COOLING INDOOR SPACES USING ADIABATIC METHODS

HAZARD

HEAT

IMPLEMENTATION STEP

CONSTRUCTION

RENOVATION

BUILDING IN OPERATION

AREA OF ACTION

COOLING

COSTS

€ € €

low medium high

LEVEL OF SKILL

medium

In the face of rising temperatures and increasing heatwaves, adiabatic cooling offers a sustainable cooling solution. The principle behind this system is simple: water is sprayed onto hot air, which loses heat and cools as the water evaporates. Adiabatic cooling is a low-consumption cooling strategy that can be implemented in new and existing buildings.

IMPACTS

Adiabatic cooling can **lower the temperature by several degrees:** from an initial temperature of 32°C with 30% humidity, the temperature is reduced to 25°C by increasing the humidity to 60% (*Les guides bio-tech – confort d'été passif*, 2014).

However, its usefulness is limited to countries subject to occasional or continuous periods of dry heat; this is because the lower the humidity level, the more water the air is able to absorb and therefore cool down.

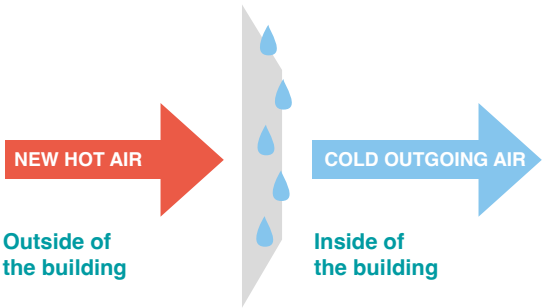
The system has a double impact because it contributes to both adaptation and mitigation: adiabatic cooling consumes up to 10 times less energy than air-conditioning and doesn't release heat to the outside world.

INSTALLATION GUIDE

There are two types of adiabatic cooling system:

- **Direct adiabatic cooling**, in which the fresh air is cooled directly by humidification. This system is reserved for large spaces with a low human occupancy rate (e.g. factories or large surfaces) because the air supplied is very humid.
- **Indirect adiabatic cooling**, in which fresh air is cooled by heating stale air, which is humidified. This system provides better control of room humidity and can be used in spaces with high occupancy rates.

DIRECT ADIABATIC COOLING OPERATING DIAGRAM



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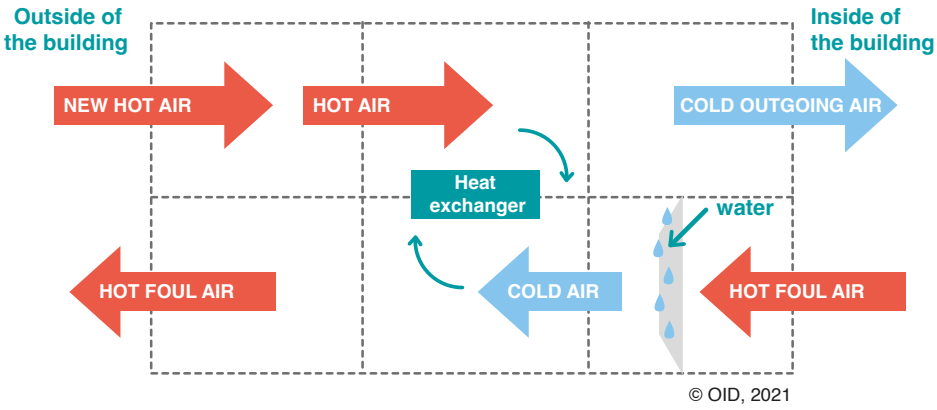
INDIRECT ADIABATIC COOLING OPERATING DIAGRAM



WEAK POINTS AND STRONG POINTS

⊖ Installing an adiabatic cooling system can lead to an **increase in water consumption**, which must be anticipated. To limit this increase and improve the building's resilience, adiabatic cooling can be fitted with an integrated water reuse function or coupled with a rainwater harvesting system.

⊖ In some cases (when using hard water or rainwater), the water used needs to be pre-treated before entering the cooling system. This **pre-treatment can be costly** and should be taken into account when considering this system.

⊕ Unlike natural ventilation systems, which require a specific architectural layout, passive cooling **can be used in almost any building**. It's an attractive option for both commercial and residential buildings, provided that suitable equipment is selected.

MALADAPTATION

Maladaptation can result from the following:

Insufficient adiabatic cooling

If adiabatic cooling is the only or main method of ensuring thermal comfort in summer, this could lead to dependency. As heat waves become more frequent and/or more intense, the method may not be sufficient to maintain comfortable indoor conditions. It's therefore essential to consider adiabatic cooling solutions as part of a comprehensive and diversified approach to tackling climate change.

Increased pressure on water resources

Adiabatic cooling can require a significant amount of water, particularly in large-scale systems such as those used in industrial or commercial buildings. In regions already facing water shortages, the intensive use of water for adiabatic cooling can exacerbate the situation by putting more pressure on local water resources.

FIND OUT MORE

Agence Parisienne du Climat (APC) (2020), Adapter mon logement aux fortes chaleurs

Agence Régionale de l'Environnement et des Nouvelles Energies (ARENE), Île-de-France and *Institut pour la Conception Écoresponsable du Bâti* (ICEB) (2014), Guide bio-tech: confort d'été passif

Guide bâtiment durable Brussels (2016), Refroidissement adiabatique

PROFEEL (2021), Guide RAFRAICHISSEMENT ADIABATIQUE dans les batiments tertaires en rénovation

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MONITORING INDICATORS

ESSENTIAL RECOMMENDATIONS WORTH THINKING ABOUT

- FAVOUR AN ADIABATIC COOLING SYSTEM THAT REUSES WATER
- COMBINE ADIABATIC COOLING SYSTEMS WITH RAINWATER RECOVERY SYSTEMS

MONITOR MY ACTIONS FOR CLIMATE CHANGE ADAPTATION

+/– : Quantitative indicator ★ : Qualitative indicator

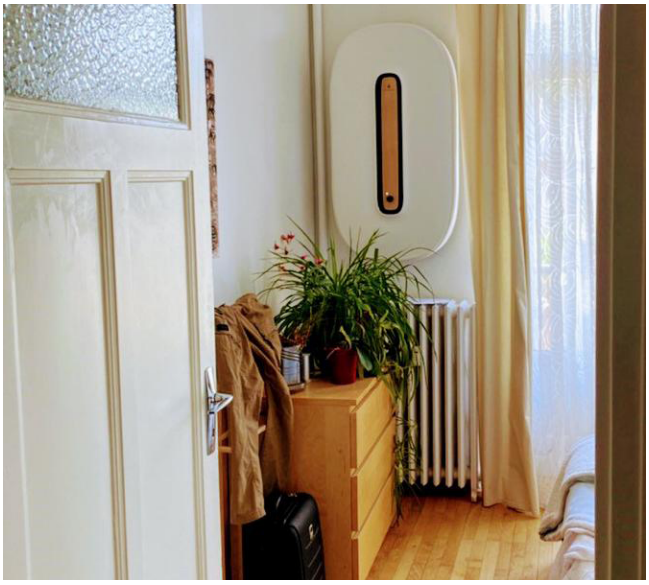
INDICATORS OF MEANS	INTERPRETATION
+/– Percentage of essential recommendations followed (%)	The maximum number of recommendations must be implemented
+/– Monthly water consumption (m^3)	To be minimised

INDICATORS OF RESULTS	INTERPRETATION
+/– Comparison between the indoor temperature using the adiabatic method and that of a control situation* (°C)	Indoor temperature using adiabatic method < control situation*.
+/– Comparison between energy consumption using the adiabatic method and a control situation* (kWh)	Energy consumption using adiabatic method < control situation*.
+/– Percentage of cooling requirements covered by the adiabatic method (%)	To be maximised

** The control situation is defined by the parameters established to isolate the influence of the adaptation action (similar conditions: weather, time of measurement, space, etc.).*

TOOL

● *Cerema* has designed the *RITE* tool (Risque d'Inconfort Thermique d'Été - **Risk of Thermal Discomfort in Summer**) to rapidly evaluate the indoor summer comfort of new buildings and renovations in response to climate change. Easy to use by all actors in the building sector, *RITE* has so far only been developed for residential housing.



Credits: Caeli Energie - Module Caeli One

REAL-LIFE EXAMPLE

ALPES ISÈRE HABITAT

REAL-LIFE EXAMPLE : ALPES ISÈRE HABITAT
USE: RESIDENTIAL
COST: 12,000€ TTC FOR 3 MODULES (PURCHASE AND INSTALLATION)

This feedback comes from the AdaptaVille.fr project, from the *Agence Parisienne du Climat*.

In 2024, the *Agence Parisienne du Climat* met with the social landlord *Alpes Isère Habitat* who installed adiabatic cooling modules in 3 of its flats in 2023. The aim was to offer an environmentally-friendly alternative to air conditioning to voluntary tenants who were affected by problems of overheating. Located in a 1970s building suffering from a lack of thermal insulation, each of these 2 or 3 bedrooms flats was fitted with an adiabatic cooling unit from Caeli Energie in its main room. The modules were installed in half a day by an experienced heating plumber, in the presence of the tenants. As part of a CSTB programme, sensors were installed in the equipped rooms, confirming the effectiveness of the system compared with adjoining flats that were not equipped. During heat peaks in the summer of 2023, when the outside temperature sometimes rose to over 40°C, the inside temperature did not exceed 27°C. One weak point was noted by residents: the noise emitted by the modules when they are in operation, particularly when maximum power is activated.

More information on this feedback on AdaptaVille.fr