Module 1
Chapter 1
Indoor Air, Thermal and Daylight Quality

Training Material
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Thematic area	Key Performance Indicator (KPI)		Unit	Reference framework
Thermal comfort	KPI 9	Percentage of time outside of thermal comfort range	[%]	4.2 Level(s)

Objective

- The control of thermal comfort is an important factor to consider in all buildings because uncomfortable circumstances can put more vulnerable residents at risk from illnesses, reduce the productivity level of the occupants, and/or may necessitate the usage of additional cooling/heating energy

Applicability

Building use:

- Residential
- Non-residential

Project stage:

- Design
- Construction / As Built
- In Use

KPI 9 Percentage of time outside of thermal comfort range

Description

- This indicator measures the percentage of time of the year, during occupation periods, when building occupiers are not comfortable with the thermal conditions inside a building.

- The indicator also seeks to measure the ability of a building (with and without building services) to maintain pre-defined thermal comfort conditions during the heating and cooling seasons

- Thermal comfort is supposed to be guaranteed when the indoor temperature in each space or zone that accounts for >10% of the reference area of a building is within a range of 18°C to 27°C. (Category III EN 16798-1 Table B.5/ Category C EN ISO 7730)

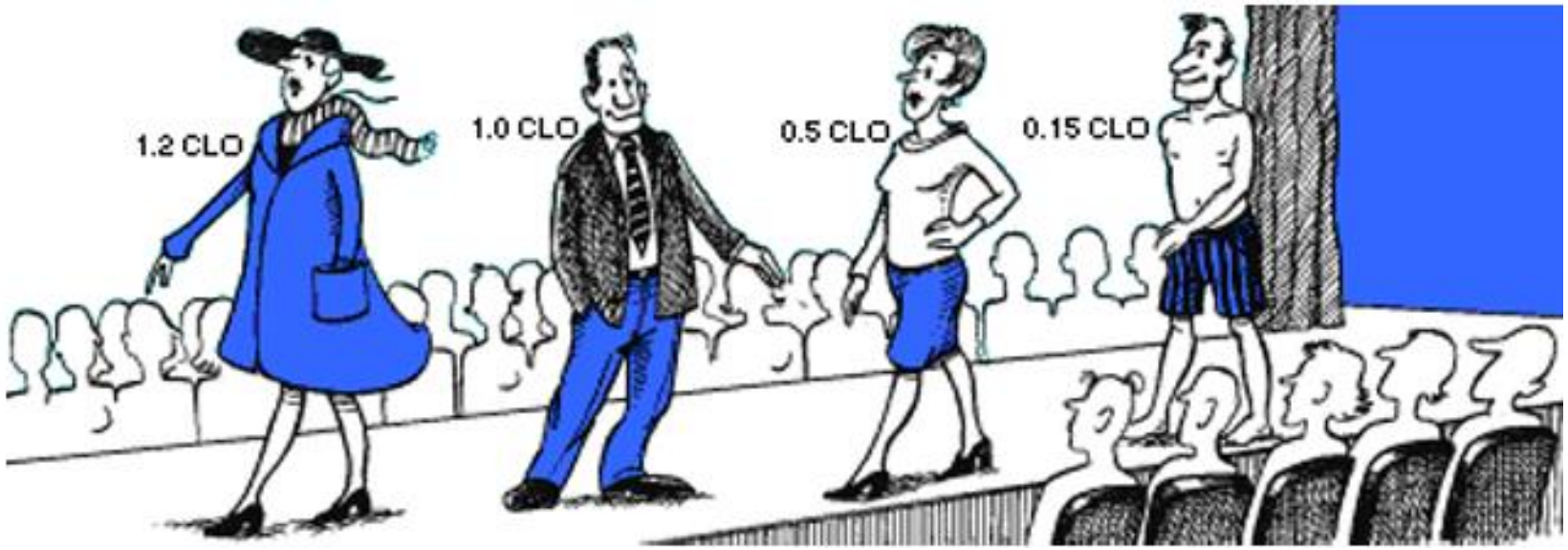
- The control of overheating is specifically addressed by the Energy Performance of Buildings Directive (EPBD) 2018/844

KPI 9 Percentage of time outside of thermal comfort range

Scope

- The indicator's scope encompasses the assessment of both the internal operating temperature and the comfort levels of the building's occupants. For buildings equipped with full or mixed-mode mechanical cooling systems, the assessment is to be done twice: with and without the use mechanical systems.

- The assessment of performance shall apply to the conditioned spaces or zones that account for >10% of the total area unit of the building.



KPI 9 Percentage of time outside of thermal comfort range

Unit of measure

- The percentage of time [%] in which the indoor operative temperature (to) is out of a range of 18°C to 27°C, (Category III EN 16798-1 Table B.5 / Category C EN ISO 7730) during the occupation periods of the year (heating and cooling seasons), with and without building services.

Cate-gory	Thermal state of the body as a whole		Operative temperature °C		Max. mean air velocity m/s	
	PPD %	PMV	Summer (0,5 clo) Cooling	Winter(1 clo) Heating	Summer(0,5 clo) Cooling	Winter(1 clo) Heating
A	< 6	-0.2 < PMV < + 0.2	23,5 – 25,5	21,0 – 23,0	0,18	0,15
B	< 10	-0.5 < PMV < + 0.5	23,0 – 26,0	20,0 – 24,0	0,22	0,18
C	< 15	0.7 < PMV < + 0.7	22,0 – 27,0	19,0 – 25,0	0,25	0,21

Table B.5 — Temperature ranges for hourly calculation of cooling and heating energy in four categories of indoor environment

Type of building or space	Category	Temperature range for heating seasons, °C Clothing approximately 1,0 clo	Temperature range for cooling seasons, °C Clothing approximately 0,5 clo
Residential buildings, living spaces (bed room's, kitchens, living rooms etc.) Sedentary activity ~1,2 met	I	21,0 –25,0	23,5 - 25,5
	II	**20,0–25,0**	**23,0 - 26,0**
	III	18,0- 25,0	22,0 - 27,0
	IV	17,0–25,0	21,0 – 28,0
Residential buildings, other spaces (utility rooms, storages etc.) Standing-walking activity ~1,5 met	I	18,0–25,0	
	II	**16,0–25,0**	
	III	14,0–25,0	
Offices and spaces with similar activity (single offices, open plan offices, conference rooms, auditoria, cafeteria, restaurants, class rooms) Sedentary activity ~1,2 met	I	21,0 – 23,0	23,5 - 25,5
	II	**20,0 – 24,0**	**23,0 - 26,0**
	III	19,0 – 25,0	22,0 - 27,0
	IV	17,0–25,0	21,0 – 28,0
During the between heating and cooling seasons (with Θ_{rm} between 10 and 15°C) temperature limits that lie in between the winter and summer values may be used. Air velocity is assumed < 0,1 m/s and RH~40% for heating season and 60% for cooling season.			

KPI 9 Percentage of time outside of thermal comfort range

Reference Standards

- EN ISO 52000 series: The calculation of the reported performance shall be based on a dynamic energy simulation complying with the EN ISO 52000-1 series.
- EN ISO 52016-1: Energy performance of buildings - Energy needs for heating and cooling, internal temperatures and sensible and latent heat loads
- EN 16798-1:2019 - Energy performance of buildings – Ventilation for buildings - Part 1: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics (it replaces EN 15251:2007).
- CEN/TR 16798-2:2019 - Energy performance of buildings - Ventilation for buildings - Part 2: Interpretation of the requirements in EN 16798-1.
- EN ISO 7730:2005 - Ergonomics of the thermal environment - Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria (under revision)

KPI 9 Percentage of time outside of thermal comfort range

Helpful links

https://www.youtube.com/watch?v=PPqATKgAoW4&t=1919s

2 – Thermal Comfort

KPI 19 - Summer thermal discomfort in 2050

2 – Thermal comfort

Thematic area	Key Performance Indicator (KPI)		Unit	Reference framework
Resilience to Overheating	KPI 19	Summer thermal discomfort in 2050	[%] of time in 2050 in which the indoor temperature exceeds 27 ° C during the cooling season	5.1 Level(s)

Objective

- The climate is set to change in the future and the heat waves, as well as tropical nights, are expected to become more frequent and severe 2050. This indicator is intended to help identify and implement climate adaptation measures that can minimize the risk of overheating and maintain an acceptable degree of thermal comfort in the summer.

Applicability

Building use:

- Residential
- Non-residential

Project stage:

- Design
- Construction / As Built
- In Use

KPI 19 - Summer thermal discomfort in 2050

Description

- This indicator measures the percentage of the year in which building occupants are not satisfied with the summer thermal conditions within a building **based on the climate condition projections for the year 2050**.

- The indicator also seeks to measure the ability of a building (with and without building services) to maintain pre-defined thermal comfort conditions during the cooling seasons in 2050.

- This indicator is intended to help identify and implement climate adaptation measures that can minimize the risk of overheating and maintain an acceptable degree of thermal comfort in the summer

- Thermal comfort is supposed to be guaranteed when the indoor temperature in each space or zone that accounts for >10% of the reference area of a building does not exceed 27°C during the cooling season.

- The indicator follows basically the same methodology as KPI 9 (Time outside of thermal comfort range), except that it uses projections for future climate in 2050 to measure the thermal performance of the building instead of past weather data

KPI 19 - Summer thermal discomfort in 2050

Scope

- The indicator's scope encompasses the assessment of both the internal operating temperature and the comfort levels of the building's occupants based on climate projection for the year 2050. For buildings equipped with full or mixed-mode mechanical cooling systems, the assessment is to be done twice: with and without the use mechanical systems.

- The assessment of performance shall apply to the conditioned spaces or zones that account for >10% of the total area unit of the building.

- Heat losses and gains, both internal and external, that may affect the comfort conditions within the building, as well as the heating and cooling energy that may be required to maintain these conditions, are to be factored into calculations.

- The assessment of performance shall apply to the conditioned spaces or zones that account for >10% of the total area unit of the building.

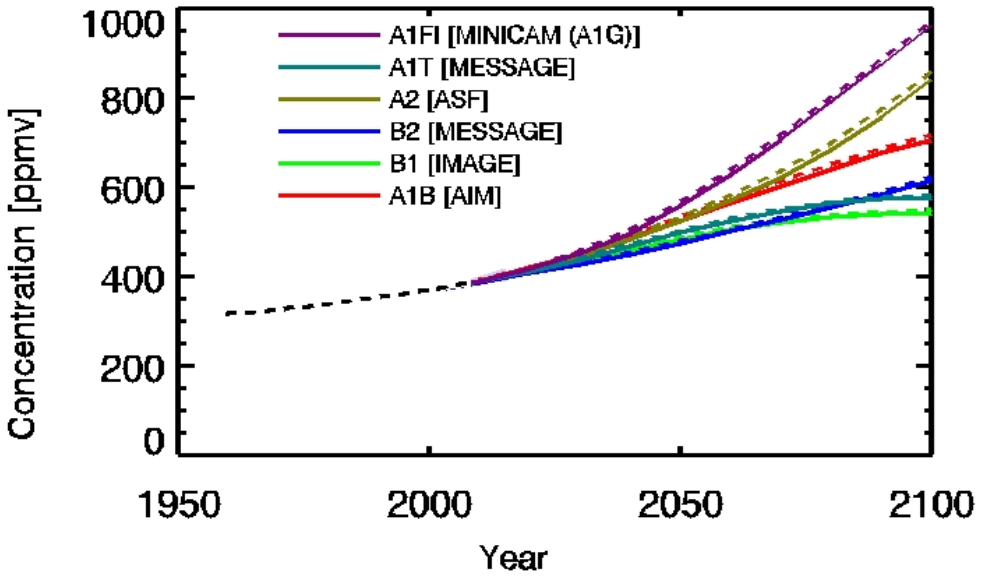
- The assessment of performance shall be done for using an hourly Dynamic simulations model

- The climate projection modeling must be based on the UN IPCC Mitigation emissions scenario (SRES A2 or RCP 6.0).

KPI 19 - Summer thermal discomfort in 2050

Unit of measure

- The percentage of time [%] in which the indoor operative temperature (to) is above 27°C, during the occupation periods for the year 2050 (based on IPCC Mitigation scenario (SRES A1B or RCP 6.0), with and without cooling system building services.



KPI 19 - Summer thermal discomfort in 2050

Reference Standards

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- EN ISO 52016-1: Energy performance of buildings - Energy needs for heating and cooling, internal temperatures and sensible and latent heat loads

- EN 16798-1:2019 - Energy performance of buildings – Ventilation for buildings - Part 1: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics (it replaces EN 15251:2007).

- EN ISO 52010-1:2018 Energy performance of buildings, External climatic conditionsPart 1: Conversion of climatic data for energy calculations

- EN ISO 7730:2005 - Ergonomics of the thermal environment - Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria (under revision)

KPI 19 - Summer thermal discomfort in 2050

Helpful links

https://www.youtube.com/watch?v=YLx8sZZLxtc