

Ensuring thermal comfort in our homes, offices, schools and public buildings

The impact of lifestyle and user behavioral choices on space cooling demands

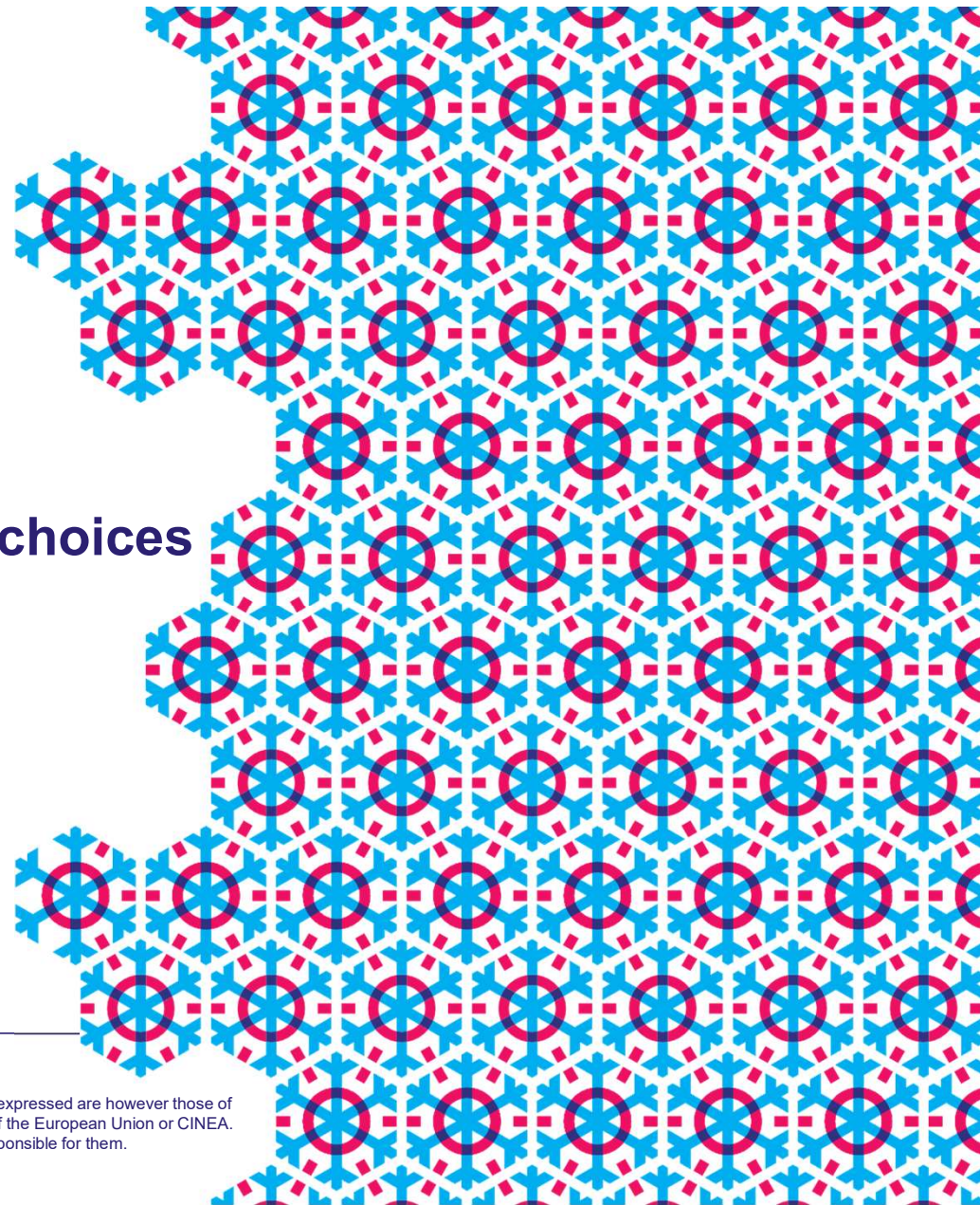
Simon Pezzutto (EURAC) and Adrienn Gelesz (ABUD)

Cooling Down Day 2025

Brussels on the 3rd of April 2025



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LIFE21-CET-COOLING-CoolLIFE

Open-Source Tools to Face the Increase in Buildings' Space Cooling Demand

<https://coollife.revolve.media/>



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CoolLIFE Tools (tool and knowledge hub)



CoolLIFE Tool – Toolchain



<https://tool.coollifeproject.eu/map>

CoolLIFE Knowledge Hub

Knowledge Hub

Search Knowledge Hub



All Knowledge Hub resources:

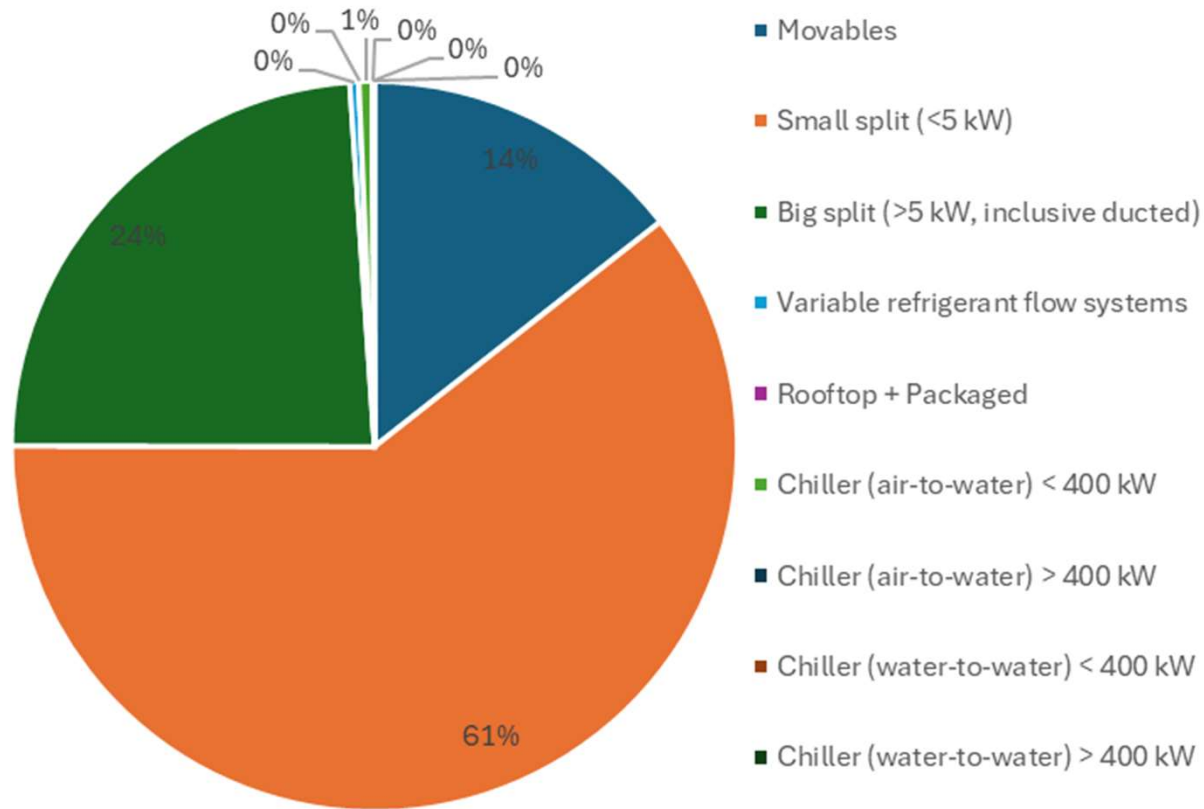
<https://knowledgehub.coollifeproject.eu/>



Technologies utilized in homes, offices, schools and public buildings

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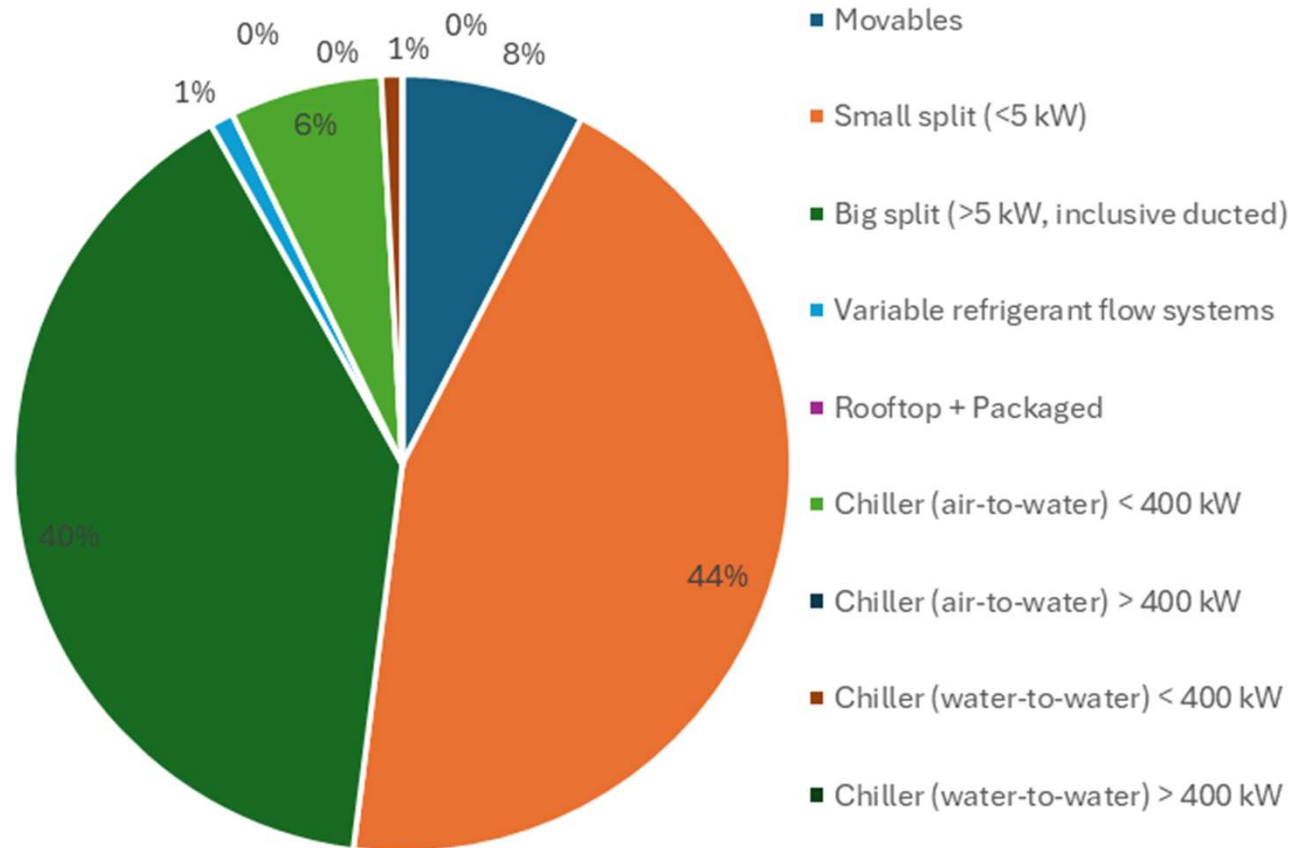
Homes



Number of units

Technologies utilized in homes, offices, schools and public buildings

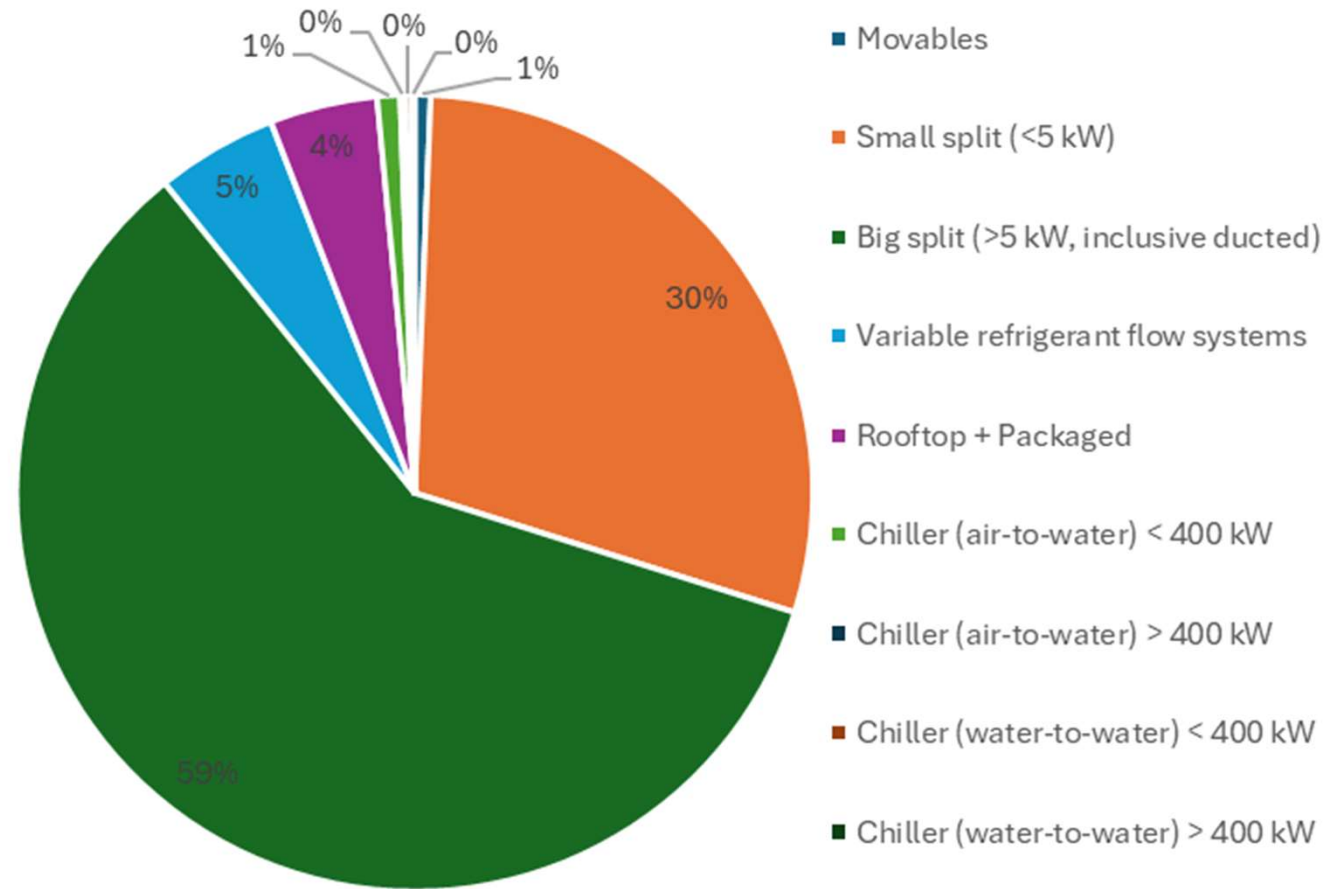
Homes



Final energy consumption

Technologies utilized in homes, offices, schools and public buildings

Service sector

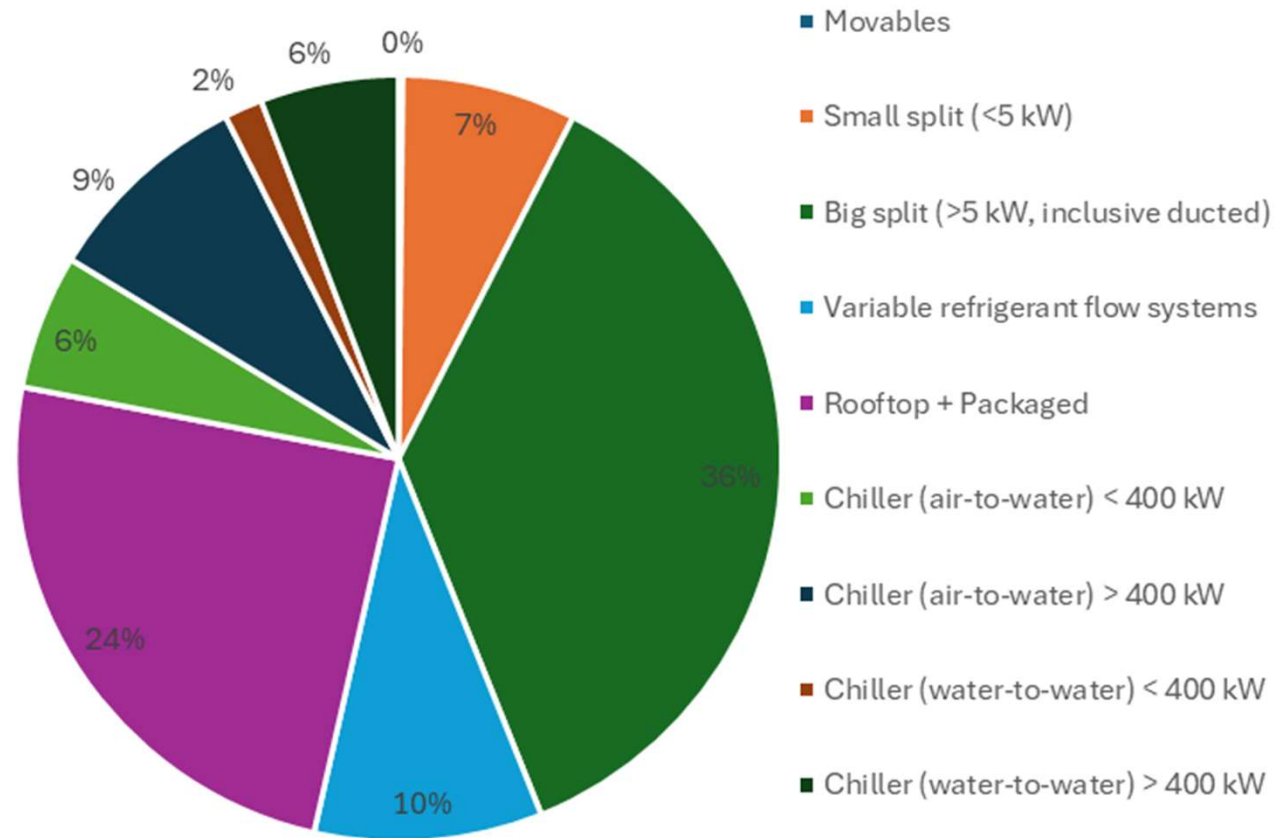


Number of units



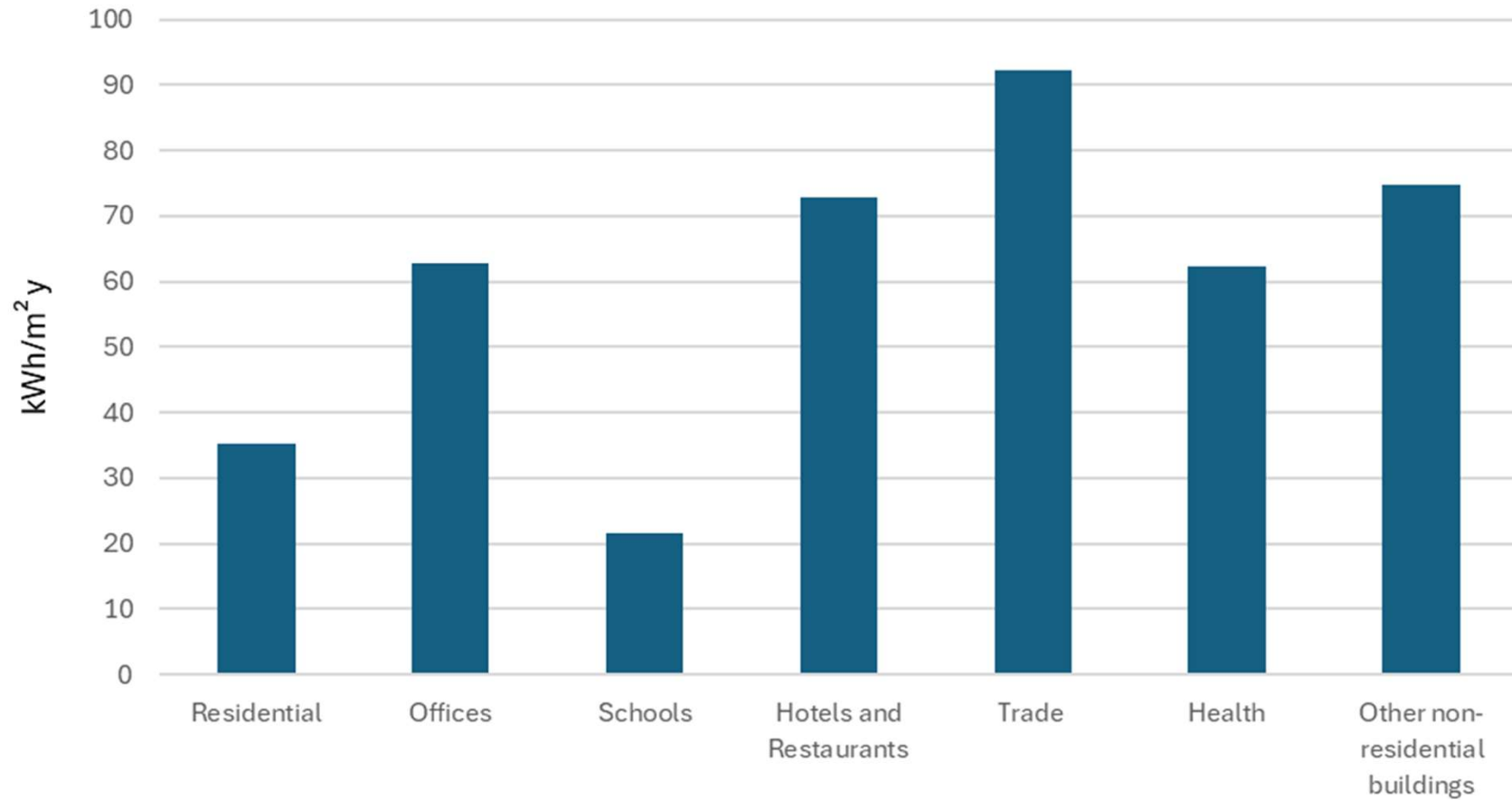
Technologies utilized in homes, offices, schools and public buildings

Service sector



Final energy consumption

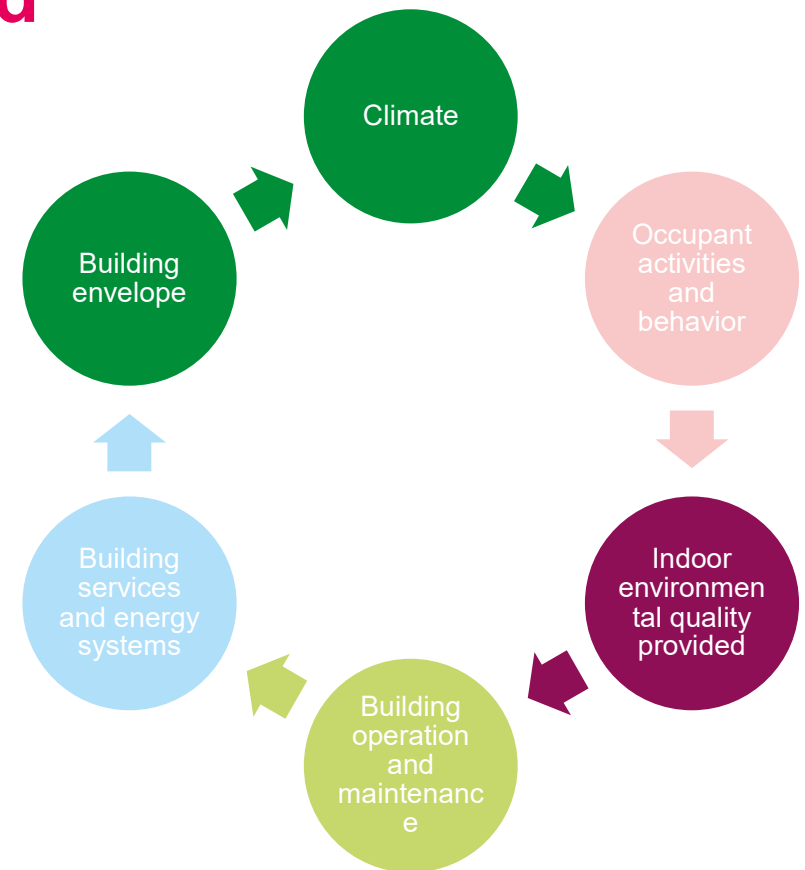
Useful energy demand per Sector/Subsector



Tackling the increasing SC demand

Topics addressed:

- Identification of passive and comfort, lifestyle, user behavioural measures
- Analysis of occupant presence and behavioural patterns
- Quantification of impacts of behavioral and lifestyle choices
- Collection and analysis of behavioral Interventions
- Co-benefits of energy efficiency investments



IEA EBC annex 53:
Six factors identified that influence energy consumption of buildings

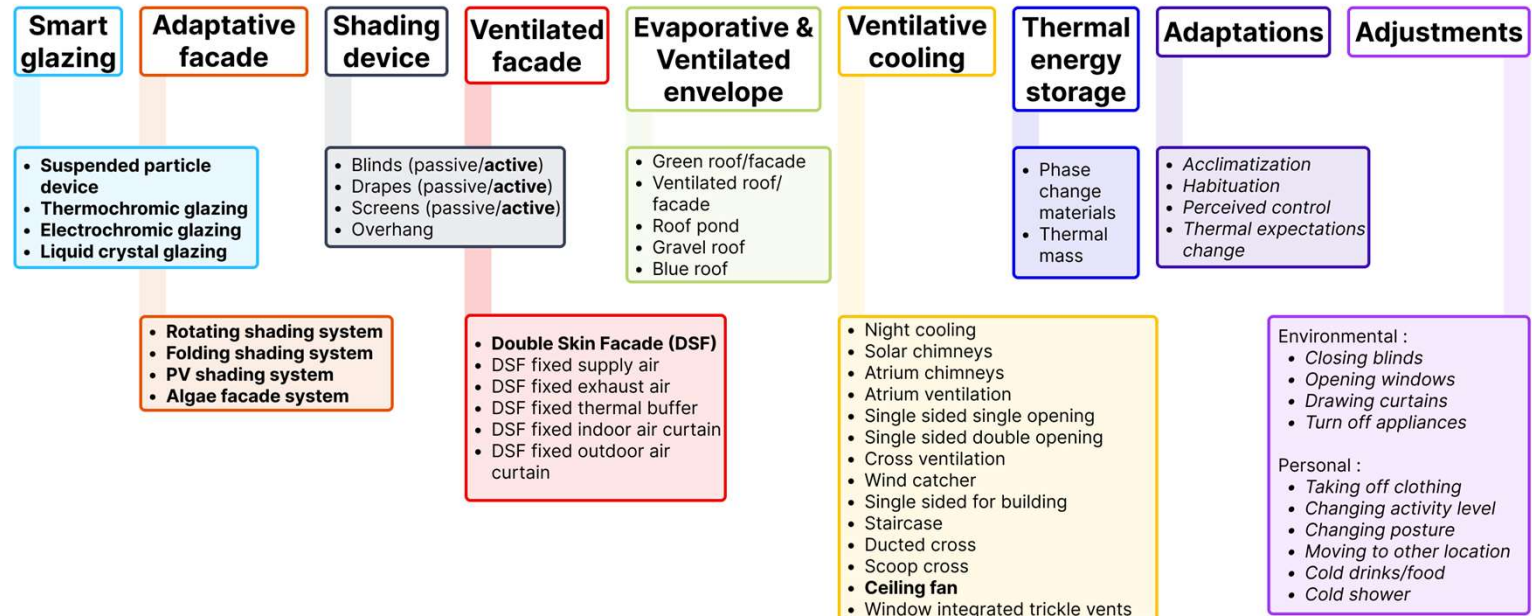
CoolLIFE Measures taxonomy

Investigation of:

- **Actives measures:** active shading systems, mechanical ventilation, automation and control systems
- **Passive measures:** natural ventilation, windows shades and blinds, building insulation
- **Comfort, lifestyle and user behaviour solutions:** comfort-responsive control strategies, adaptative comfort

Approach

- Screening of :
 - Scientific and technical literature
 - International Patent Classification
 - Manufacturers, suppliers, retailers
- Interviews of dedicated experts



Type: Active / Passive / Lifestyle

For the most part, these technologies are **on the way to the market** (TRL = 6-9)

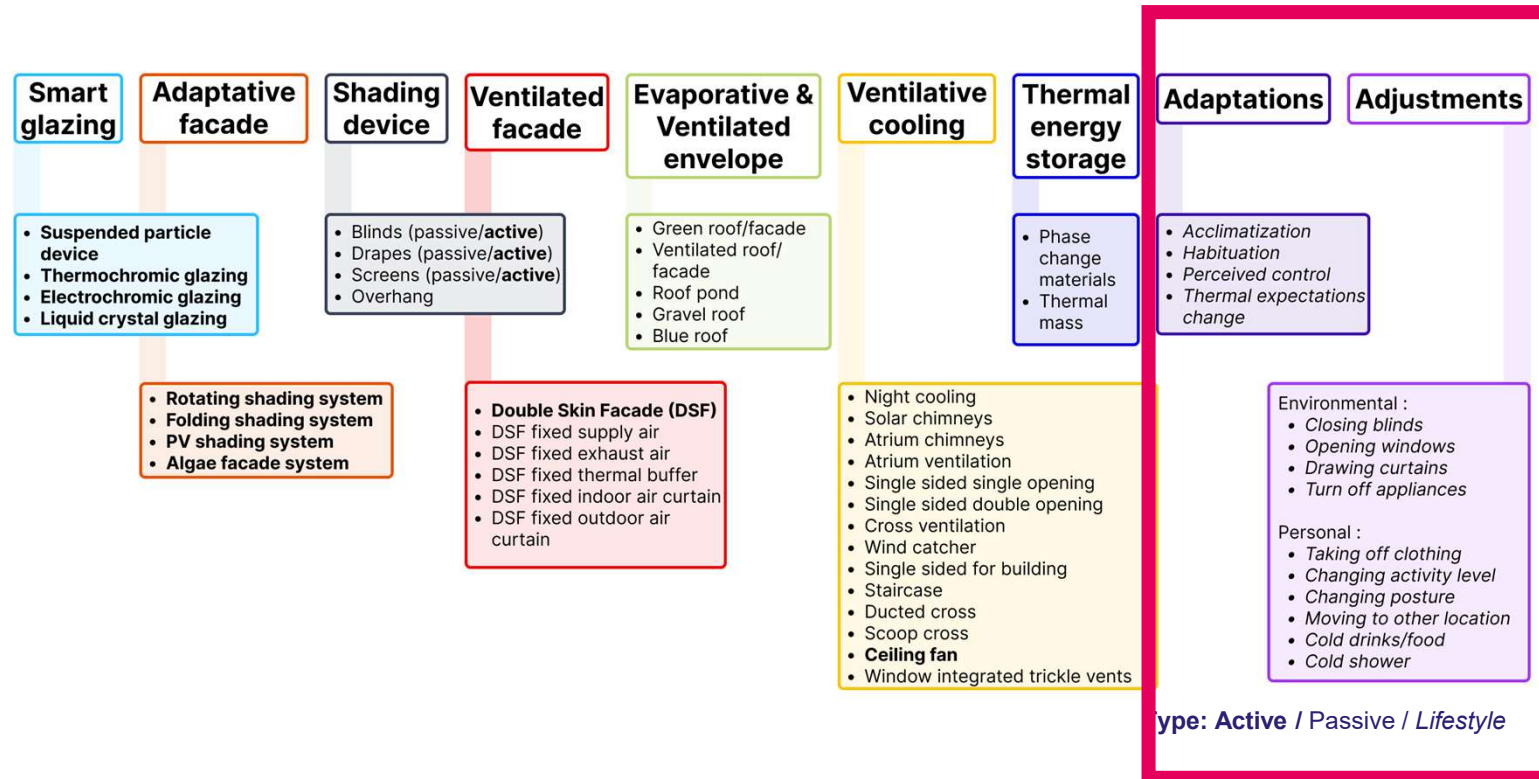
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Household survey for Hungary

Methodology

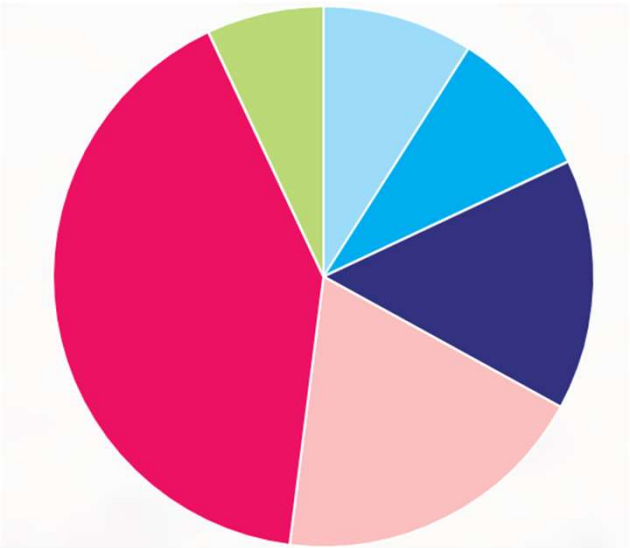
- ✓ Hungary
 - ✓ 75 questions in 5 sections
 - ✓ Multidisciplinary approach
-
- Patterns of energy demand, energy efficiency, and energy use in everyday situations;
 - Schedules of occupancy, differentiated by weekdays and weekends;
 - Space cooling related comfort requirements; Thermal comfort and practices, including coping strategies with hot weather;
 - Location and characteristics of dwelling
 - Characteristics of households: socio-economic characteristics as gender, age, education level and financial situation.

More information: <https://coolife.revolve.media/resources/>
D3.1 Knowledgebase for occupant-centric space cooling

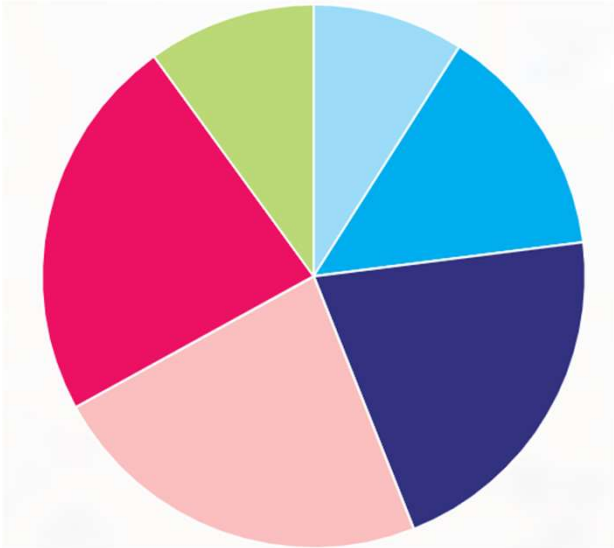


A. Gelesz, A. Csizmady, Z. Ferencz, L. Kőszeghy, A. Vincze, A. Reith: Residential space cooling behaviour – results from a country-wide representative survey in Central Europe, BEHAVE 2023 7th European Conference on Behaviour Change and Energy Efficiency Maastricht, 28-29 November 2023

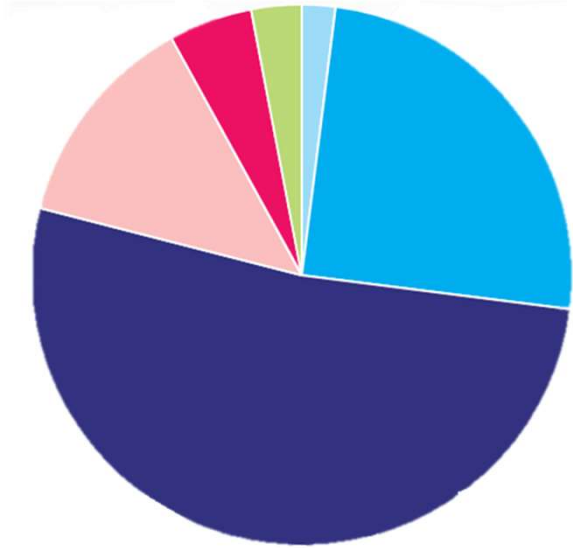
Preferred temperatures in dwellings



Hungary (CoolLIFE survey)

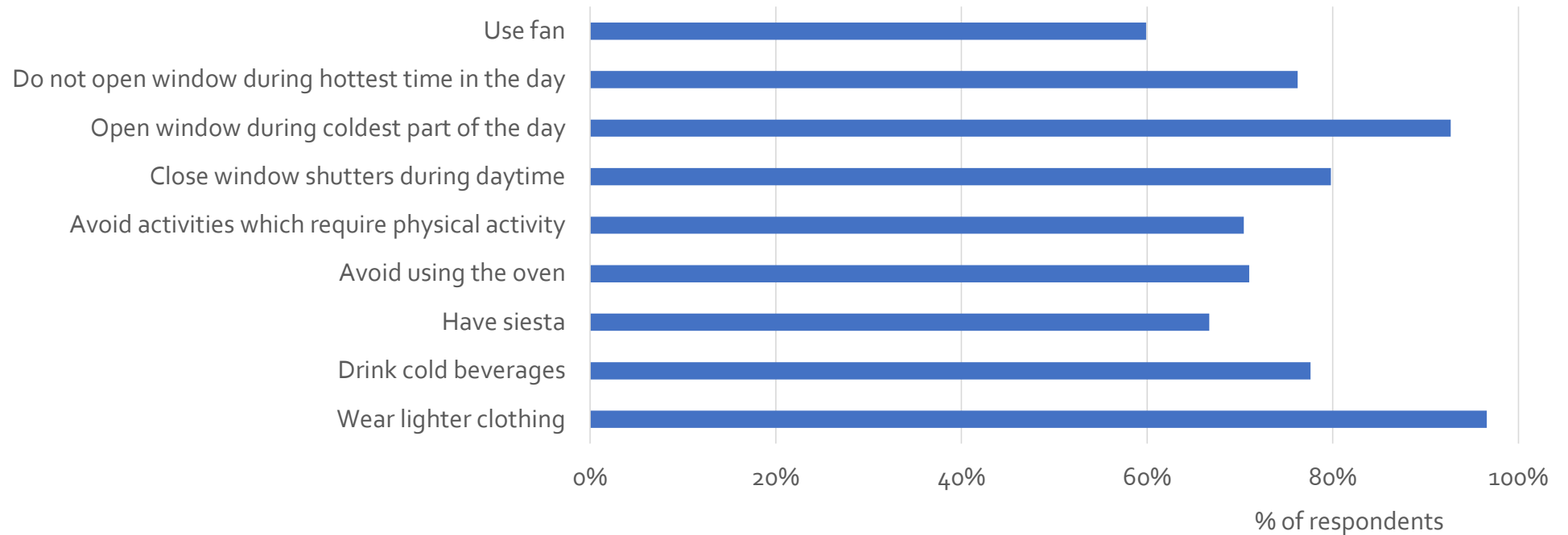


France (Enable.EU)



Germany (Enable.EU)

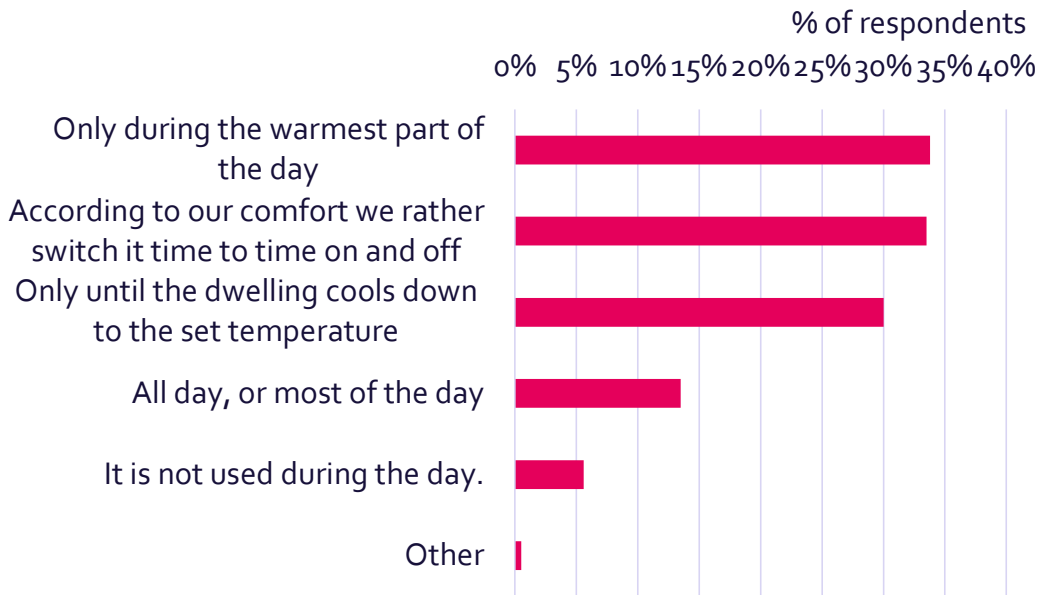
Measures applied on hot days



More information: <https://coollife.revolve.media/resources/>
D3.1 Knowledgebase for occupant-centric space cooling

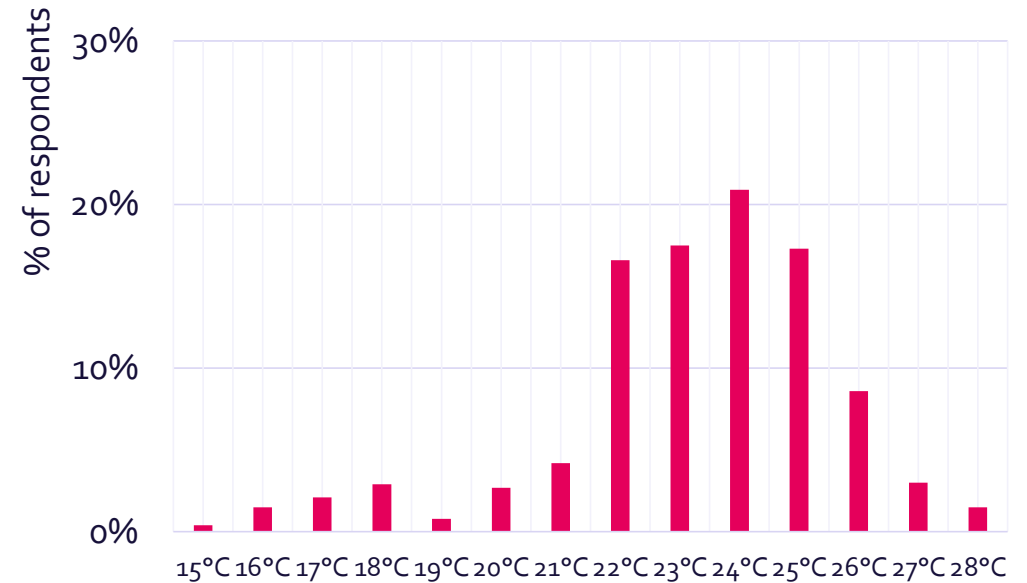
Air conditioning use

For how long do you use air conditioning during the day once you use it?



More information: [https://coollife.revolve.media/resources/D3.1 Knowledgebase for occupant-centric space cooling](https://coollife.revolve.media/resources/D3.1%20Knowledgebase%20for%20occupant-centric%20space%20cooling)

**What temperature do you aim for once you use air conditioning?
A fixed temperature.**



Quantification of the effect of OPA on space cooling demand

- 6 locations selected through on social and climatic factors
- 3 behavioural scenarios

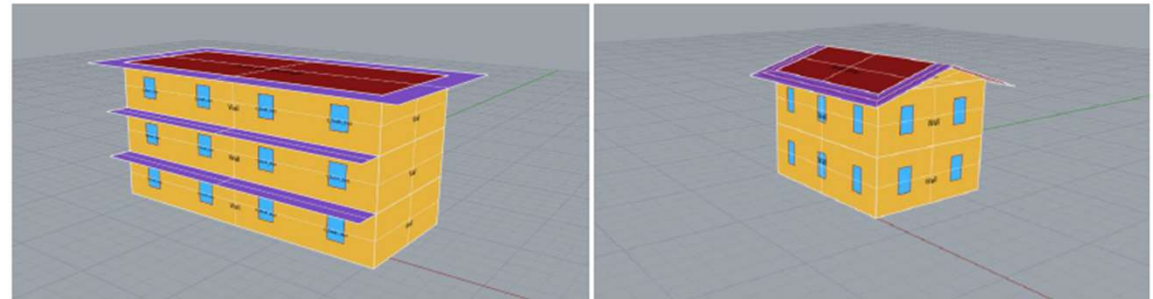
Residential building types

- Single Family House
- Multifamily House
- Apartment Buildings

Non-residential

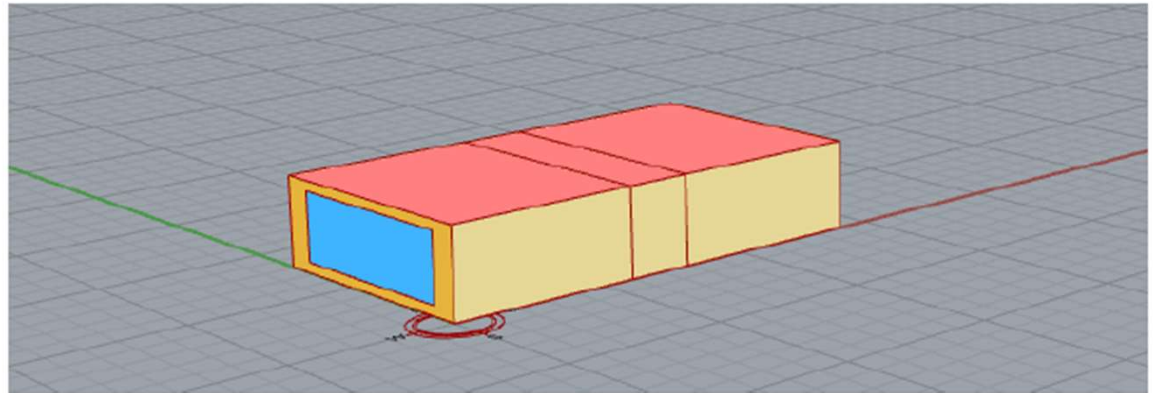
- Education (Classroom)
- Hotel (Hotel Room)
- Office (Open Office)
- Healthcare (Hospital Ward)

- Climate change (RCP4.5): 2020, 2050, 2080



Multifamily

Single family



Non-residential building spaces

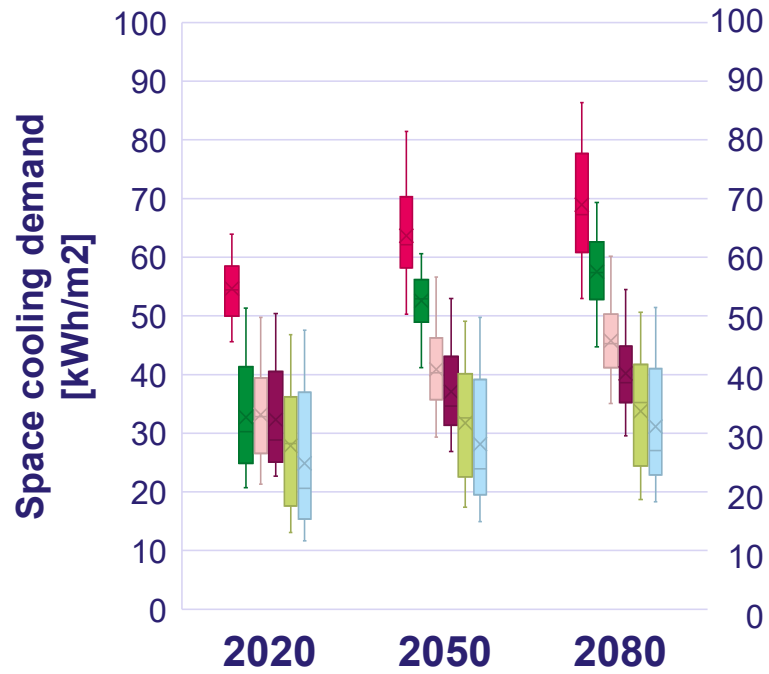
Impact of behavioural choices

User behaviour scenario	BASELINE unconscious	MITIGATION occupants react to a discomfort condition	ADAPTATION occupants prevent the discomfort condition
Indoor temperature expectations	Cooling setpoint (category 2 EN 16798-1: 26°C)	Adaptive thermal model (EN 16798-1)	Adaptive thermal model, night setback (h22-7) and fans (EN 16798-1)
Ventilation	Constant ventilation rate	Daytime natural ventilation (7am - 10pm)	Daytime natural ventilation and night ventilation
Shading control	no dynamic shading system or control	Shading are activated if the building zone is overheated and if the solar radiation on window is significant (higher than 400 W/m ²)	Shading are activated everytime the solar radiation on window is higher than 150 W/m ² to prevent building overheating
Internal loads	lighting and appliances standard use profile from EN 16798.	Lighting and appliances reduced profile	Lighting and appliances reduced profile

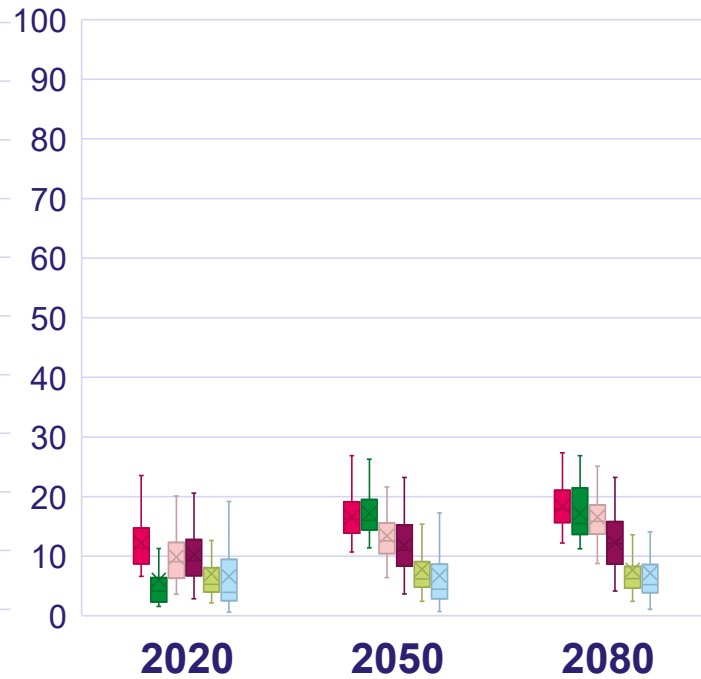
Results - Residential

- Milan (IT)
- Berlin (DE)
- Budapest (HU)
- Amsterdam (NL)
- Innsbruck (AT)
- Stockholm (SE)

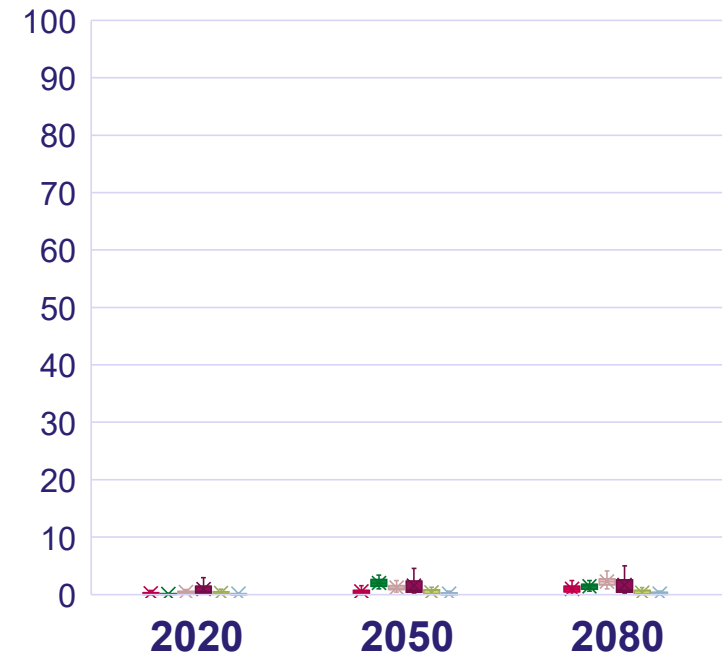
Unconscious



Mitigation

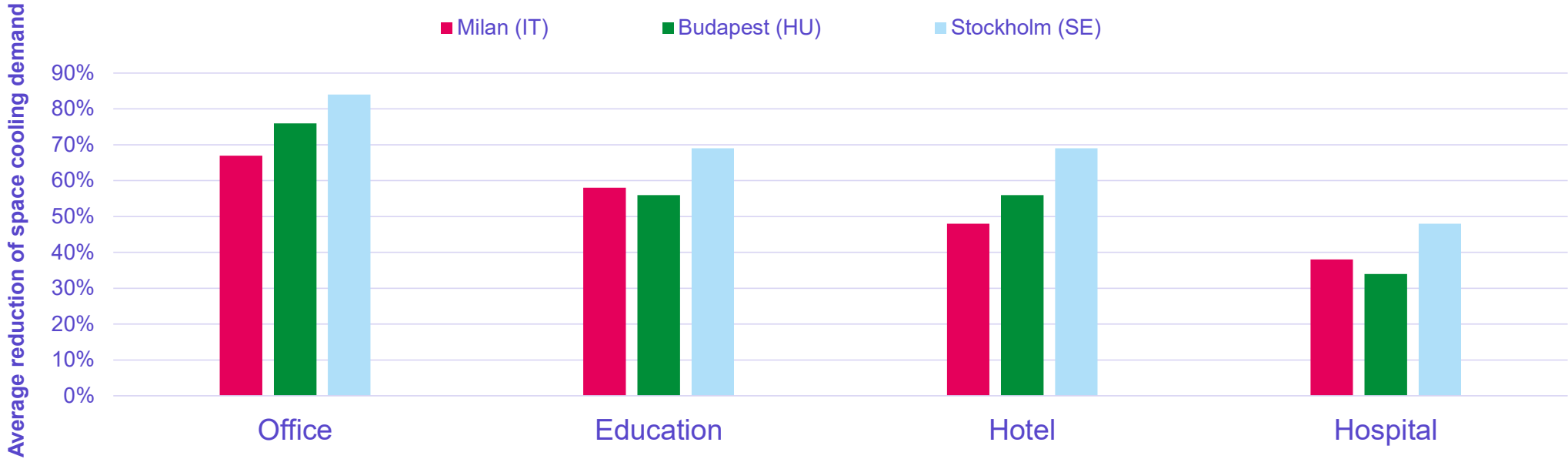


Adaptation



Results – non-residential

Percentage reduction from the worst to the best performing behavioural combination



Behavioural interventions

- **Providing feedback and information** on energy consumption to promote energy conservation of SC appliances (and other appliances that generate heat loads), encourage setting higher SC set-points, motivate the uptake of natural ventilation (including night-time ventilation), and encourage adaptive health-related behaviours during extreme heat events.
- **Monetary incentives** (i.e.: dynamic pricing) to shift peak load, encourage pre-cooling, and promote energy conservation of SC appliances.
- **Nudging** occupants, through social comparisons or default settings, to conserve electricity in their usage of SC appliances (and other appliances that generate heat loads), set higher SC set-points motivate the uptake of natural ventilation measures, and adopt efficient shading practices.
- **Policy** best practices on providing cool spaces or relaxing requirements for opening hours or thermal setpoints

Behavioural interventions

Feedback and information

Feedback
Feedback with videos demonstrating alternatives for comfort, using positive language
Information provision through ambient displays

Up to 16% savings

Monetary incentives

Dynamic pricing: Real-time pricing (RTP)
Dynamic pricing: Time-of-use tariff (ToU)
Dynamic pricing: Critical Peak Pricing (CPP)

Up to 8.7% load shift

Nudge

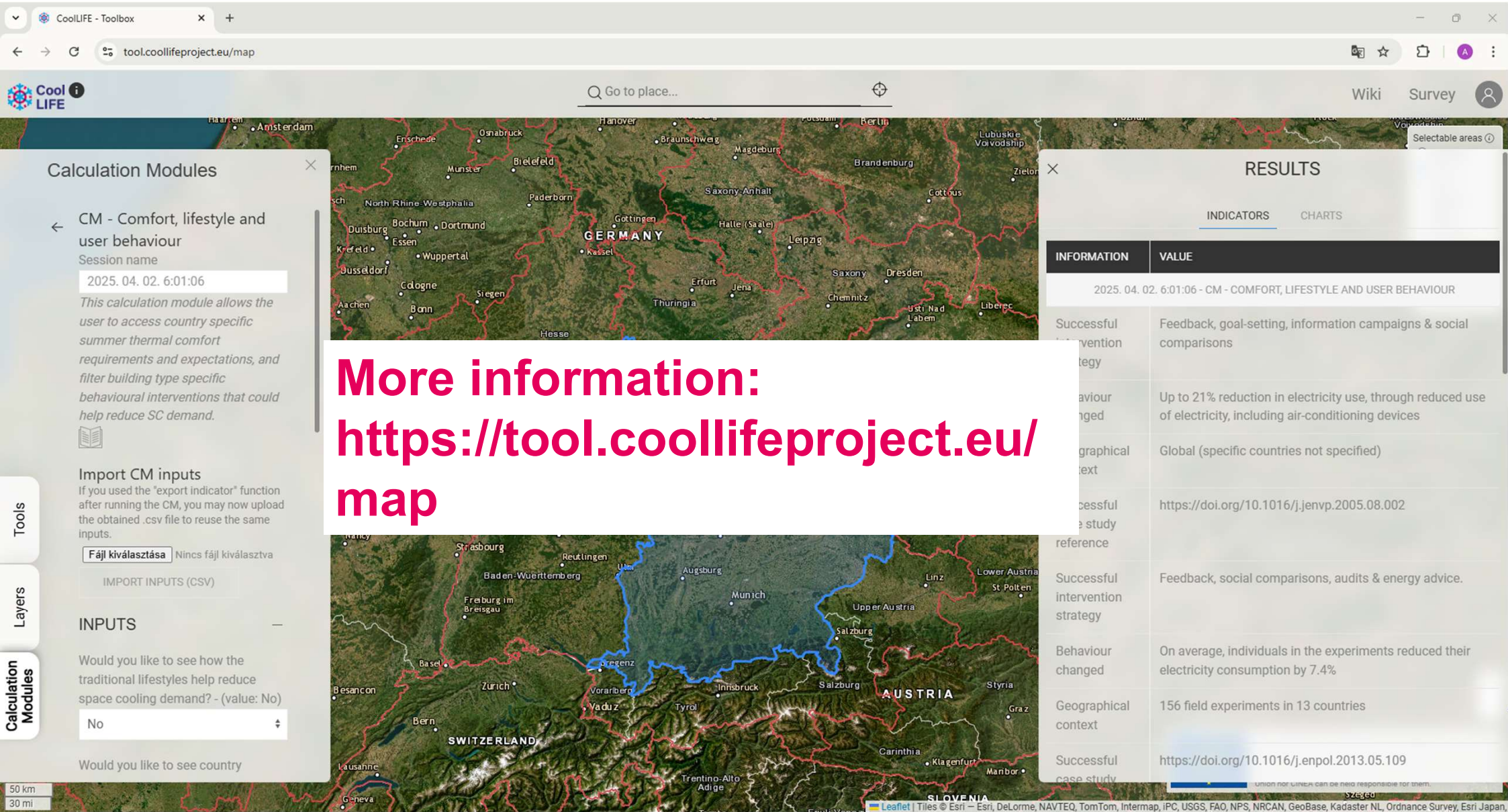
Engagement strategy - Information provision and default shading system settings.
Feedback & framing
Gamification through an App
Social comparisons
Serious games and gamification

**Up to 30% savings
1.52°C temperature increase**

Policy

"Summer Fridays"
Course scheduling
Flexible workplace attire in summer months
Policy implementation of higher setpoints
Providing "cool islands" promoted through an app

**Reduced heat mortality,
20% reduction in energy**



**More information:
<https://tool.coollifeproject.eu/map>**

Calculation Modules

CM - Comfort, lifestyle and user behaviour

Session name

2025. 04. 02. 6:01:06

This calculation module allows the user to access country specific summer thermal comfort requirements and expectations, and filter building type specific behavioural interventions that could help reduce SC demand.

Import CM inputs

If you used the "export indicator" function after running the CM, you may now upload the obtained .csv file to reuse the same inputs.

Fájl kiválasztása Nincs fájl kiválasztva

IMPORT INPUTS (CSV)

INPUTS

Would you like to see how the traditional lifestyles help reduce space cooling demand? - (value: No)

No

Would you like to see country

RESULTS

INDICATORS CHARTS

INFORMATION	VALUE
2025. 04. 02. 6:01:06 - CM - COMFORT, LIFESTYLE AND USER BEHAVIOUR	
Successful intervention strategy	Feedback, goal-setting, information campaigns & social comparisons
Behaviour changed	Up to 21% reduction in electricity use, through reduced use of electricity, including air-conditioning devices
Geographical context	Global (specific countries not specified)
Successful case study reference	https://doi.org/10.1016/j.jenvp.2005.08.002
Successful intervention strategy	Feedback, social comparisons, audits & energy advice.
Behaviour changed	On average, individuals in the experiments reduced their electricity consumption by 7.4%
Geographical context	156 field experiments in 13 countries
Successful case study reference	https://doi.org/10.1016/j.enpol.2013.05.109

Thank you for your attention

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