EBC
Energy in Buildings and Communities Programme

IEA EBC Annex 80 - Resilient Cooling

Webinar 3: Examples of Resilient Cooling Solutions

AIVC venticool INIVE Institute of Building Research & Innovation ZT-GmbH iea Energy Technology Network

13/09/2022

EBC
Energy in Buildings and Communities Programme

IEA EBC Annex 80 - Resilient Cooling

Webinar 2: Future weather data and heatwaves

Philipp Stern

on behalf of the Operating Agent EBC Annex 80
Institute of Building Research & Innovation
Vienna, Austria

Institute of Building Research & Innovation ZT-GmbH

Federal Ministry Republic of Austria Climate Action, Environment, Energy, Mobility, Innovation and Technology

iea Energy Technology Network

31/05/2022

IEA EBC Annex 80

EBC Energy in Buildings and Communities Programme

Series of webinars in cooperation with AIVC & venticool

1. Indicators to assess resilience of cooling in buildings [May 10, 15:00-16:15 CEST]
2. Future weather data and heatwaves [May 31, 16:00-17:15 CEST]
3. **Examples of resilient cooling solutions [September 13, 15:00-16:15 CEST]**
4. Case studies and policy recommendations [September 20, 15:00-16:15 CEST]

https://annex80.iea-ebc.org/

AIVC venticool the platform for resilient ventilative cooling INIVE

Today's Programme

Programme (Brussels time)

15:00	**Introduction to Annex 80, AIVC & venticool** Philipp Stern for Operating Agent EBC Annex 80 Institute of Building Research & Innovation, AT	**15:40**	**Adsorption Chiller and its Applications** Gamze Gediz Ilis, Gebze Technical University, TR
15:05	**Overview of resilient cooling technologies** Ongun Berk Kazanci, ICIEE/DTU, DK	**15:55**	Questions and answers
15:25	**Recent progress on building products for heat mitigation** Mat Santamouris, UNSW, AU	**16:15**	End of the webinar

IEA EBC Annex 80

- **Members**

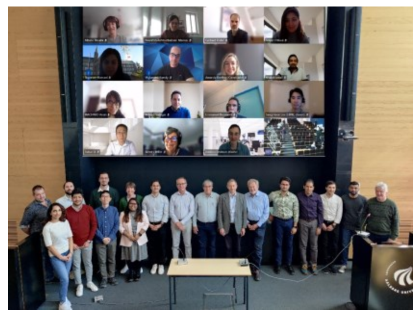
  36 institutions from 16 countries (Americas, Europe, Asia, Australia)

- **Guests** (not part of EBC yet)

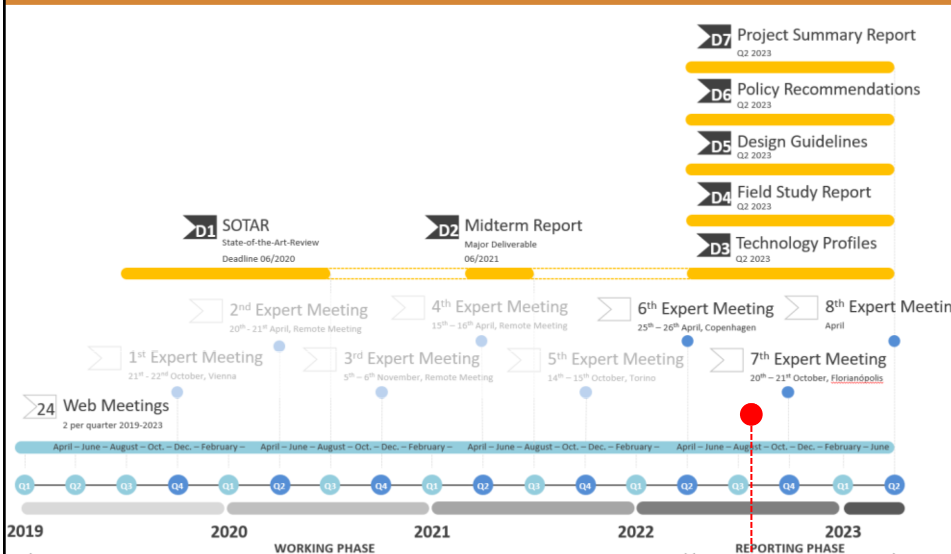
  Mexico, **José Roberto Garcia Chavez**, Metropolitan Autonomous University Mexico City

  India, **Rajan Rawal**, CEPT University, CARBSE

1. Preparation Phase (1 year)
   June 2018 – June 2019
2. Working Phase (3 years)
   June 2019 – June 2022
3. Reporting Phase (1 year)
   June 2022 – June 2023



Annex 80 Roadmap



Annex 80 Objectives

"Support a transition to an environment where ***affordable low energy*** *and* ***low carbon*** *cooling systems are the mainstream and preferred solutions for cooling and overheating issues in buildings."*

A Assess benefits, potentials and performance indicators. Provide guidance on design, performance calculation and system integration.

B Research towards implementation of emerging technologies. Extend boundaries of existing solutions.

C Evaluate the real performance of resilient cooling solutions.

D Develop recommendations for policy actions.

Definition of Resilient Cooling

"Affordable low energy and low carbon cooling solutions, strengthening the ability of individuals and communities to withstand and prevent the thermal - and other - **impacts of changes in global and local climates."**

Groups of Technologies

a. **Reduce heat loads to people and indoor environments**

b. **Remove sensible heat from indoor environments**

c. **Enhance personal comfort apart from space cooling**

d. **Remove latent heat from indoor environments**

Annex 80 Deliverables

D1	State-of-the-Art-Report	▪ Research community and associates ▪ Real Estate developers ▪ Urban planning experts ▪ Policy makers	OA, STA, STB, STC, STD
D2	Midterm Report	▪ Research community and associates ▪ IEA and EBC Programme	OA, STA, STB, STC, STD
D3	**Technology Profiles**	▪ Building component developers and manufacturers ▪ Architects and design agencies ▪ Engineering offices and consultants	STB
D4	**Field Studies**	▪ Building component developers and manufacturers ▪ Architects and design agencies ▪ Engineering offices and consultants ▪ Real Estate developers	STC
D5	**Design and Operation Guidelines**	▪ Architects and design agencies ▪ Engineering offices and consultants ▪ Real Estate developers	STA, STB, STC
D6	**Recommendations for policy actions, legislation and standards**	▪ Policy makers ▪ Legal interest groups ▪ Experts involved in building energy performance standards and regulation	STD
D7	**Project Summary Report**	▪ Research community and associates ▪ IEA and EBC Programme ▪ Real Estate developers ▪ Policy makers	OA, STA, STB, STC, STD

Annex 80 Publications

1. "**Developing an understanding of resilient cooling**: a socio-technical approach City and Environment Interactions" (Wendy Miller et al; published in Elsevier City and Environment 2021) https://doi.org/10.1016/j.cacint.2021.100065
2. "**Resilient cooling of buildings to protect against heat waves and power outages**: key concepts and definition" (Shady Attia et al; published in Energy and Buildings 2021) https://doi.org/10.1016/j.enbuild.2021.110869
3. "**Resilient cooling strategies - a critical review and qualitative assessment**" (Chen Zhang et al; published in Energy and Buildings 2021) https://doi.org/10.1016/j.enbuild.2021.111312
4. Report of Thermal Conditions Task Group "**Framework to evaluate the resilience of different cooling technologies**" (Shady Attia et al; published) http://dx.doi.org/10.13140/RG.2.2.33998.59208

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Next:

Dr. Ongun Berk Kazanci
Technical University of Denmark
Department of Environmental and Resource Engineering
Indoor Environment

DTU

iea Energy Technology Network

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Thank you for joining

see you again on September 20th!

Please fill in the survey after the meeting.
Your feedback is very important for us.

Overview of Resilient Cooling Technologies

Ongun Berk Kazanci, PhD
Assistant Professor

International Centre for Indoor Environment and Energy - ICIEE
Department of Environmental and Resource Engineering
Technical University of Denmark

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Agenda of today's presentation

- Annex 80 - Subtask B summary
- Radiant cooling systems
- Personalized Environmental Control Systems (PECS)
- Results from preliminary simulations
- Summary and future steps

2

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Subtask B summary

- Subtask B: Solutions
  - Develop criteria and methodology to qualitatively and quantitatively evaluate resiliency of existing cooling technologies
  - Assess benefits, limitations and performance of cooling technologies with a focus on heat waves and power outages
  - Develop guidelines for design and implementation of resilient cooling technologies and their combinations

Subtask B summary

- A. Reduce heat gains to indoor environments and people indoors
  - Advanced solar shading and glazing, etc.
- B. Remove sensible heat from indoor environments
  - High temperature cooling systems, etc.
- C. Enhance personal comfort apart from space cooling
  - Personal Environmental Control Systems (PECS), etc.
- D. Remove latent heat from indoor environments
  - Desiccant dehumidification, etc.

Subtask B summary

- Two major outputs so far
- Working on quantitative KPIs and technology profile sheets

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journal homepage: www.elsevier.com/locate/enb

ELSEVIER

Resilient cooling strategies – A critical review and qualitative assessment

Chen Zhang[a,*], Ongun Berk Kazanci[b], Ronnen Levinson[c], Per Heiselberg[a], Bjarne W. Olesen[b], Giacomo Chiesa[d], Behzad Sodagar[e], Zhengtao Ai[f], Stephen Selkowitz[c], Michele Zinzi[g], Ardeshir Mahdavi[h], Helene Teufl[h], Maria Kolokotroni[i], Agnese Salvati[i], Emmanuel Bozonnet[j], Feryal Chtioui[j], Patrick Salagnac[j], Ramin Rahif[k], Shady Attia[k], Vincent Lemort[l], Essam Elnagar[l], Hilde Breesch[m], Abantika Sengupta[m], Liangzhu Leon Wang[n], Dahai Qi[o], Philipp Stern[p], Nari Yoon[c,t], Dragos-Ioan Bogatu[d], Ricardo Forgiarini Rupp[b], Taha Arghand[q], Saqib Javed[q], Jan Akander[r], Abolfazl Hayati[r], Mathias Cehlin[r], Sana Sayadi[r], Sadegh Forghani[r], Hui Zhang[s], Edward Arens[s], Guoqiang Zhang[f]

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[b] International Centre for Indoor Environment and Energy - ICIEE, Department of Civil Engineering, Technical University of Denmark, Denmark
[c] Building Technology and Urban Systems Division, Lawrence Berkeley National Laboratory, USA
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[e] School of Architecture and the Built Environment, University of Lincoln, UK
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[o] Department of Civil and Building Engineering, Université de Sherbrooke, Canada
[p] Institute of Building Research & Innovation, Austria
[q] Division of Building Services Engineering, Department of Architecture and Civil Engineering, Chalmers University of Technology, Sweden
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ABSTRACT

The global effects of climate change will increase the frequency and intensity of extreme events such as heatwaves and power outages, which have consequences for buildings and their cooling systems. Buildings and their cooling systems should be designed and operated to be resilient under such events to protect occupants from potentially dangerous indoor thermal conditions.

This study performed a critical review on the state-of-the-art of cooling strategies, with special atten-

Aalborg Universitet

AALBORG UNIVERSITY DENMARK

IEA EBC Annex 80 - Dynamic simulation guideline for the performance testing of resilient cooling strategies

Zhang, Chen; Kazanci, Ongun Berk; Attia, Shady; Levinson, Ronnen; Lee, Sang Hoon; Holzer, Peter; Salvatif, Agnese ; Machard, Anaïs; Pourabdollahtootkaboni, Mamak ; Gaur, Abhishek ; Olesen, Bjarne W.; Heiselberg, Per

https://vbn.aau.dk/ws/portalfiles/portal/455865444/Dynamic_simulation_guideline_DCE_report_No.299.pdf

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https://doi.org/10.1016/j.enbuild.2021.111312

Radiant heating and cooling systems

- Low temperature heating and high temperature cooling principle
- Heat emission or removal by radiation and convection (more than half by radiation)
- Mostly water-based
- Floor, wall and ceiling can be used; large surface area for heat exchange
- Three main types
  - Radiant heating and cooling panels
  - Pipes isolated from the main building structure (radiant surface systems)
  - Pipes embedded in the main building structure (Thermally Active Building Systems - TABS)

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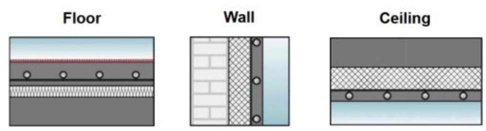
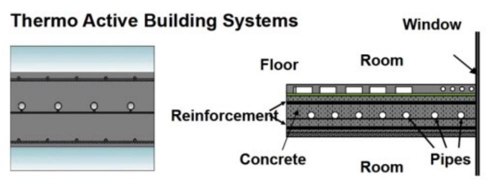
Radiant heating and cooling systems

Source: REHVA, 2007





Source: Olesen, 2000

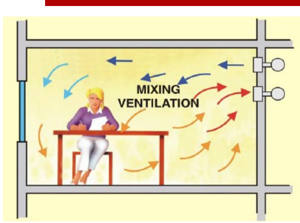
Radiant heating and cooling systems

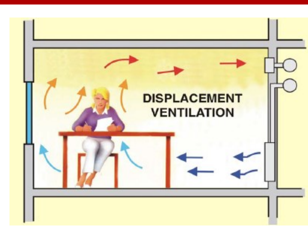
- Integration of renewable energy resources
- Transferring peak loads to off-peak hours, and peak load reductions
- Favorable operating conditions for heating and cooling plants
- Smaller-capacity heating and cooling plants, and downsized ventilation systems
- Reduced total energy use
- Less space requirement, lowered construction heights and saved building materials
- Free use of space, no cleaning requirements, quiet operation
- Uniform temperature distribution, reduced risk of draught, and reduced vertical air temperature differences
- Initial, operational, and energy cost savings

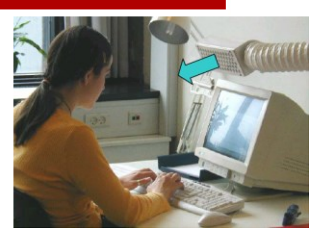
Personalized Environmental Control Systems

- Personalized environmental control systems - PECS (micro-climatization systems, localized heating and cooling systems, personalized ventilation, etc.)
- Heating, cooling, ventilation, lighting, and acoustics
- PECS condition the immediate surroundings of occupants, creating a ”personalized” space
- PECS provide individual control over different aspects of indoor environment -> personalized control

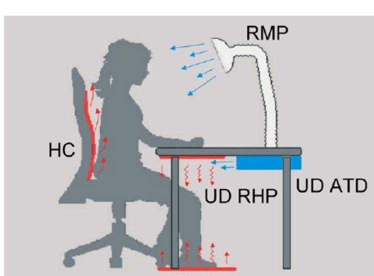
Examples of PECS







Source: Melikov 2010



Source: Watanabe et al. 2010

Source: Zhang et al. 2010

PECS

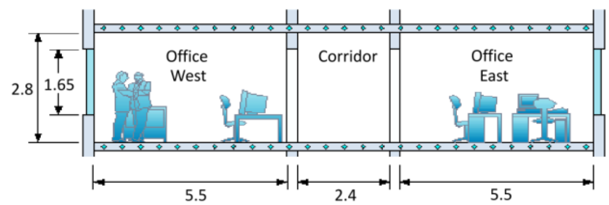
- Several benefits compared to ambient (total volume) conditioning systems
  - Improved comfort, health and productivity
  - Higher satisfaction with the indoor environment, due to
    - Improvements in the immediate indoor environment experienced by the occupants
    - Possibility of personalized control
  - Potential energy and cost savings
  - Increasing focus on individual differences between people → PECS can address these individual differences
  - Resiliency (both thermal and air quality)
  - Pandemic-proofing

Resiliency benefits of radiant cooling, and PECS

- Radiant cooling, by activation of thermal mass
  - Possibility to absorb heat gains over a longer period (also pre-cooling)
  - Integration of renewable energy resources
  - Transferring peak loads to off-peak hours, and peak load reductions (peak shaving and peak shifting)
  - Possibility of intermittent operation
- PECS, by creating a personalized/localized space
  - Temperature setpoint relaxation
  - Higher room temperatures are acceptable
  - Personalized spaces can be occupied longer, and sooner after the heat wave or power outage

Preliminary simulations

- Simulation study of radiant vs. all-air systems
- TABS vs. Packaged Terminal Air Conditioner (PTAC)
  - Intermittent (12-hour) and 24-hour operation
- Future weather files for Copenhagen, DK
- Lightweight and heavyweight construction
- With and without power outage during heat wave



Room width = 3.6 m, window portion of the external wall = 30%

Kazanci, O.B., Shinoda, J., Olesen, B.W., Revisiting radiant cooling systems from a resiliency perspective. CLIMA 2022 Conference.

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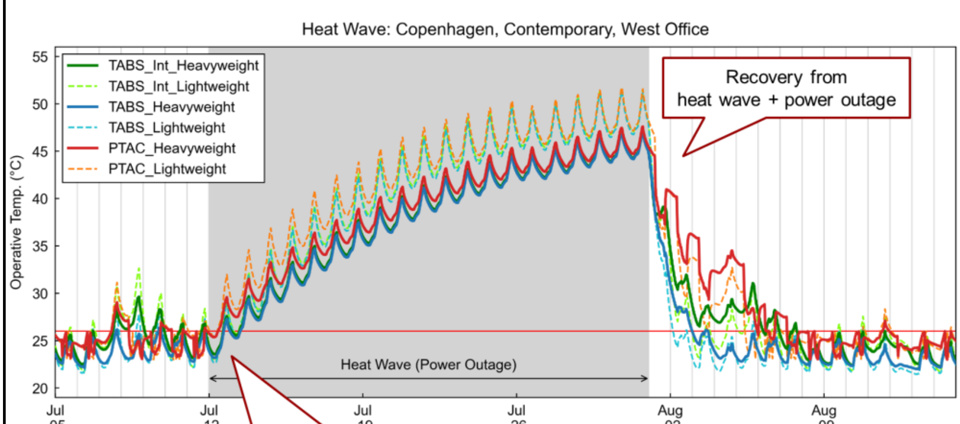
Preliminary simulations

- Operative temperature, before, during & after heat wave and power outage



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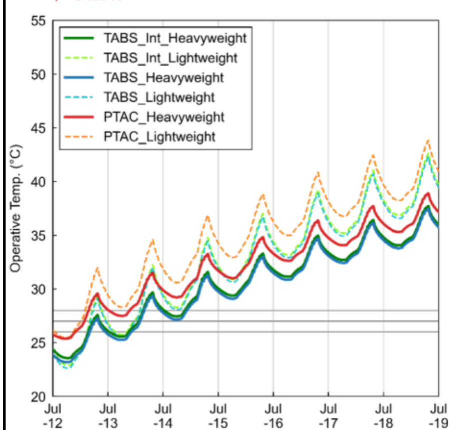
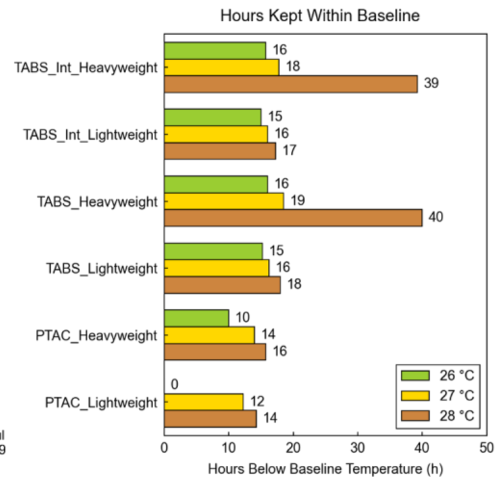
Preliminary simulations

- Maintaining comfort conditions

Heat Wave + Power Outage Starts





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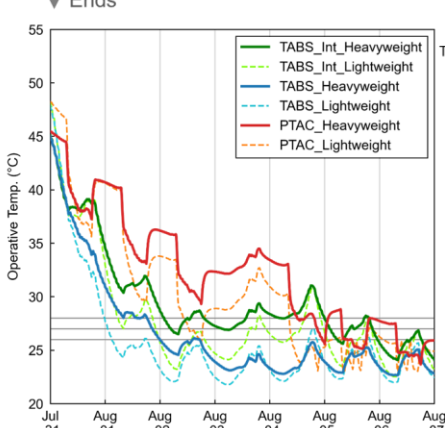
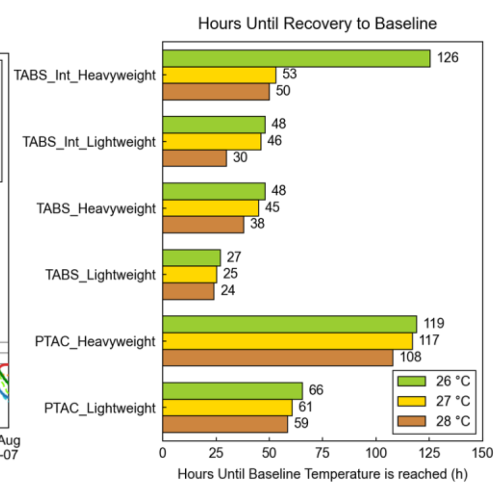
Preliminary simulations

- Recovery to comfort conditions

Heat Wave + Power Outage Ends





Saturday: Cooling off

Sunday: Precooling for Mon.

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Preliminary simulations

- Extended temperature ranges for PECS (standards and literature)
- Hours below baseline temperature at the beginning of heatwave/power outage and hours until baseline after heatwave/power outage

Baseline Temperature (° C)	Hours maintained below baseline temperature (h)	Hours until baseline temperature is reached (h)
26	0 – 16	27 – 126
27	12 – 19	25 – 117
28	14 – 40	24 – 108
29	15 – 42	23 – 106
30	17 – 64	21 – 64

Summary and future steps

- Radiant cooling systems, and PECS have several benefits compared to conventional systems
- They are also promising solutions during heat waves and power outages
- Different operation strategies are needed
- Exact benefits will depend on several factors

Summary and **future steps**

- Further studies to quantify the exact benefits under different boundary conditions
- Quantitative key performance indicators, both long- and short-term
- Design, sizing, and operation guidelines based on detailed simulations
  - System sizing issues ->should we size systems based on future weather files?
- Develop an approach for considering building, systems, and occupants simultaneously

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Thank you for your attention!

Ongun Berk Kazanci
onka@dtu.dk


Recent progress on building products for heat mitigation
M. Santamouris
UNSW Sydney, Australia

1

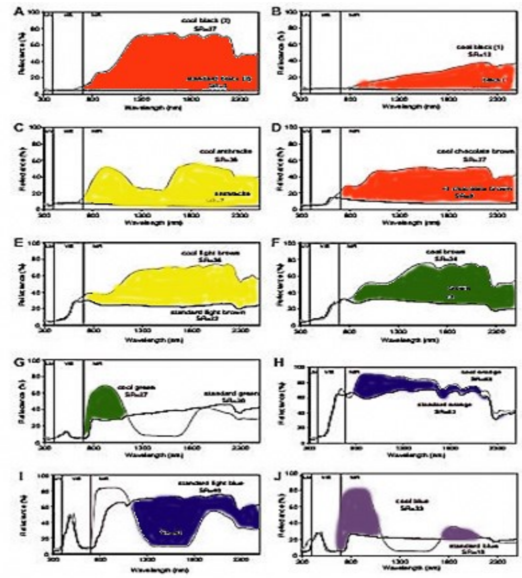

Urban Overheating and Its impact. Recent Progress on Mitigation Technologies
Global urban population exposure to extreme heat, PNAS Vol. 118 | No. 41.
C Tuholske , K Caylor, C Funk, A Verdin, S Sweeney, K Grace, P Peterson, and T Evans
Challenges – Urban Overheating and Regional Climate Change
13,000 OVERHEATED CITIES
THREE TIMES MORE OVERHEATING SINCE 1980
1.7 BILLION PEOPLE UNDER SEVERE OVERHEATING
118 BILLION OVERHEATUNG MAN HOURS

2

Urban Overheating and Its impact. Recent Progress on Mitigation Technologies

A. Synnefa, M. Santamouris and K. Apostolakis : On the development, optical properties and thermal performance of cool colored coatings for the urban environment, Solar Energy 81 (2007) 488–497

Development in Heat Mitigation Technologies



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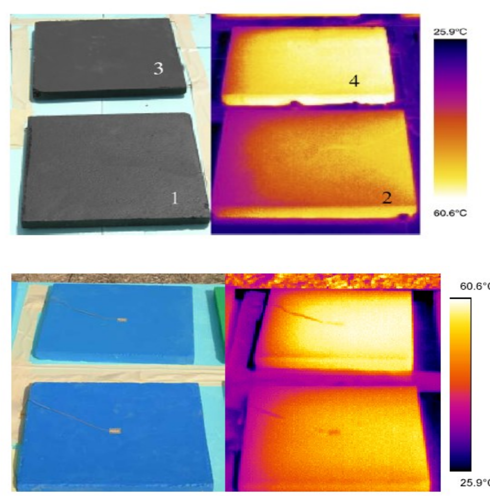
Urban Overheating and Its impact. Recent Progress on Mitigation Technologies

A. Synnefa, M. Santamouris and K. Apostolakis : On the development, optical properties and thermal performance of cool colored coatings for the urban environment, Solar Energy 81 (2007) 488–497

Development in Heat Mitigation Technologies



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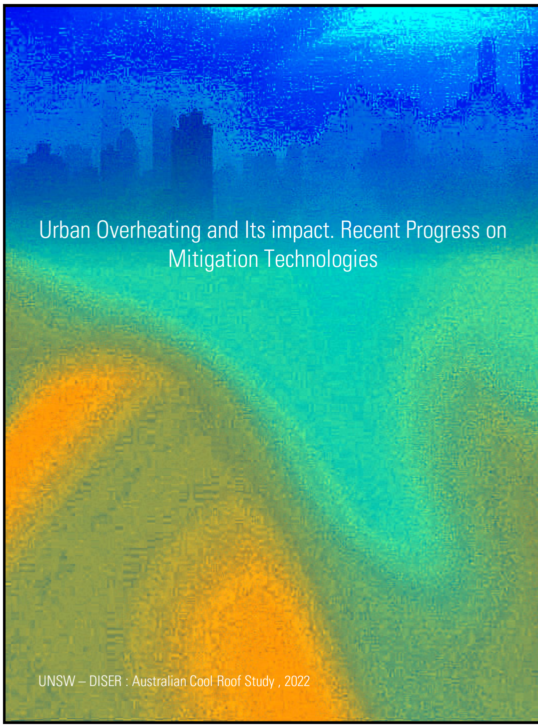
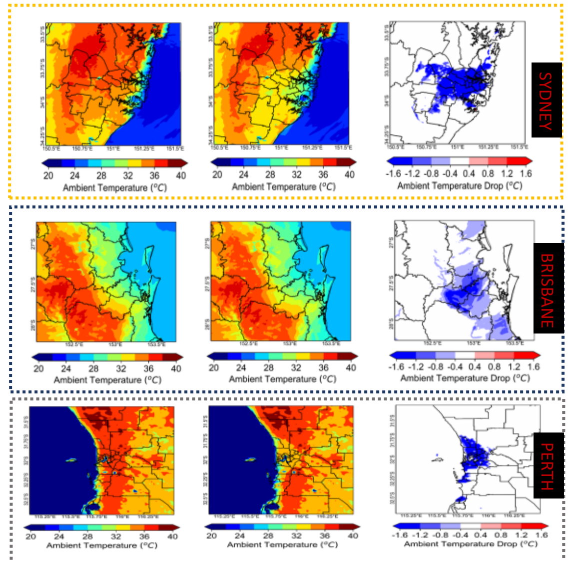


Development in Heat Mitigation Technologies
Sydney, Brisbane, Perth



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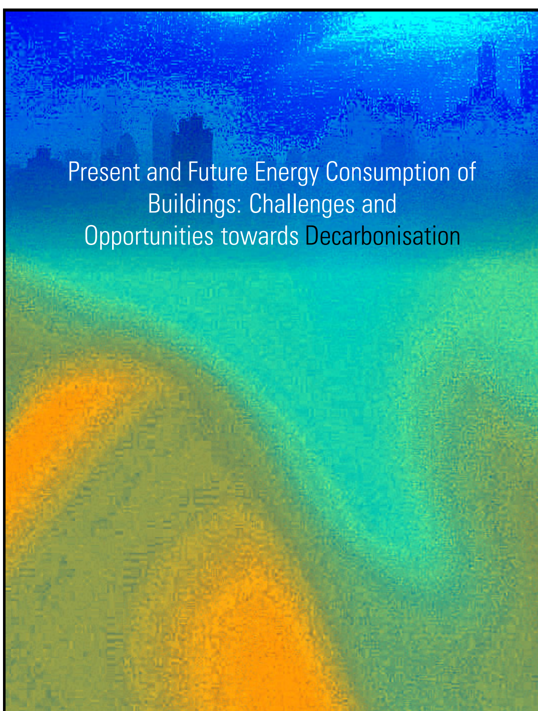
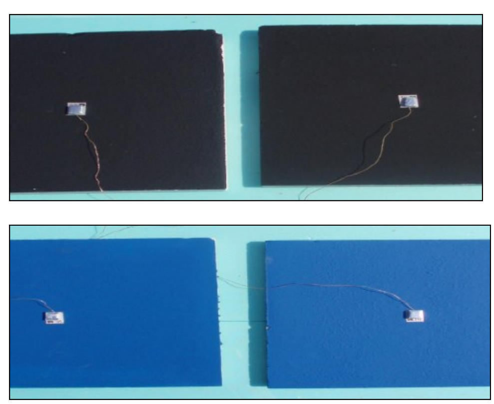


Development in Heat Mitigation Technologies



To further decrease the surface temperature of highly reflective colored coating phase change microcaplules containing parafins, (phase change T = 18 C), have been incorporated in the cool coatings. Microcapsules have a diameter of 17-20 μm and are protected externally by a polymeric material. The optical and thermal performance of the materials have been tested extensively

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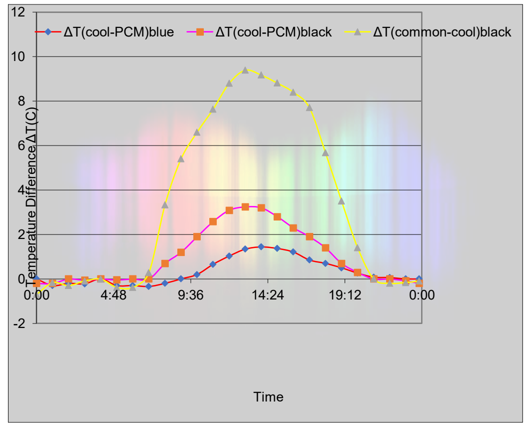
Present and Future Energy Consumption of Buildings: Challenges and Opportunities towards Decarbonisation

Development in Heat Mitigation Technologies



The surface temperature of the black cool material with PCM microcapsules was almost 3,8 C lower than the temperature of the cool black and 13,3 C lower than the common black
Also, the surface temperature of blue cool material with PCM microcapsules was almost 1,8 C lower than the temperature of the cool blue

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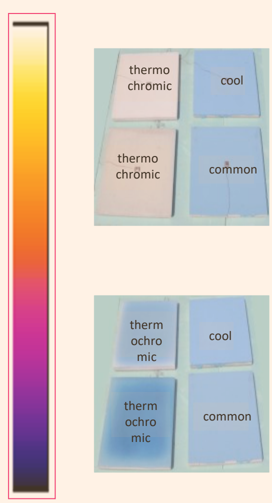
Urban Overheating and Its impact. Recent Progress on Mitigation Technologies

T. Karlessi, M. Santamouris, K. Apostolakis, A. Synnefa, I. Livada: Development and testing of thermochromic coatings for buildings and urban structures, Solar Energy, Volume 83, Issue 4, April 2009, Pages 538-551

Development in Heat Mitigation Technologies



Thermochromic coatings change color as a function of the ambient temperature.

For low outdoor temperatures (winter), the coatings may be dark presenting a high absorptivity. For higher ambient temperatures (summer), the coating becomes white presenting a high reflectivity. Thus, when applied on roofs or walls they may present the best performance all year round.

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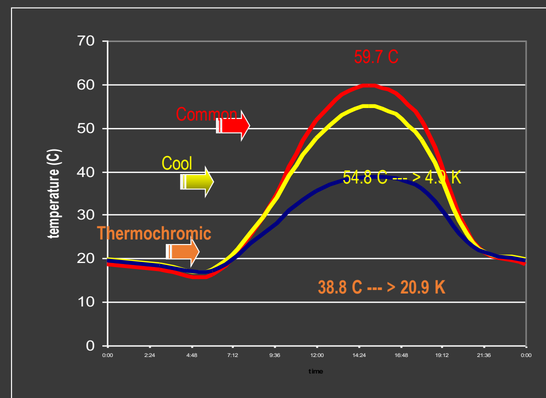
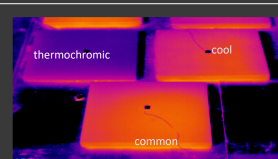
Urban Overheating and Its impact. Recent Progress on Mitigation Technologies

T. Karlessi, M. Santamouris, K. Apostolakis, A. Synnefa, I. Livada: Development and testing of thermochromic coatings for buildings and urban structures, Solar Energy, Volume 83, Issue 4, April 2009, Pages 538-551

Development in Heat Mitigation Technologies





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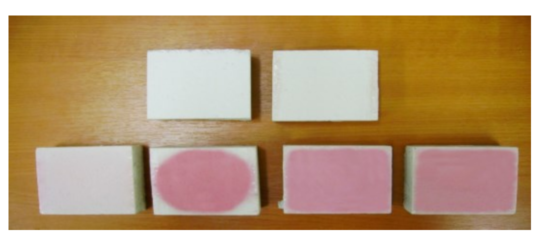
Present and Future Energy Consumption of Buildings: Challenges and Opportunities towards Decarbonisation

Development in Heat Mitigation Technologies



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Urban Overheating and Its impact. Recent Progress on Mitigation Technologies

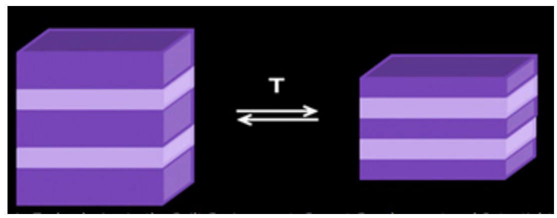
S. Garshasbi and M. Santamouris : Using Advanced Thermochromic Technologies In the Built Environment. Recent Development and Potential to Decrease the Energy Consumption and Fight Urban Overheating, Solar Energy Materials and Solar Cells, 191 (2019) 21–32

Development in Heat Mitigation Technologies

Thermochromic mechanism of photonic crystals and plasmonics

Thermochromic working mechanism of photonic crystals and plasmonic is based on temperature-sensitive physical or optical property variation of one of their components.

The outstanding feature of nano-scale TC materials compared to their bulk counterparts is the lower rate of photodegradation together with their adjustable temperature-sensitive properties.



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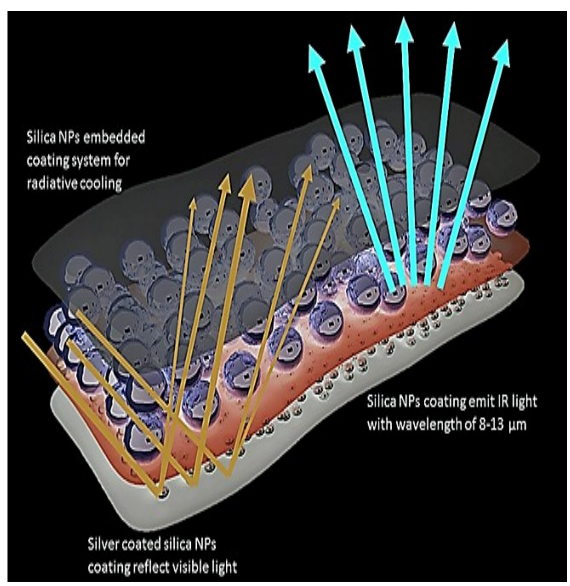
Urban Overheating and Its impact. Recent Progress on Mitigation Technologies

Jie Feng, Kai Gao, M. Santamouris, K.W. Shah and G. Ranzi : Dynamic Impact of Climate on the Performance of Daytime Radiative Cooling Materials, Solar Energy Materials and Solar Cells, Volume 208, May 2020, 110426

Development in Heat Mitigation Technologies



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Urban Overheating and Its impact. Recent Progress on Mitigation Technologies

Jie Feng , A, Khan and M, Santamouris : The heat mitigation potential and climatic impact of super-cool broadband radiative coolers on a city scale Cell Reports Physical Science, 100485 July 21, 2021

Development in Heat Mitigation Technologies

Urban Overheating and Its impact. Recent Progress on Mitigation Technologies

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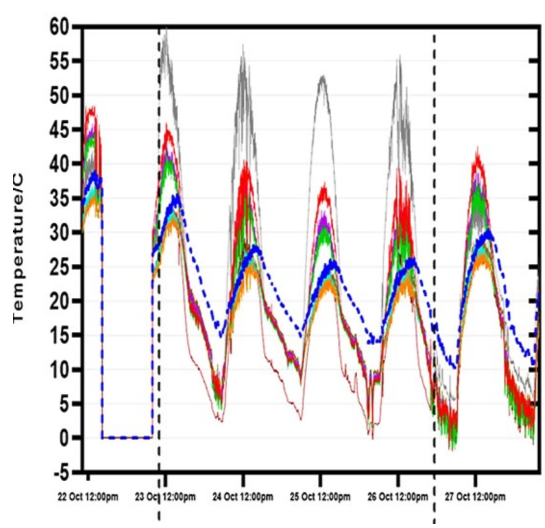
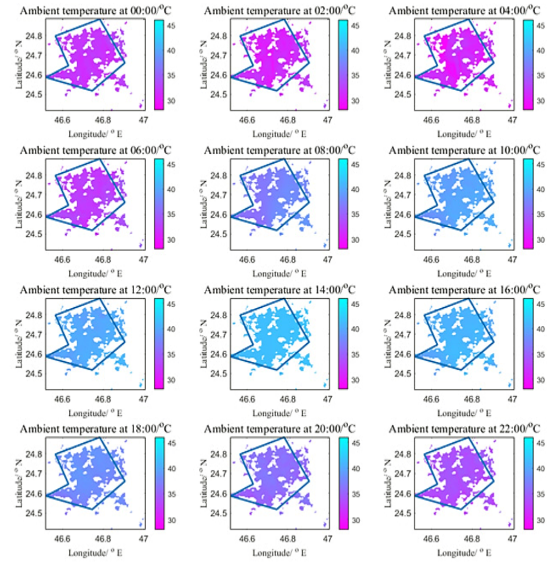
Development in Heat Mitigation Technologies



Urban Overheating and Its impact. Recent Progress on Mitigation Technologies

UNSW : Heat Mitigation Study, Riyadh, Saudi Arabia, 2022

Development in Heat Mitigation Technologies Riyadh KSA



Urban Overheating and Its impact. Recent Progress on Mitigation Technologies

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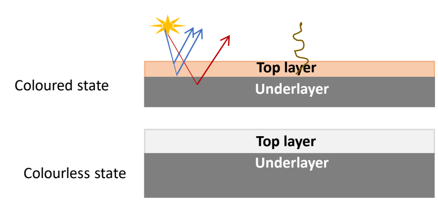

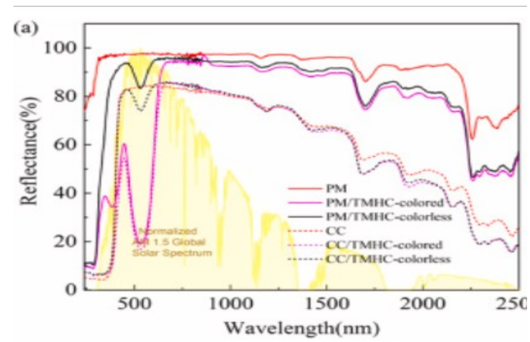

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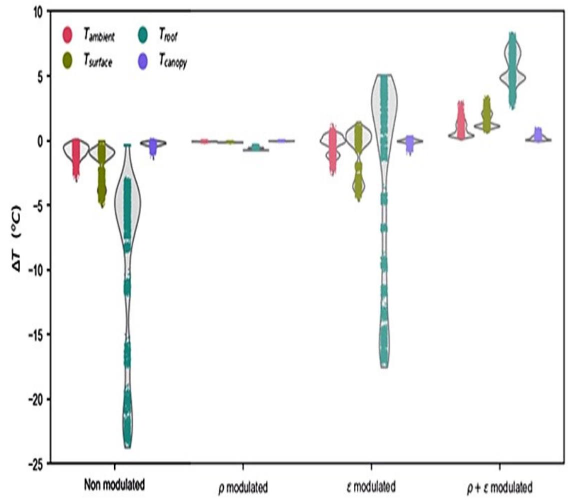
Development in Heat Mitigation Technologies

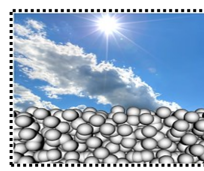


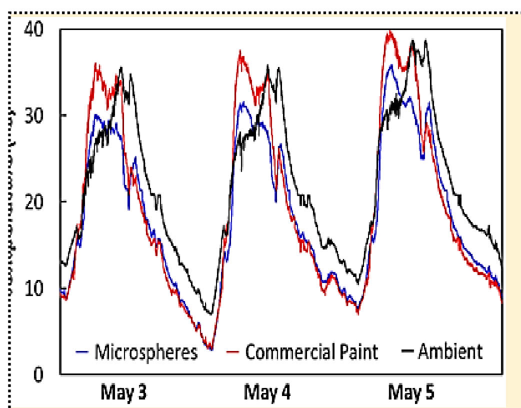
Ansar Khan, Laura Carlosena, Samiran Khorat, Rupali Khatun Quang-Van Doan, Jie Feng, Mattheos Santamouris On the Winter Overcooling Penalty of Super Cool Photonic Materials in Cities, Advances Solar Energy 2021

Cooling the Cities : Impact of Overheating and Mitigation Science

Development in Heat Mitigation Technologies

Super Cool Paints



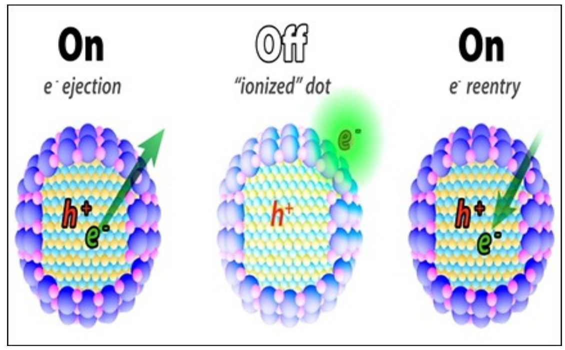


Urban Overheating and Its impact. Recent Progress on Mitigation Technologies

Garshasbi and M. Santamouris: Adjusting Fluorescent Properties of Quantum Dots: Moving Towards Best Optical Heat-rejecting Materials, Solar Energy, 2022

Development in Heat Mitigation Technologies

Quantum dots (QD) are very small semiconductor particles, only several nanometers in size, so small that their optical and electronic properties differ from those of larger particles. They are a central theme in nanotechnology. Many types of quantum dot will emit light of specific frequencies if electricity or light is applied to them, and these frequencies can be precisely tuned by changing the dots' size, shape and material, giving rise to many applications.



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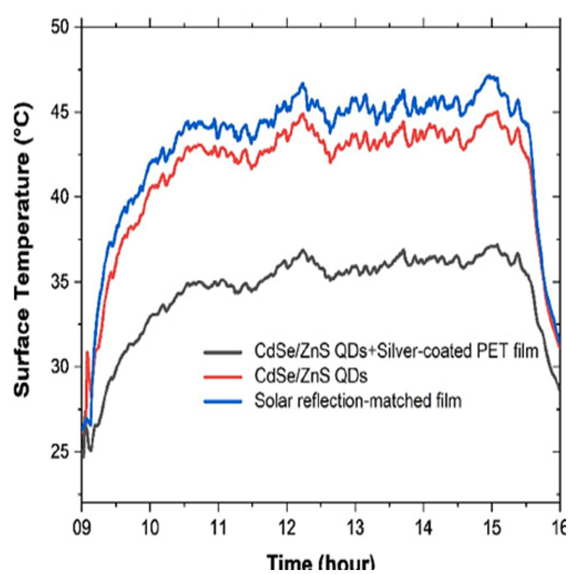
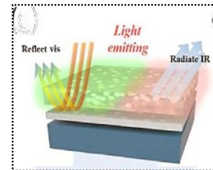


Urban Overheating and Its impact. Recent Progress on Mitigation Technologies

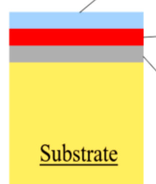
Colorful surfaces for radiative cooling : Lyu Zhou, Jacob Rada, Haomin Song,3Boon Ooi, Zongfu Yu,C and Qiaoqiang Gan

Development in Heat Mitigation Technologies

Coloured Super Cool Materials



Top layer: Thermal emitter component - Thermal emitter material with high solar transmission (300-2500 nm) and high thermal emission (8-13 μm)

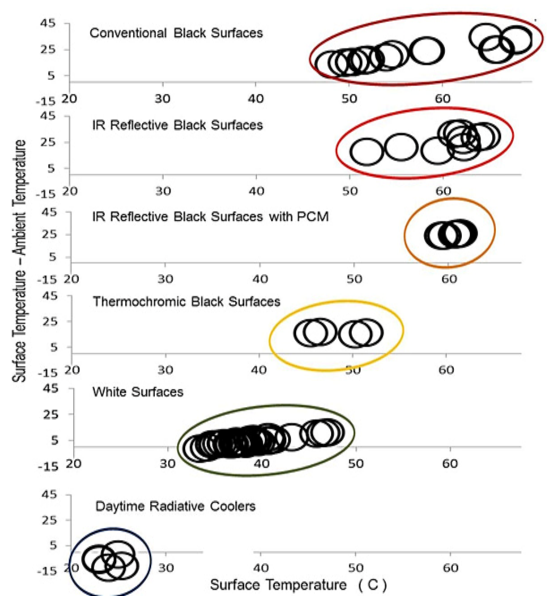


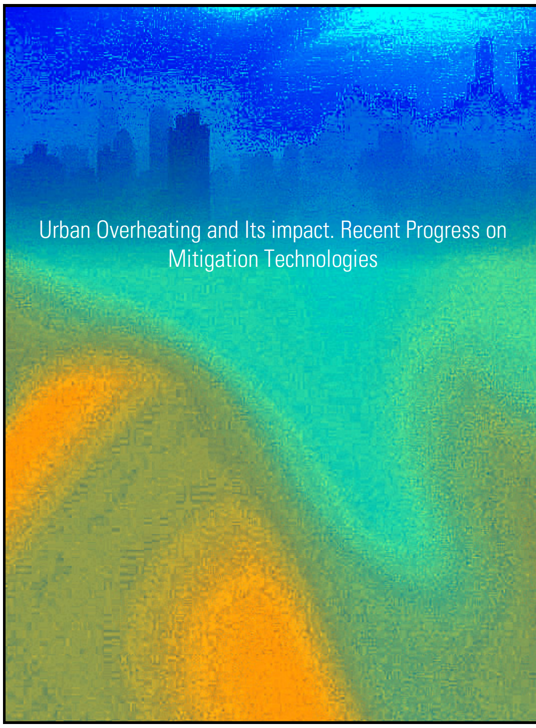
Mid layer: Solar reflective component - layer 1: non-thermal emitter (fluorescent) material (white/metallic or non-white/non-metallic) with fluorescence in (300 nm-λ_{AE}) and high light transmission in (λ_{AE} -2500 nm)

Base layer: Solar reflective component - layer 2: Reflective material with high solar reflection in (λ_{AE} -2500 nm)

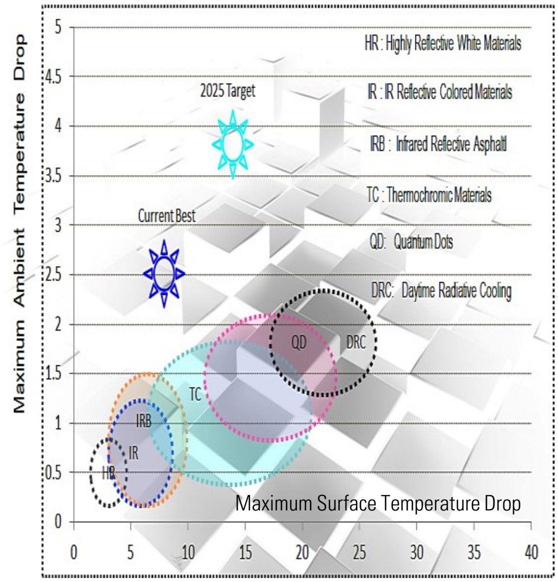
Present and Future Energy Consumption of Buildings: Challenges and Opportunities towards Decarbonisation

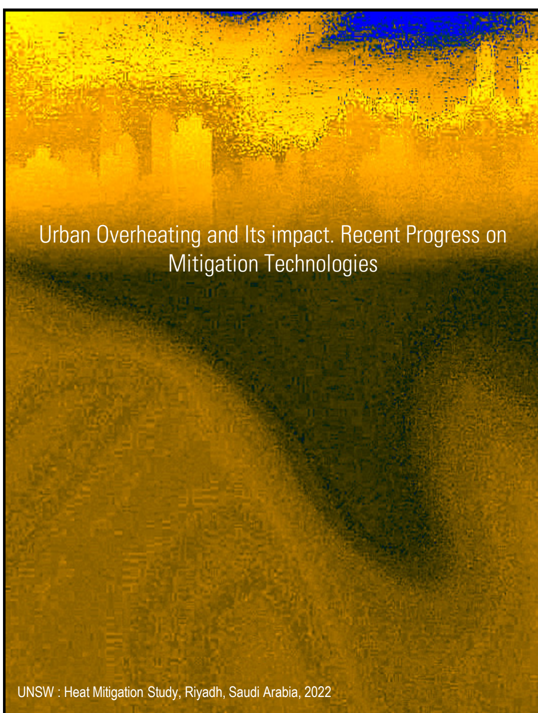
Development in Heat Mitigation Technologies



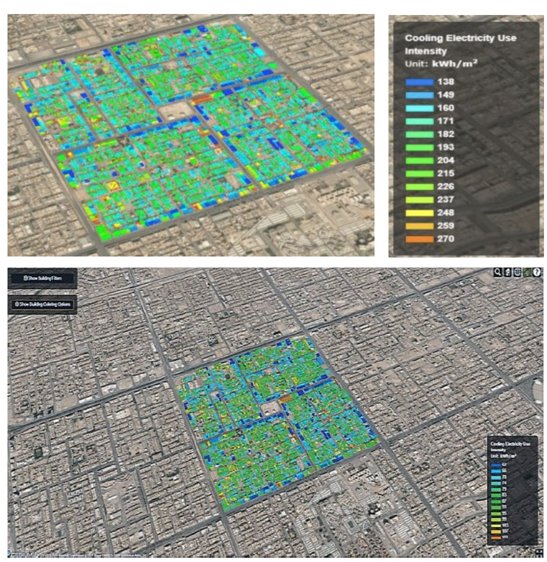


Development in Heat Mitigation Technologies





Energy Impact of Heat Mitigation Technologies
Cooling Energy Demand - Mitigation



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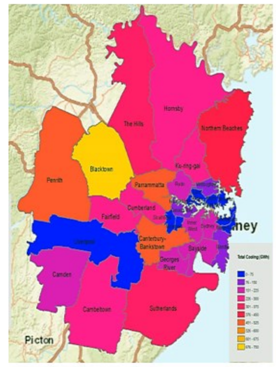
UNSW – DISER : Australian Cool Roof Study , 2022

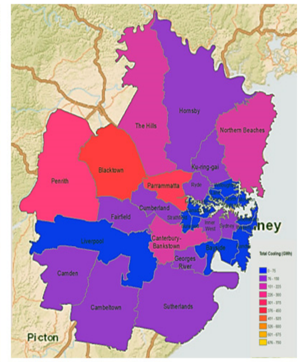
Energy Impact of Heat Mitigation Technologies

Reference



Total Cooling Consumption Residential and Commercial Buildings : 6300 GWh

Cool Roofs at the City and Building Scale



Total Cooling Consumption Residential and Commercial Buildings : 3260 GWh

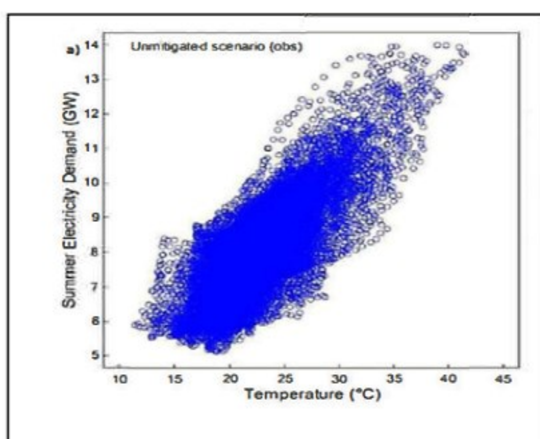
49 %

Urban Overheating and Its impact. Recent Progress on Mitigation Technologies

UNSW – DISER : Australian Cool Roof Study , 2022

Energy Benefits Heat Mitigation Technologies

Potential decrease of the peak hourly cooling demand caused by the implementation of cool roofs

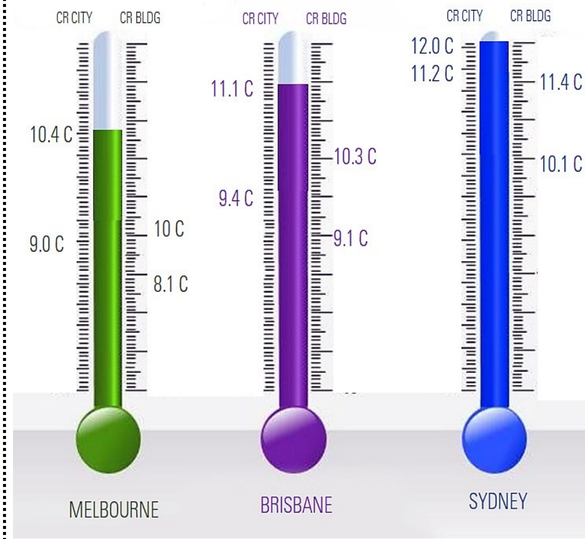


Urban Overheating and Its impact. Recent Progress on Mitigation Technologies

UNSW – DISER : Australian Cool Roof Study , 2022

Environmental and Other Benefits of Heat Mitigation Technologies

Reduction of the maximum indoor air temperature _low-rise office without roof insulation



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Urban Overheating and Its impact. Recent Progress on Mitigation Technologies

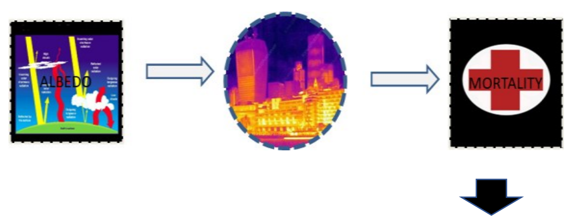
M. Santamouris and F. Fiorito : On the Impact of Modified Urban Albedo on Ambient Temperature and heat Related Mortality, Solar Energy 216, March 2021 493-507

Environmental and Other Benefits of Heat Mitigation Technologies

0.1 increase albedo

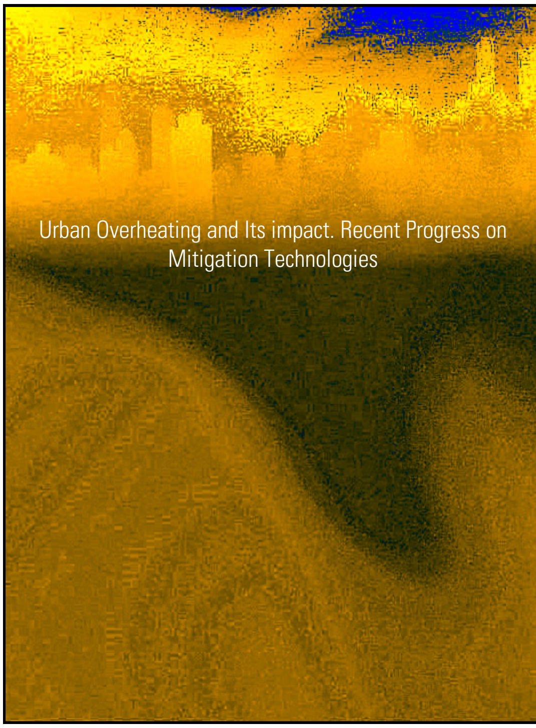
Decrease 0.09 C 17 PM Temp

Drop 0.1 to 4 deaths per day

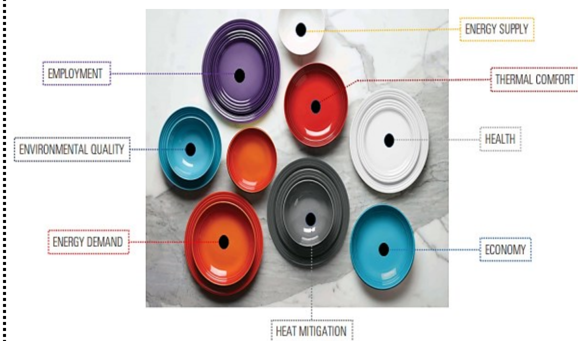


- An average decrease of deaths close to 19.8% per degree of temperature drop,
- About 1.8% decrease of mortality per 0.1 increase of the albedo

28



Impact of Heat Mitigation Technologies



ADSORPTION CHILLER AND ITS APPLICATIONS

Assoc. Prof. Dr. Gamze GEDIZ ILIS

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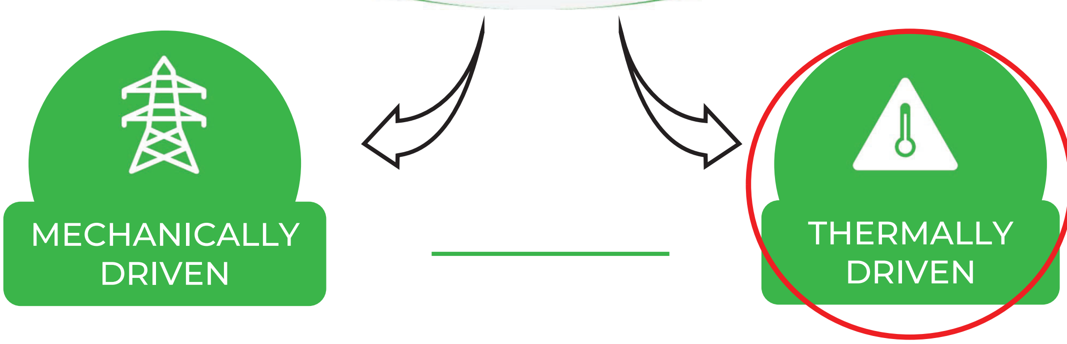
INTRODUCTION

The European Union has decided to reduce CO_2 emissions by 80-95% (according to 1990 level) by 2050.

What is GD – AdC?

https://www.youtube.com/watch?v=rLfsJ-lxZ1E&t=64s

REFRIGERATION SYSTEMS

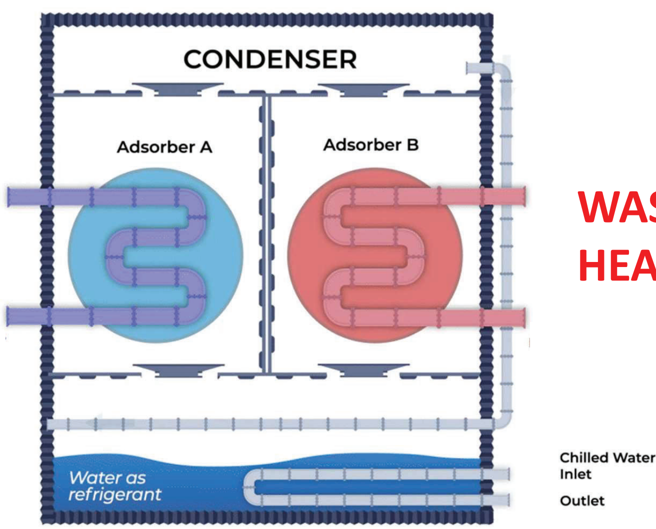


What is GD – AdC?

GD – AdC is an innovative Adsorption Chiller with innovative design

- GD – AdC uses water “H2O” as a coolant.
- Adsorbers use special Silica Gel which is an environmentally friendly material.
- Therefore, GD – AdC is a completely GREEN cooling system.

www.iddconsultancy.com



WASTE HEAT!!

... AdS-CHILLER WORKING PRINCIPLE

www.iddconsultancy.com

G&D Adsorption Chiller

- The IDD team developed G&D, which can convert waste heat from plants into chilled water.
- The produced chilled water can be used for your cooling processes.
- G&D consumes only as much electricity as a light bulb.
- It is completely environmentally friendly without any CO_2 emissions.
- Refrigerant: Water
- Waste heat water temperature: 75-105 °C

Other Adsorption Chillers in the Market



Our Difference: Innovative Adsorber Design

Innovative adsorber design

The condenser of the chiller is placed inside the adsorbers.

Thanks to the new design of the GD – AdC, its weight and size have been reduced.

- Better Functionality
- Light Weight
- Adaptation to different temperatures and flow rates
- Small Size

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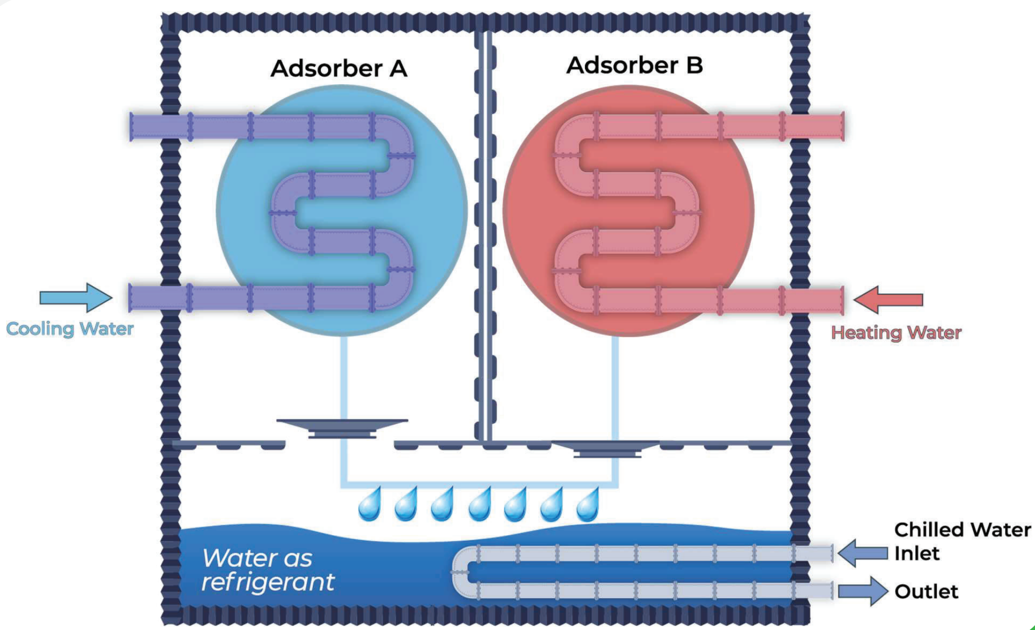

G&D APPLICATION AREAS

- Food and Beverage Facilities
- Casting Plants
- Power Plants
- Solar Power Plants
- Cooling Chimneys
- Chemical Process Plants

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G&D ADVANTAGES

- It is maintenance free and has a lifespan of more than 25 years.
- Low electricity consumption (1 bulb)
- Works without noise and vibration
- Uses waste heat as power source at temperatures as low as 50°C

G&D ADVANTAGES

- Uses water
- Innovative condenser embedded adsorber design
- Environmentally friendly and complies with the Paris Agreement
- It is the lightest and smallest size adsorption cooling system on the market.

G&D I&DD

AdC Disadvantages

G&D

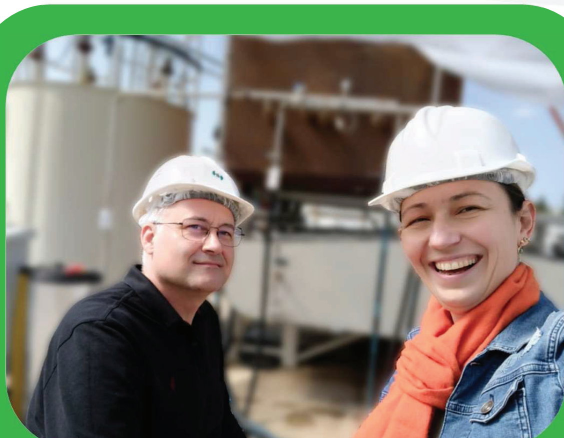
- It requires high technology and special designs to provide high vacuum.
  - Not Problem for G&D ☺
- It has large volume and weight compared to the traditional mechanical heat pump system.
  - Not Problem for G&D ☺
- Its primary energy efficiency value is comparable to conventional heat pumps, while having low specific cooling and heating powers (SCP/SHP) and coefficient of performance (COP).
  - Not Problem for G&D ☺

I&DD

Why Adsorption instead of Absorpsion

	Adsorpsion GD-AdC	Absorpsion Chiller
Life Maintenance	More Than 20 Years Negligible Maintenance	7-9 Years High Maintenance
Dessicant	Innovative Silica Jel	Highly Corrosive Lithium Bromide
Regenerasyon	Down to 50 °C	Shots down 82 °C

G&D Field Works




HOW WE CAN USE G&D AS A SOLUTION OF RESILIENT COOLING

I&DD

RESILIENT COOLING+ G&D

www.iddconsultancy.com

I&DD

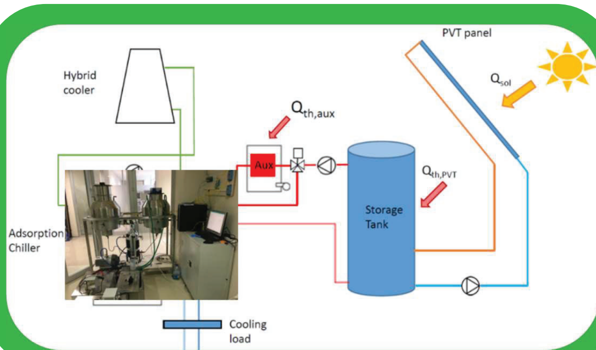
RESILIENT COOLING+ G&D

I&DD

PV-PV/T + G&D

I&DD

PV-PV/T Performance Reduction

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ELSEVIER

Effectiveness and constraints of using PV/Thermal collectors for heat-driven chillers

Stefano Aneli[a,*], Antonio Gagliano[a], Giuseppe Marco Tina[a], Gamze Gediz Ilis[b], Hasan Demir[c]

[a] Department of Electrical, Electronic and Computer Engineering, University of Catania, Catania, Italy
[b] Department of Mechanical Engineering, Gebze Technical University, Turkey
[c] Department of Chemical Engineering, Osmaniye Korkut Ata University, Turkey

PVT+AdC achieves cooling power of around 2.3 kWh/d (0.264 kWh/kW) and even 4.5 kWh (0.515 kWh/kW) more than the PV+VCC system on typical and peak days.

With the greatest power demands (ie on the busiest days), PVT+AdC provides the highest electrical efficiency and contributes to reducing the risks of power outages.