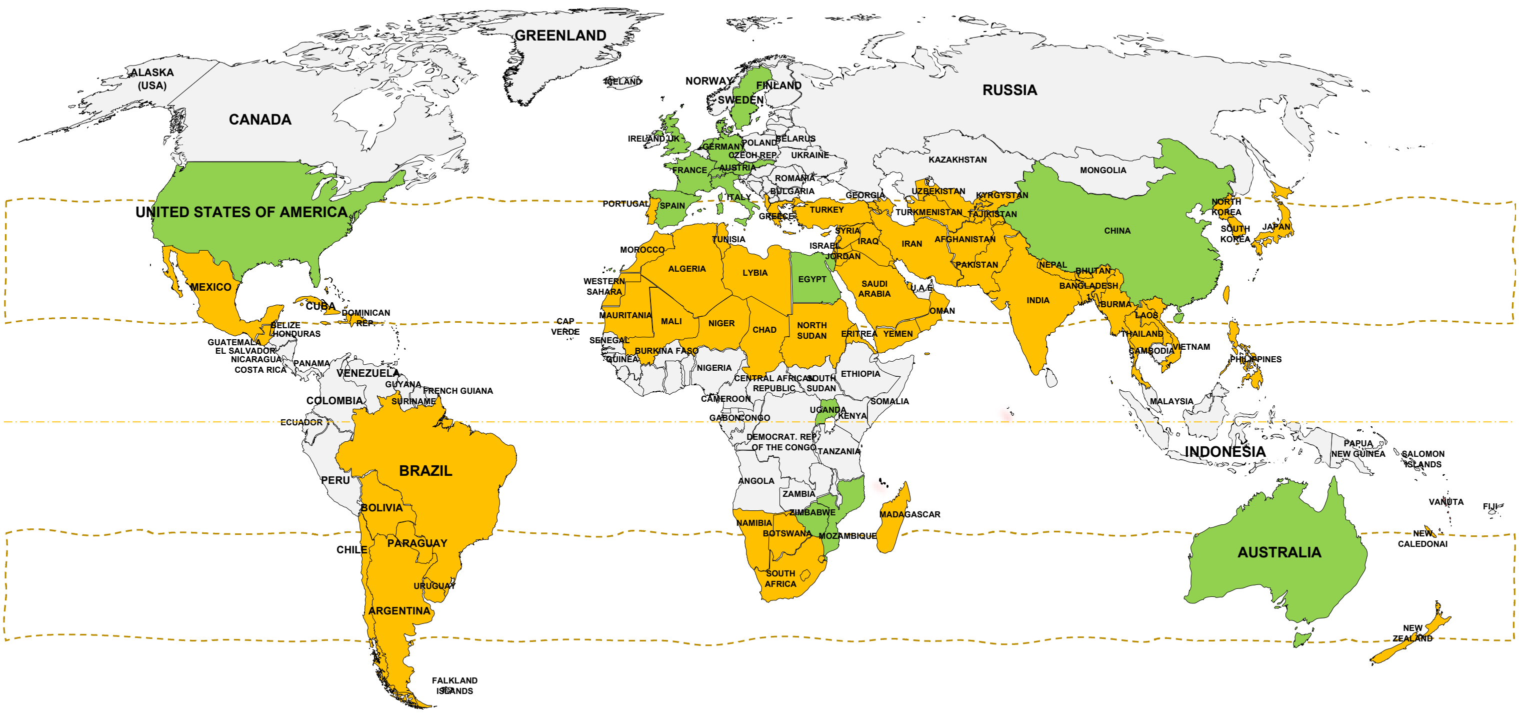
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Show Cases on System and Component Level & Adapted Components



IEA SHC TASK 65 | SOLAR COOLING FOR THE SUNBELT REGIONS

Technology Collaboration Programme
by iea

SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Show Cases on System and Component Level & Adapted Components

This is a report from SHC Task 65: Solar Cooling for the Sunbelt Regions and work performed in Subtask A: Adaptation & B: Demonstration

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Cover photo credit: World map with Sunbelt regions (marked yellow) and the 18 countries of the participating Task 65 experts (marked green), source: Neyer Brainworks & JER

Solar Heating & Cooling Technology Collaboration Programme (IEA SHC)

The Solar Heating and Cooling Technology Collaboration Programme was founded in 1977 as one of the first multilateral technology initiatives ("Implementing Agreements") of the International Energy Agency.

Our mission is *"Through multi-disciplinary international collaborative research and knowledge exchange, as well as market and policy recommendations, the IEA SHC will work to increase the deployment rate of solar heating and cooling systems by breaking down the technical and non-technical barriers."*

IEA SHC members carry out cooperative research, development, demonstrations, and exchanges of information through Tasks (projects) on solar heating and cooling components and systems and their application to advance the deployment and research and development activities in the field of solar heating and cooling.

Our focus areas, with the associated Tasks in parenthesis, include:

- Solar Space Heating and Water Heating (Tasks 14, 19, 26, 44, 54, 69)
- Solar Cooling (Tasks 25, 38, 48, 53, 65)
- Solar Heat for Industrial and Agricultural Processes (Tasks 29, 33, 49, 62, 64, 72)
- Solar District Heating (Tasks 7, 45, 55, 68)
- Solar Buildings/Architecture/Urban Planning (Tasks 8, 11, 12, 13, 20, 22, 23, 28, 37, 40, 41, 47, 51, 52, 56, 59, 63, 66)
- Solar Thermal & PV (Tasks 16, 35, 60)
- Daylighting/Lighting (Tasks 21, 31, 50, 61, 70)
- Materials/Components for Solar Heating and Cooling (Tasks 2, 3, 6, 10, 18, 27, 39)
- Standards, Certification, and Test Methods (Tasks 14, 24, 34, 43, 57)
- Resource Assessment (Tasks 1, 4, 5, 9, 17, 36, 46, 71)
- Storage of Solar Heat (Tasks 7, 32, 42, 58, 67)

In addition to our Task work, other activities of the IEA SHC include our:

- SHC Solar Academy
- *Solar Heat Worldwide*, annual statistics report
- SHC International Conference

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1 Executive Summary

This document is the final report for joint activities A2, “Adapted components”, and B1, “Show cases on system and component level” of the IEA SHC Task 65, “Solar Cooling for the Sunbelt Regions. The first part of the report presents results from 32 investigated projects across 18 countries representing a range of 10 weather profiles such as the tropical wet and dry (Aw), hot desert (BWh), hot semi-arid (BSh), hot summer-Mediterranean (Csa), warm-summer Mediterranean (Csb), humid subtropic (Cfa), monsoon-influenced humid subtropical (Cwa), hot summer humid continental climate zones. The 32 projects studied are over 17.06 MW of thermal cooling projects. The essential findings are:

- Solar Thermal (ST) cooling is by far the most applied solar cooling technology over solar electric cooling. Of the cases studies, 30% of cases studied use ETCs, Flat plate collectors (17%), Fresnel collectors (17%), Parabolic trough collectors (10%), and PV panels (10%). These are some of the most preferred options.
- Of the available ST cooling techniques, 71% of them use solar absorption whereas, 19% use solar adsorption cooling and other technologies such as ejector cooling and PV assisted cooling (3% each)
- The major application was in public buildings (34%), with an average working span of 8 hours/day, while some others were utilized in the domestic building (25%), process industry (9%), and food processing sector, among others.

This comprehensive analysis underscores the effectiveness and versatility of solar thermal cooling technologies across diverse climatic conditions, paving the way for their broader adoption in various sectors and contributing to sustainable energy solutions in sunbelt regions worldwide.

2 Introduction

The work in this report contains the public outcomes from Task 65 Subtasks B and A, particularly Activity B1 and A2. Figure 1 below briefly illustrates the flow diagram of the tasks involved in the activities carried out.

As shown in Figure 1, some of the sub-activities of A2 and B1 (e.g. data collection and processing) partially overlap. Thus, it was decided to combine the activities and report the results in this document.

The processing of the data followed the data collection activity. The possibility of using and adapting the outcomes of IEA SHC Task 38 concerning the "monitoring procedure" was checked, which allowed for processing of data in a common format. The last step is related to the calculation of the Key Performance Indicators (KPIs), that will be treated in the PART II of this report (confidential).

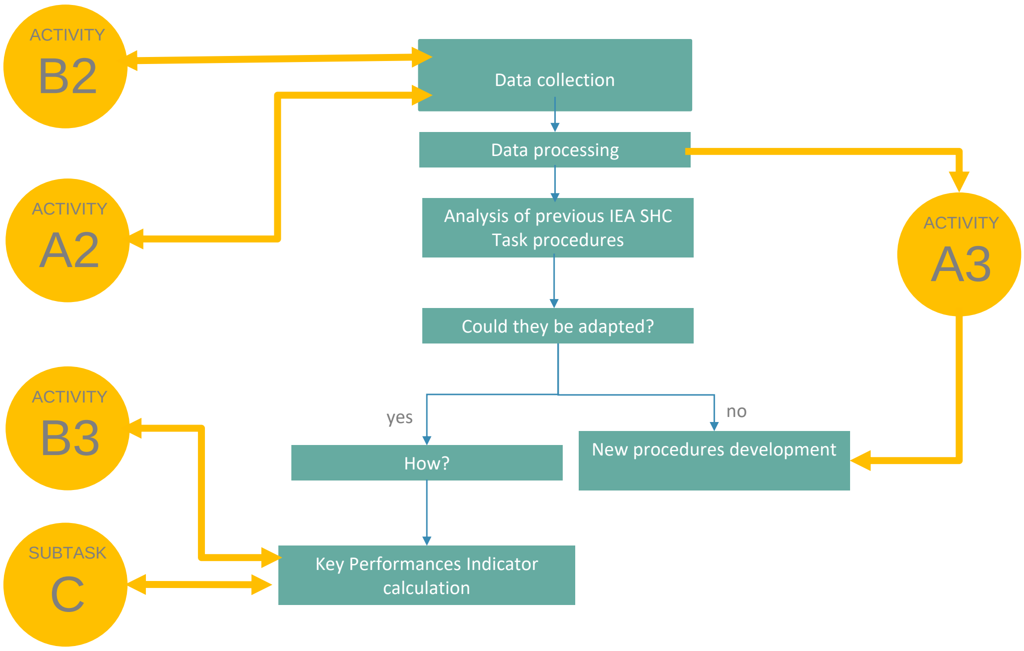


Figure 1: Workflow scheme – relation with other subtasks is highlighted (IEA SHC Task 65).

3 Scope of Activity A2

Different climates found in the Sunbelt are characterized by specific boundary climatic conditions to be considered during the design process (e.g., temperature, humidity, presence of dust, availability of tap water, etc.). The selection and effectiveness of all components, as well as the performance of the solar cooling systems are strongly influenced by the combination of operating conditions such as solar irradiation, ambient temperature, relative humidity, wind, and other parameters. Once the conditions are documented through reliable data, the components and systems can be selected from a specific regional market and/or adequately adapted. If a component/system cannot operate under certain boundaries, the operation limits must be documented:

A well-documented summary of available components forms the basis for promoting solar cooling and demonstrating the current state of the art. With that in mind, , Activity A2 aims to document existing components, providing an up-to-date overview of all necessary apparatuses for the solar cooling systems, from the transformation to useful energy:

1. Collectors: Photovoltaic, Thermal, PVT, etc.
2. Storage units: cold, hot side, etc.
3. Chillers: vapor compression, ab/adsorption, hybrid, DEC, etc.
4. Heat rejection systems: dry coolers, hybrid, wet towers, etc.

Combining the existing components with the climatic boundary conditions and typical applications results in the necessary adaptation from a technical point of view. The data will be collected, taking into account the involved countries (Figure 2 and Table 1) and the Köppen climate classification.

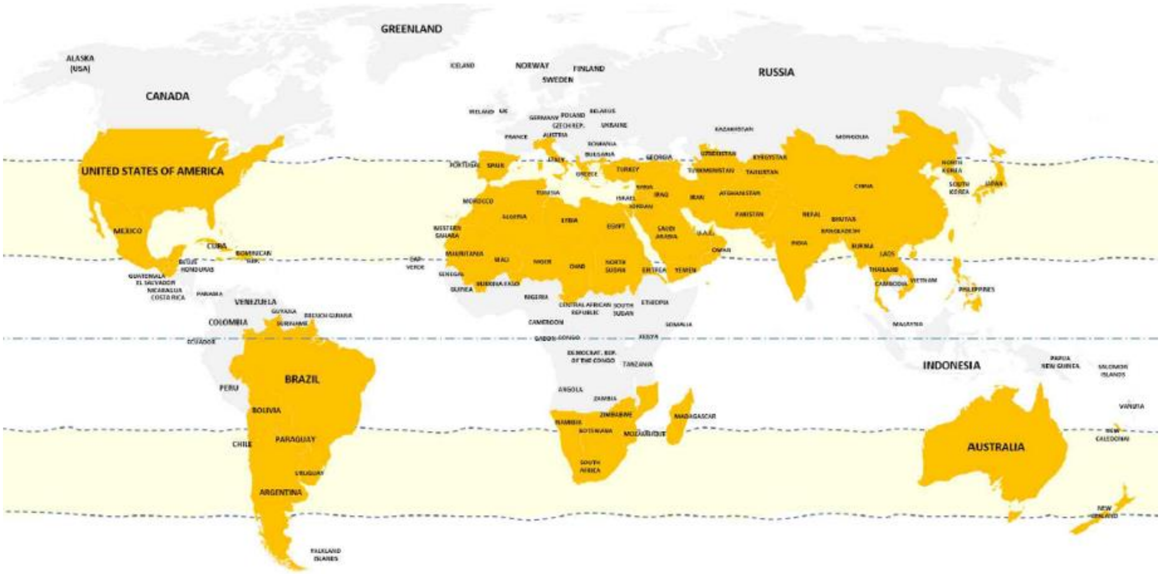


Figure 2: Countries involved in the data collection for the showcases and adapted components (Neyer, D. and Jakob, U., 2020).

Table 1: Countries involved in the data collection for the showcases and adapted components (Neyer, D. and Jakob, U., 2020).

Afghanistan	Dominican Republic	Madagascar	Saudi Arabia
Albania	Egypt	Mali	South Africa South Korea
Algeria	Eritrea	Malta	Spain
Argentina	Greece	Mauritania	Swaziland
Armenia	Guatemala	Mexico	Syria
Australia	Haiti	Morocco	Taiwan
Azerbaijan	India	Mozambique	Tajikistan
Bahrain	Iran	Namibia	Thailand
Bangladesh	Iraq	Nepal	The Bahamas
Belize	Israel	New Caledonia	Tunisia
Belize	Italy	New Zealand	Turkey
Bolivia	Jamaica	Niger	Turkmenistan
Botswana	Japan	North Korea	United Arab Emirates
Brazil	Jordan	North Sudan	United States of America
Bhutan	Jordan, West	Oman	Uruguay
Burma	Kuwait	Pakistan	Uzbekistan
Chad	Kyrgyzstan	Paraguay	Vanuatu
Chile	Laos	Philippines	Vietnam
China	Lebanon	Portugal	Western Sahara
Cuba	Lesotho	Puerto Rico	Yemen
Cyprus	Libya	Qatar	Zimbabwe

Such a climate classification divides climates into five main climate groups, with each group being further divided based on seasonal precipitation and temperature patterns. The five main groups are A (tropical), B (dry), C (temperate), D (continental), and E (polar). Each group and subgroup is represented by a letter. All climates are assigned a main group (the first letter). All climates except those in the E group are given a seasonal precipitation subgroup (the second letter). For example, Af indicates a tropical rainforest climate. The system assigns a temperature subgroup for all groups other than the A group, indicated by the third letter for climates in B, C, and D and the second letter for climates in E. For example, Cfb indicates an oceanic climate with warm summers, as indicated by the ending b. Climates are classified based on specific criteria unique to each climate type (Figure 3). As shown, all the involved countries lie within the A, B, C, and D main groups. This approach will provide an appropriate qualitative classification of systems and components accordingly. However, the economic potential through simplification during adaption will also be investigated in the second stage of the activity.

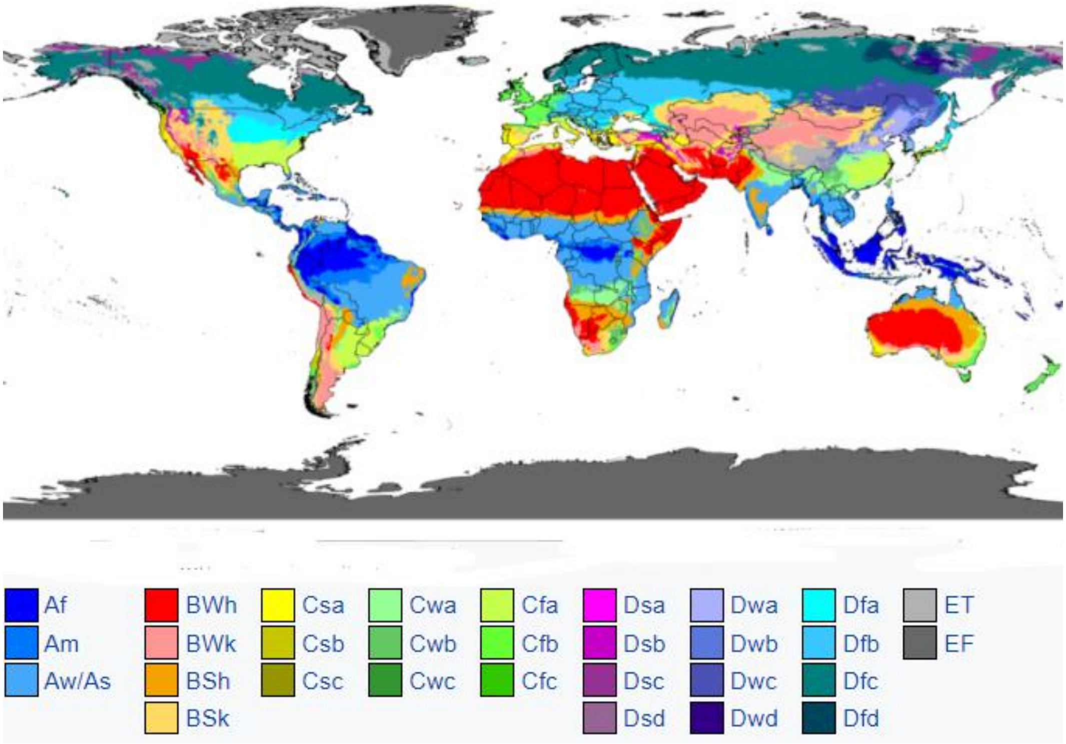


Figure 3: Updated Köppen–Geiger climate map used for the classification of the data collected (Beck et al., 2018)***.***

4 Scope of Activity B1

Activity B1 includes the presentation of the cases on systems and components. It is divided into three subtasks. During Activity B1.1, the identification of applications and the use of the existing projects and products are carried out. Indeed, the implementation of solar cooling systems across Sunbelt countries is a key activity in this Task. The collection of system designs and evaluated monitoring data of existing and new demonstration plants forms the basis for the calculation of technical and economic KPIs (Activity B3, Subtask C). Moreover, through existing projects, new MI IC7 activities, as well theoretical investigations through simulations, showcases on existing and potential applications at the system and component levels will be elaborated. Meanwhile, the proven components for the local environment will be defined.

Regarding Activity B1.2, the comparison of the designed and effective performance is used to evaluate and improve the performance of the solar cooling plants. Lessons learned can be derived from the deviation of design and field performances as well as general design rules. Finally, Activity B1.3 concerns the identification of social aspects (acceptance) to accelerate implementation and, in particular, the development of a dissemination plan and strategy (to be integrated into Subtask D) to communicate with various industries, communities of building owners and operators, local authorities and others who could serve as multipliers.

The results and analysis on show cases on system and component level is available on request as internal report of Task 65.

5 Data Collection

Data collection was conducted in two stages for the study, with responses from various stakeholders documented. To enhance the effectiveness of the data collection campaign for the various systems and adapted components, an exploratory questionnaire was distributed, either in the .docx version or electronically using the Google Form tool (Table 2).

The survey questionnaire covered the following topics:

1. Background

i) Typology of case
ii) Country & location
iii) Application sector

2. Technology

iv) Thermal Driven Chiller (Capacity)
v) Solar Thermal Collectors (Gross Area)
vi) Solar PV Panels (if any) (Gross Area)
vii) Heat storage/heat backup
viii) Cold storage/cold backup
ix) Heat Rejection System

3. Profile of the energy needs

x) Availability of space for the installation of renewable/ energy efficient technologies
xi) Availability of data/monitoring system
xii) Time period of availability of data/monitoring system
xiii) Plant scheme

4. Qualitative information: actual performance

xiv) Manufacturer/Model of Thermal chiller
xv) Actual and Design sizing
xvi) Manufacturer/Model of Solar Thermal Collector
xvii) Actual and Design sizing
xviii) Manufacturer/Model of PV Panels
xix) Actual and Design sizing
xx) Manufacturer/Model of Heat storage/heat backup
xxi) Actual and Design sizing
xxii) Manufacturer/Model of Cold storage/cold backup
xxiii) Actual and Design sizing
xxiv) Manufacturer/Model of Heat Rejection System

Table 2: Summary table of received information.

NAME	RESPONSIBLE	COUNTRY	STATUS/ TYPE OF CASE	TECHNOLOGY OF TDC	SURVEY TOOL	
freescoo at ENEA Research Centre in Lampedusa	SolarInvent	Lampedusa Island - ITALY	Implemented case	DEC solid	Google Form	Flat plate
freescoo at the public media library in Pantelleria	SolarInvent	ITALY, Pantelleria island	Implemented case	DEC solid	Google Form	Flat plate

Solar thermal cooling in the sunbelt region	Simulation	Sunbelt region	Detailed project	Absorption	Google Form	Fresnel
Honeywell Technology Solutions Lab Pvt. Ltd.	Thermax Pvt. Ltd., India	Hyderabad, India	Detailed project	Absorption 100 TR (350 kW)	Doc	Parabolic Trough
Mahindra Vehicle Manufacturers Ltd.	Thermax Pvt. Ltd., India	Pune, India	Detailed project	Absorption 90 TR (315 kW)	Doc	Parabolic dish
National Institute of Solar Energy	Thermax Pvt. Ltd., India	Gurugram, India	Implemented case Detailed project	Absorption 30 TR (100 kW)	Doc	Parabolic Trough
Ice slurry cold thermal energy storage	ILK Dresden	Zossen, Germany	Implemented case Detailed project	(compression chiller)	Doc	PV
Small Scale Thermal Solar District Units for the Madrilenian Communities	Elswedy Company	Egypt -Elsharkia-Belbies	Implemented case	Absorption	Doc	ParabolicTrough
Solar Cooling 2.0 – Large solar cooling systems with concentrating collectors and double absorption chiller	FH OOE, F&E, Solid, Ecotherm, Fresnex, Güssing Energy Technologies, C&G Energie	Arizona, USA	N/A	Absorption	Doc	Flat plate
Zero Emission Cooling	FH Oberöst, Alois Resch	Wels, Upper, Austria	Concept	Adsorption	Doc	PVT
Data Center Johannesberg	Collector: Industrial Solar, Chiller: Unknown	Johannesburg, South Africa	Implemented case	Absorption (H20-LiBr), double lift, 330 kW cooling capacity	Doc	Fresnel
Solar steam generation & solar cooling in Jordan	Collector: Industrial Solar GmbH, Chiller: Unknown	Amman, Jordan	Implemented case	Absorption (H20-LiBr), double lift, 580 kW cooling capacity	Doc	Fresnel

After the 1st stage of the survey, the use of published studies in the sector was also selected to gain a more elaborate perspectives on the experimental system, case studies, and simulations with actual load profiles from residential, commercial, and industrial facilities. The summary of the same is tabulated below (Table 3):

Table 3: Summary of Literature Review.

Title	COUNTRY	STATUS/ TYPE OF CASE	TECHNOLOGY OF TDC	SURVEY TOOL	Solar Collector
Dynamic simulation and parametric analysis of solar-assisted desiccant cooling system	Pakistan	Concept	DEC solid	(Farooq et al., 2020)	PV/T
Solar Cooling Demonstration Facility for Hotel	Spain	Implemented case	Absorption	(Martínez et al., 2020)	Flat plate
Evaluation of Coupling PV and Air Conditioning vs. Solar Cooling Systems	Jordan	Detailed project	Absorption	(Albatayneh et al., 2021)	Evacuated Tube
Comparison of the Thermal Performance of Solar Adsorption Cooling System	Egypt/Morocco	Concept	Absorption	(Mohamed H. et al., 2018)	Evacuated Tube
Dimensioning of the Cold room of a Solar Adsorption Cooling System	Morocco	Concept	Adsorption	(Abakouy et al., 2019)	-
Optimization of design and operation of solar-assisted district cooling systems	Qatar	Concept	Absorption	(Alghool et al., 2020)	Flat plate
Optimum operational strategies for a solar absorption cooling system	Mexico	Implemented	Absorption	(Aguilar-Jiménez et al., 2020)	Flat plate
Thermodynamic Performance Investigation of a Small-Scale Solar Compression-Assisted Multi-Ejector Indoor Air Conditioning System	UAE	Concept	Solar Ejector Refrigeration	(Eveloy & Alkendi, 2021)	Evacuated Tube
Investigation on an air solar-driven open sorption system	Sun-belt countries	Concept/Validated	DEC solid	(Nielsen et al., 2022)	Solar Air Collectors

Performance assessment and optimization of a solar cooling system in multi-family buildings	Italy	Concept	Absorption	(Bilardo et al., 2020)	Evacuated Tube
Eco-friendly combined solar cooling and heating system, powered by hybrid Photovoltaic thermal (PVT)	Iran	Concept/Validated	Solar ejector-vapor compression system (Hybrid)	(Zarei et al., 2020)	PV/T
Tests of an Absorption Cooling Machine at the Gijón Solar Cooling Laboratory	Spain	Implemented	Absorption	(López et al., 2020)	Flat plate
Experimental assessment of solar absorption-subcooled compression hybrid cooling system	China	Implemented	solar absorption-subcooled compression hybrid cooling system	(Yu et al., 2019)	Compound Parabolic Trough
Performance Analysis of a Solar Cooling System with Equal and Unequal Adsorption/Desorption Operating Time	Iraq	Implemented	Adsorption	(Lattieff et al., 2021)	Evacuated Tube
Zeosol Hybrid Solar cooling and Heating System	Sunbelt countries	Implemented	hybrid adsorption-compression chiller	(Palomba et al., 2019)	Evacuated Tube
METESCO (Medium Temperature Solar Cooling)	Italy	Implemented	Absorption	Survey	Parabolic Trough

6 Results and Analysis on Adapted Components

A set of results analyzes the components used in various solar cooling technologies and their interdependencies with various factors such as the solar collector type, climatic zone, application, and adapted components used.

Solar cooling has the potential to be an effective and efficient solution for decarbonization in countries across the Sunbelt regions. With an expected increase in cooling demands in these countries, it could be a great opportunity to identify the right component choice and analyze existing projects to further catapult its reach and impact. The study summarizes 32 works from across 18 countries in the Sunbelt regions. The demographic distribution of projects is depicted below in Figure 4.

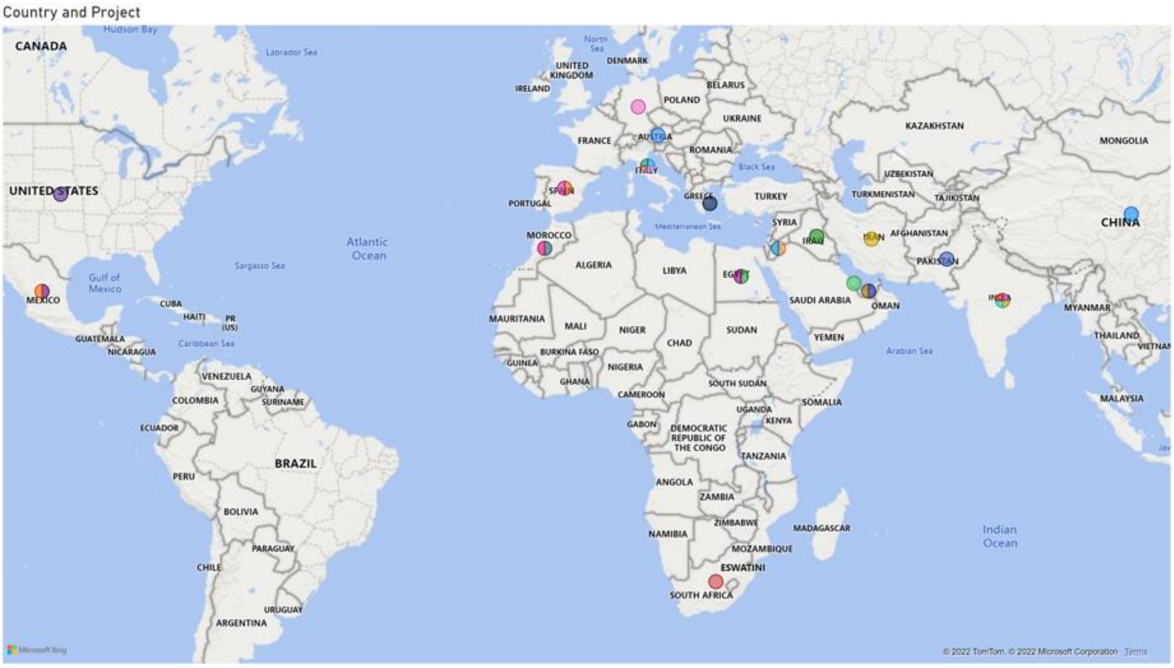


Fig. 4. Representation of projects from across different countries (Beccali *et al.*, 2024)

6.1 Koppen-Geiger Climate Classification

Koppen-Geiger climate classification divides climate across the globe into five main categories (A, B, C, D, E) and 30 sub-types. It is classified based on monthly air temperature, precipitation, and their maximum and minimum values. Knowing the climate zone each country falls in can be a critical criterion for choosing the right type of cooling system and solar energy collectors. Figure 5 shows the distribution of the investigated projects studied across various climate classification zones.

Each of these climate types, except for Group B, is defined by temperature criteria. Thus, it provides a reasonable estimate of the intensity of solar insolation, the number of sunny days, and the maximum and minimum temperatures in a zone. Countries in the Sunbelt region fall within the range of Group A (tropical climates), Group B (dry climates), and Group C (temperate climates). The plants included in this study are located (actual or simulated) in 60% of the Sunbelt region across a span of 10 sub-types. The majority of the projects reported are from BWh (hot desert) (23%) and BSh (hot semi-arid) and Csa (hot summer-Mediterranean) (both 20%) climate regions.

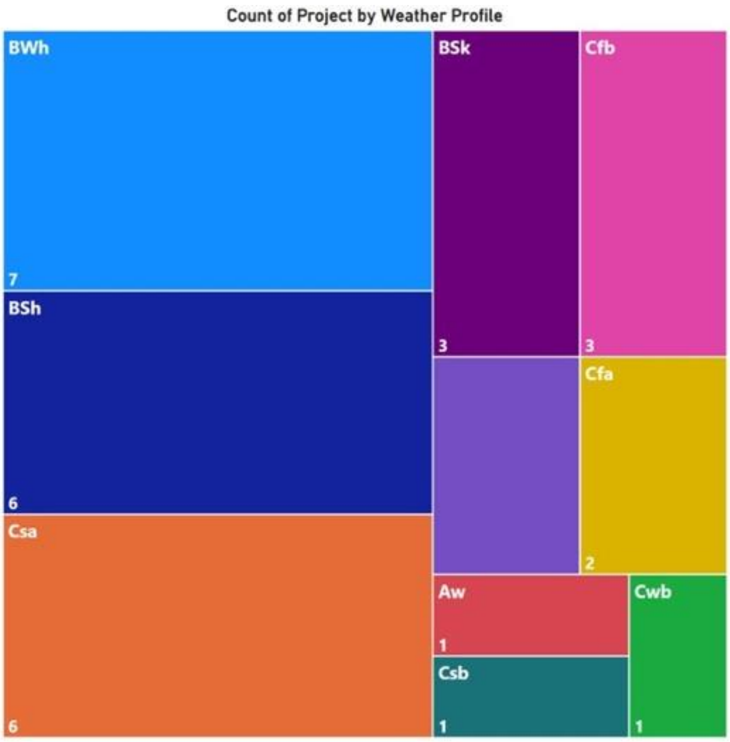


Fig. 5. Representation of projects studied and their climate classification (Beccali *et al.*, 2024)***.***

6.2 Project Typology

The studies conducted covered a wide range of types, as shown in Figure 6. 50% of the projects are in the implementation phase at various stages, while 18% of the works are operational projects with established results. A quarter of these works are project concepts studied for implementation, simulated using various tools such as TRNSYS, Python, Matlab, and other mathematical modeling tools that can be an effective way to estimate the performance of a system before its implementation. Some published works of laboratory experiments and simulations, validated by real-time building energy use, have also been used in the survey to enable a broad range of analyses.

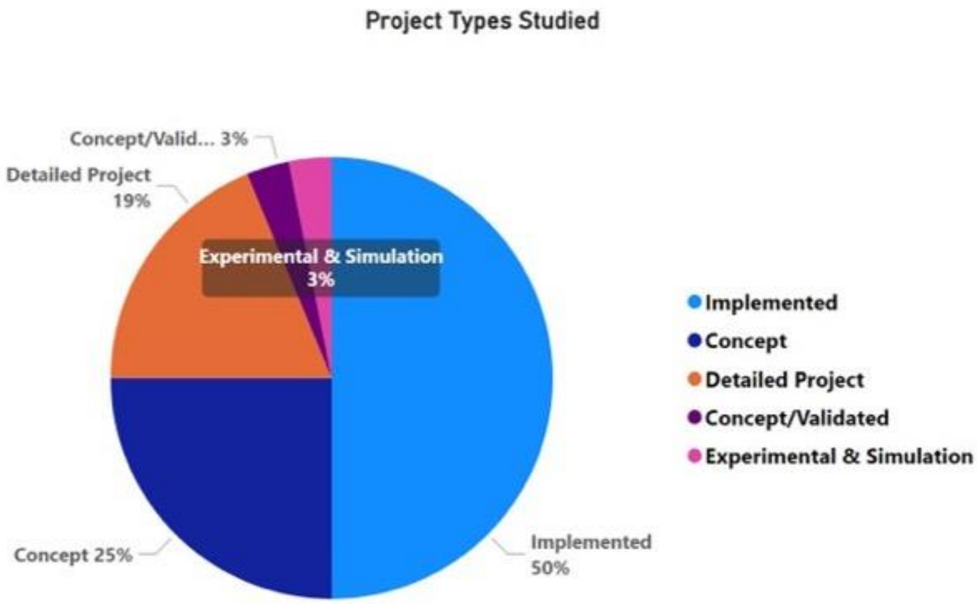


Fig. 6. Project typology (Beccali *et al.*, 2024)***.***

6.3 Solar Collector Types

Solar Cooling uses a range of solar energy-harnessing devices. Evacuated tube collectors (ETC) constitute 30% of the projects studied, flowed equally by flat plate collectors (17%) and Fresnel collectors (17%) (Figure 7). From the studies, it was also noted that Fresnel collectors and flat plate collectors are the most popular options in implemented projects, with evacuated tubes the highest in simulation projects.

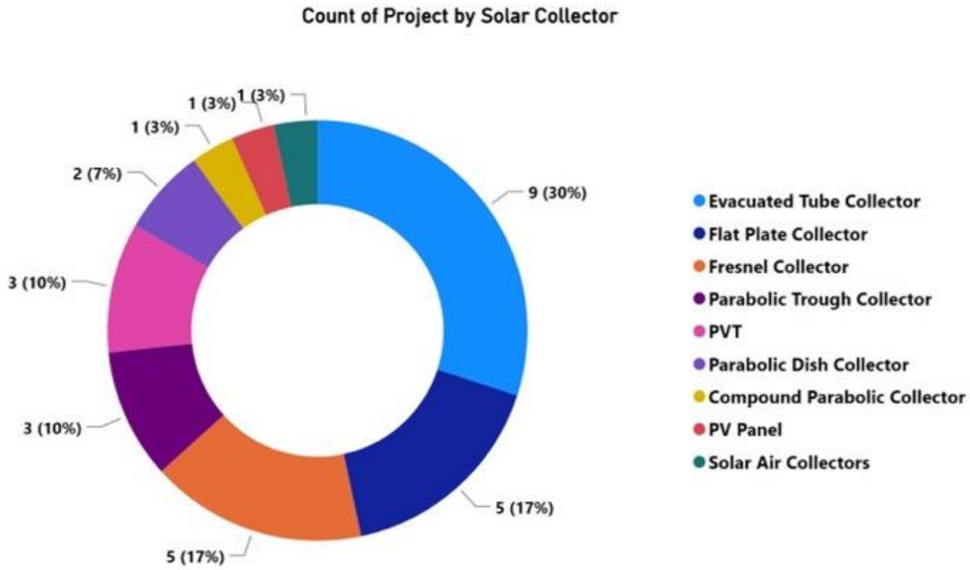


Fig. 7. Solar collector types (Beccali *et al.*, 2024)***.***

The distribution of different solar collectors over various temperature profiles gives a fair understanding of which is most suitable in different scenarios. As shown below (Figure 8), ETCs have widespread application over three climate regions: BSk (cold semi-arid), BWh (hot desert climates), and Csa (hot-summer Mediterranean climate). Similarly with flat plate collectors over a range of five different profiles from hot desert (BWh) to warm-summer Mediterranean climate (Csb).

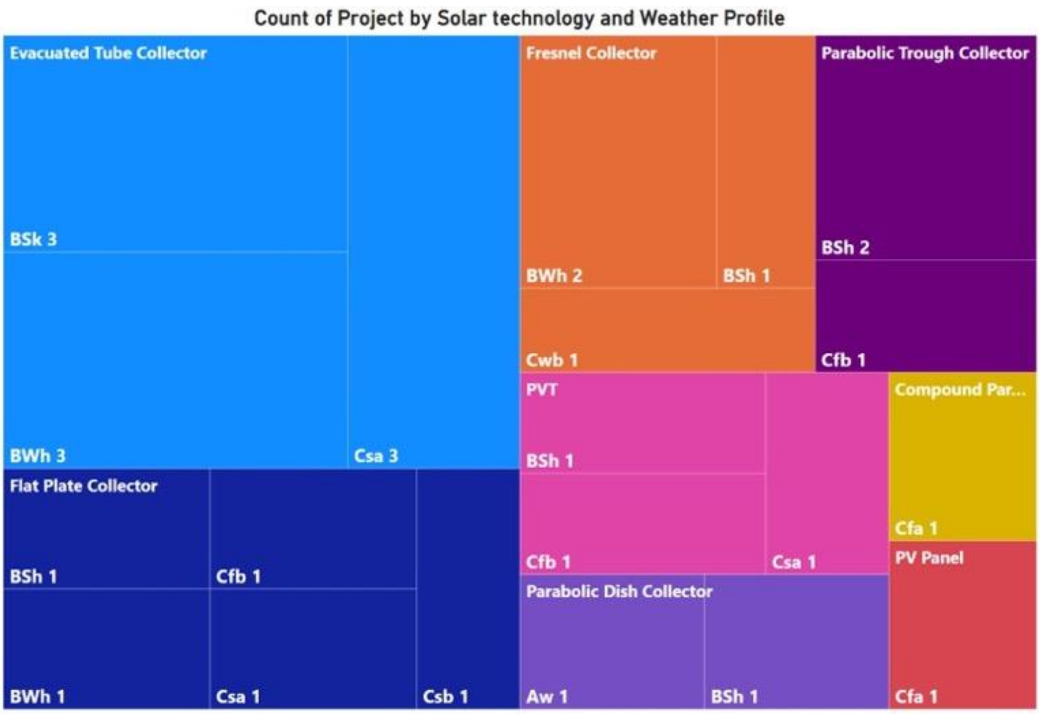


Fig. 8. Representation of solar collector type by weather profile (Beccali *et al.*, 2024)***.***

6.4 Solar Cooling Applications

In most of the cases studied, solar cooling systems are installed in public buildings (34%) such as offices, schools, and university buildings, making it suitable to utilize the sun directly during the daytime. Domestic buildings (25%) appear to be the next most studied because of their widespread need in the Sunbelt region for enhancing indoor comfort (Figure 9). Other sectors, such as food preservation, process industries, etc., also have good potential.

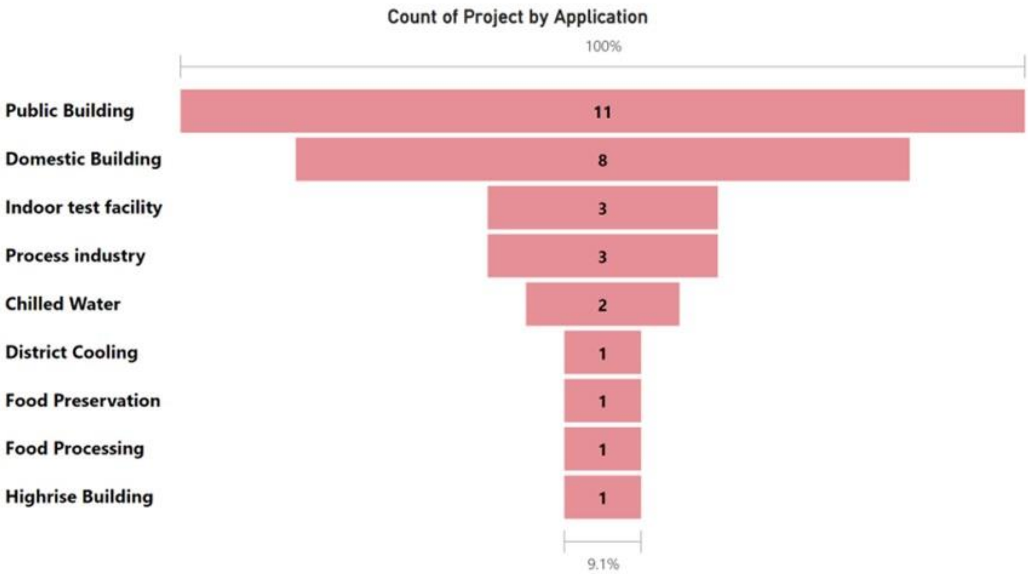
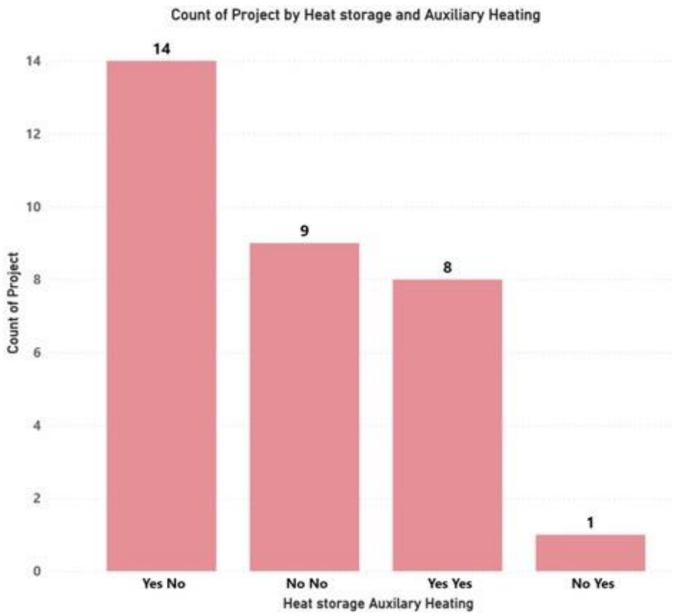


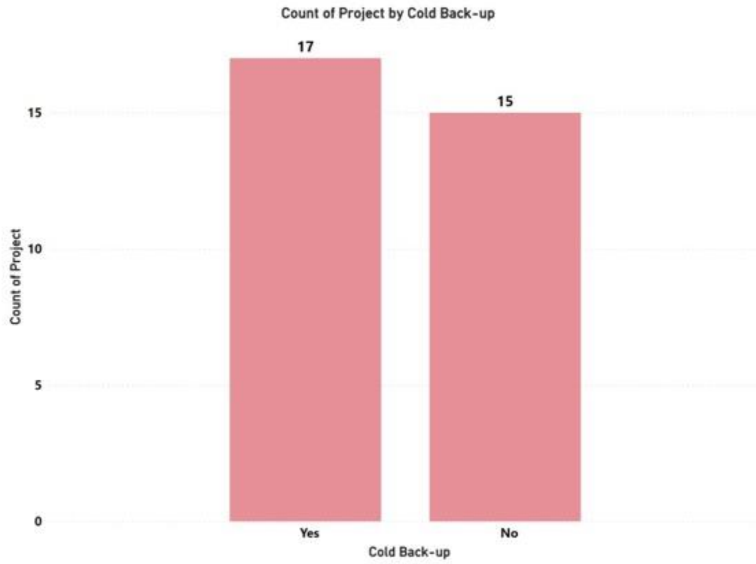
Fig. 9. Solar cooling applications (Beccali *et al.*, 2024)***.***

6.5 Heat and Cold Backup

The use of a heat storage tank and auxiliary heating is to meet the cooling load when there is low or zero solar radiation (e.g., during nighttime). In public buildings such as office spaces and educational institutions, the cooling load is concentrated during the daytime, reducing the need for and capacity of these components (Figure 10a). For domestic applications such as villa houses, multi-family buildings, and process industries, the cooling demand could be needed throughout the day. Cold backup components include devices that can prolong the cooling effect even when the solar cooling device does not function such as a vapor compression system (Figure 10b).



a)



b)

Fig. 10. a) Heat storage auxiliary heating in projects b) Cold backup in projects (Beccali *et al.*, 2024)**.**

6.6 Heat Rejection Systems

In a solar cooling system, the heat rejection system plays a crucial role in dissipating the excess heat generated during the cooling process. The primary function of the heat rejection system is to ensure the proper operation and efficiency of the chiller by removing the absorbed heat from the cooling cycle. The two major types of heat rejection systems used in the projects considered are water-cooled evaporator cooling using a cooling tower and dry cooling using air (forced or passive). Indirect evaporative cooling is used in cases where the working fluid is not in contact with the refrigerant used for the cooling effect.

In the investigated projects, 60% of them use a wet heat rejection system, which is a common type of cooling tower that effectively removes heat (Figure 11). 33.3% of them use air-cooled systems, which are comparatively easier to operate. It was also the case where most of the simulation studies did not consider a specific heat rejection system but rather modeled a heat dissipation rate to evaluate the system performance.

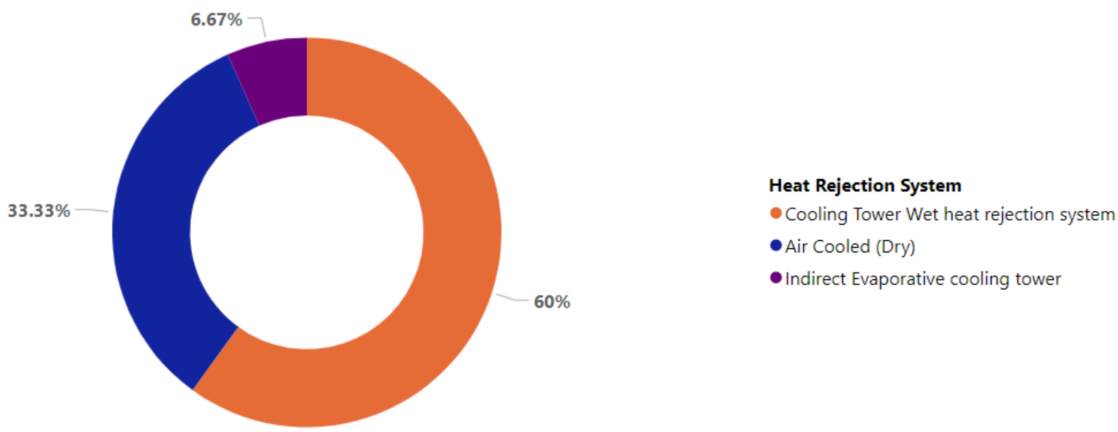


Fig. 11. Heat rejection systems (Beccali *et al.*, 2024)**.**

6.7 Three-Stage Sankey Diagram

Figure 12 below depicts the interrelation between the climate classification each project has been based on, the solar collector used, and the adopted solar cooling system. This gives an insight into commonalities in the appropriate component and system use with regard to the climatic zone a project falls into.

Some of the observations are:

1) A maximum number of projects are from BWh (hot desert climate), Fresnel, and ETCs, which are mostly preferred over flat plate collectors and others to harness solar energy.
2) Similarly, Csa (hot summer-Mediterranean) and BSk (tropical and subtropical steppe climate), the majority of the studies show ETCs are mostly preferred.
3) Solar absorption cooling is the most common solar cooling technology, with PV-assisted cooling, and ejector cooling following the list.

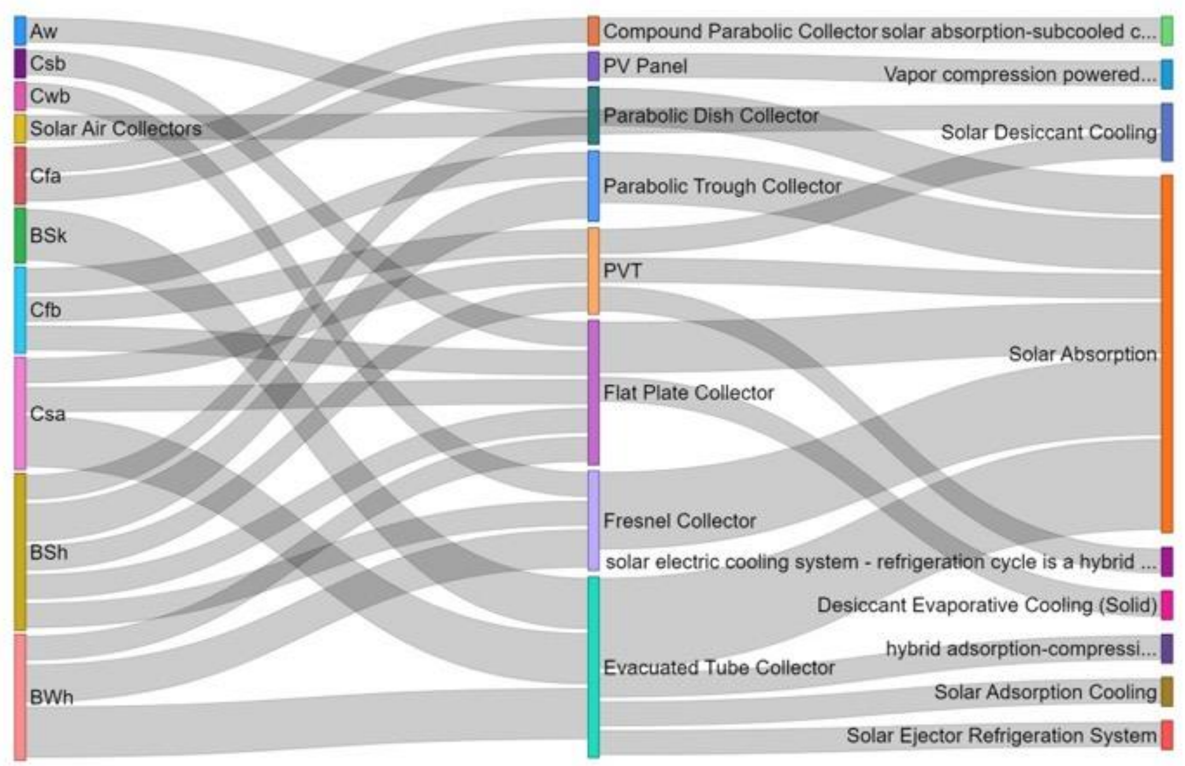


Fig. 12. Representation of weather profile with solar collector and solar cooling technology used (Beccali *et al.*, 2024)***.***

6.8 Summary of Analysis

Results are drawn from 32 projects across 18 countries representing a range of 10 weather profiles such as the tropical wet and dry (Aw), hot desert (BWh), hot semi-arid (BSh), hot summer-Mediterranean (Csa), warm-summer Mediterranean (Csb), humid subtropic (Cfa), monsoon-influenced humid subtropical (Cwa), hot summer humid continental climate zones. The 32 projects studied are over 17.06 MW of thermal cooling projects, which are summarized as follows:

i) Most of the projects reported are from BWh (hot desert) (23%), and BSh (hot semi-arid) and Csa (hot summer-Mediterranean) (both 20%) climate regions.
ii) Almost 70% of the projects studied are either implemented or detailed projects with 25 % of them being concepts. 6% of the project is experimentation and validated using real-time buildings.
iii) ST cooling is by far the most applied solar cooling technology over solar electric cooling. Of the cases studied, 30% use ETCs, flat plate collectors (17%), Fresnel collectors (17%), Parabolic trough collectors (10%), and PV panels (10%). These are some of the most preferred options.
iv) Of the available ST cooling techniques, 71% of them use solar absorption, whereas 19% use solar adsorption cooling and other technologies such as Ejector cooling and PV assisted cooling (3% each).

v) Hot water storage or heat back-up by auxiliary heating was used in 72% of the projects with heat storage being more popular over heat backup.

vi) Cold backup was comparatively less in use with 53% when compared to heat up. To account for the intermittency of the solar radiation, heat storage or auxiliary heating are observed to be the common practice.

vii) 60% of the projects also use cooling towers with evaporative cooling using water, while 33.3% of them used air-cooled systems as a means to dissipate the excess heat generated during the cooling process.

viii) The major application was on public buildings (34%) with an average working span of 8hr/day; while some others were utilized in the domestic building (25%) and, process industry (9%), food processing sector, among others.

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