



BERLIN 23/06/2022
Mario Cunial

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Sustainability and PERformances for HEROTILE-based energy efficient roofs



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HEROTILE

High energy savings in the cooling of buildings by the Roof tiles shape optimization through a better above sheathing ventilation

(LIFE14 CCA/IT/000939)

By Mario Cunial

Coordinator of HeroTile project

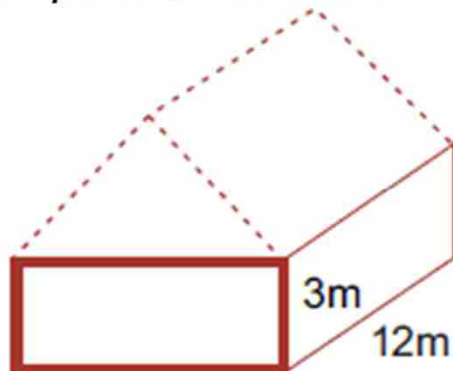
Industrie Cotto Possagno S.p.A



Beginning before project

AND

We compare 2 houses of "different shapes", but which have the same living area: 96 m²



House «A» 8m

With empty attic or roof terrace

Living area: 96 m²

Low floor: 8x12 = 96 m²

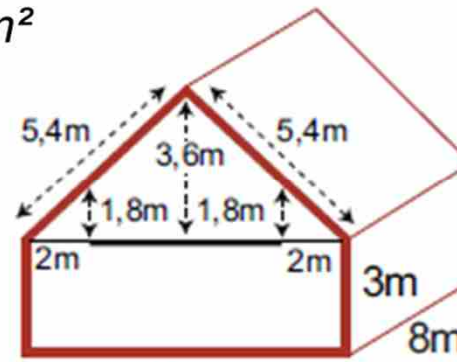
External walls (floor included): 312 m²

Low floor: 8x12 = 96 m²

Ceiling: 8x12 = 96 m²

Facades: (3x12) x 2 = 72 m²

Sprockets: 3x8x2 = 48 m²



House «B» 8m

With sloping roof and habitable attic

Living area: (height > 1.80 m) 96 m²

Low floor: 8x8 = 64 m²

High floor: 4x8 = 32 m²

External walls (floor included): 275 m²

With an equivalent living area, the house with habitable attic is more compact, and therefore presents less heat dispersion surfaces than the house with empty attic or roof terrace



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Beginning before project

lack of reference legislation, the covering of a building is in fact the skin and is not considered **BUT**

In today's world, where the environmental behaviour of a house is of increasing concern, the pitched roof has an important part to play. Depending on the design of a building, it can bring many environmental benefits.

STUDIES PROVE IT

A recent study has compared the environmental performance of single family houses with different roof solutions on the basis of the most commonly used indicators for building assessment (standard EN 15804).

Using the tool GPRBouwbesluit and the Environmental product database of the Netherlands, the study showed that a pitched roof house with clay tiles performs much better than comparable flat roof houses, notably:

- 41% better than a 2 storeys house with a concrete flat roof;
- 21% better than a 3 storeys house with a concrete flat roof;
- 25% better than a 3 storeys house with a green flat roof.



	Pitched (45°)	Flat	Flat	Flat green
Number of storeys	3	2	3	3
Gross floor area (m2)	139.2	93	139.2	139.2
Structure of the roof	wood/clay tiles	concrete	concrete	concrete/sedum
Environmental score (in comparison to pitched roof)		+41%	+21%	+25%
Contribution of the roof to the overall impact of the building	7.7%	14.2%	11.1%	14.6%

Source: Environmental assessment of flat and pitched roof, KNB, the Netherlands, 2015.

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The European Commission is looking at cost-efficient ways to make the European economy more climate-friendly and less energy-consuming.

Its **low-carbon economy** roadmap suggests that:

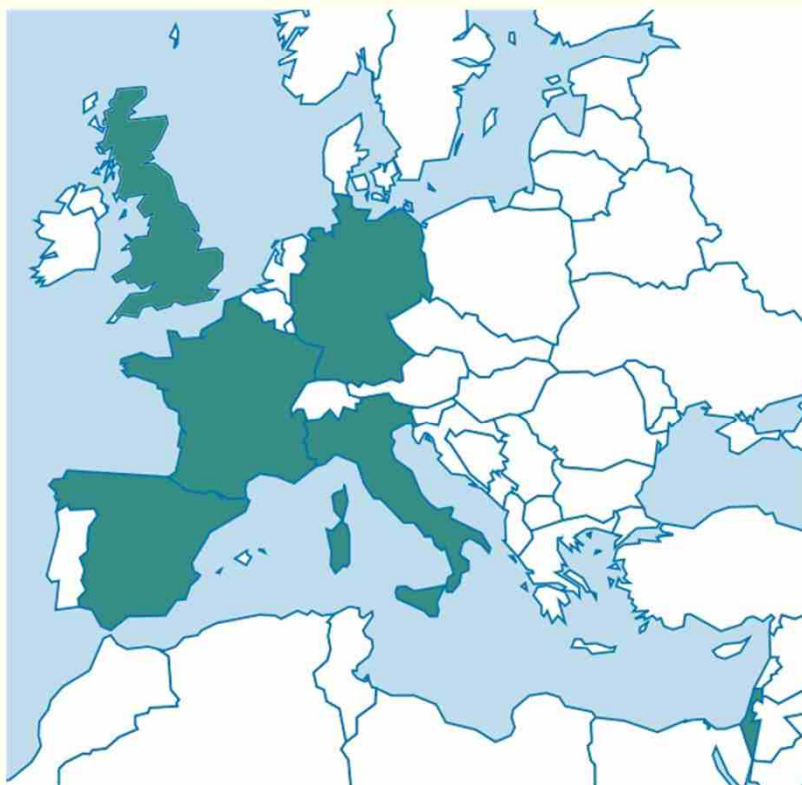
- Within the 2050, the EU should cut greenhouse gas emissions of the **80%** - below the levels in 1990.
- The milestones to achieve this goal are the **40% cuts of the emissions** within the **2030** and of the **60% within the 2040**.
- **All the sectors** need to contribute.
- The way to get to the low-carbon economy is **feasible & affordable**.



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Progetto Life-Herotile - GOALS

The aim is to **enhance the energy performance of buildings**, through the development of **new roof tiles, with increased ventilation capabilities**.



Project Location

Italy, France, Germany, England, Spain and Israel.

Cost of the project

2.515.306,00 € | 60% EC Co-funding

Duration

2015 – 2019

Partners



Progetto Life-Herotile – GOALS



Reduction of specific
cooling power



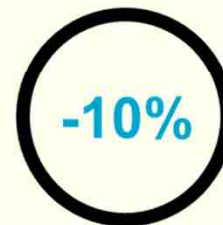
Reduction of the
carbon footprint



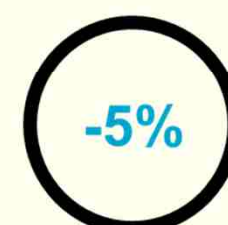
Reduction of the **inlet
watts to be cooled** in
comparison with a
non-ventilated roof



Reduction of
maximum
temperature peak of
the **under-tile airflow**



Reduction of
greenhouse gases
emissions



Reduction of
atmospheric pollution



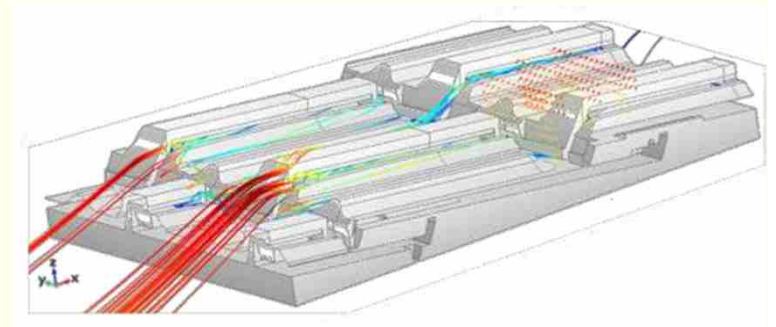
Action 1 | Shape optimization CFD ANALYSIS

Basis

The CFD model had been implemented to understand **how much the roofing tiles could have affected the air permeability.**

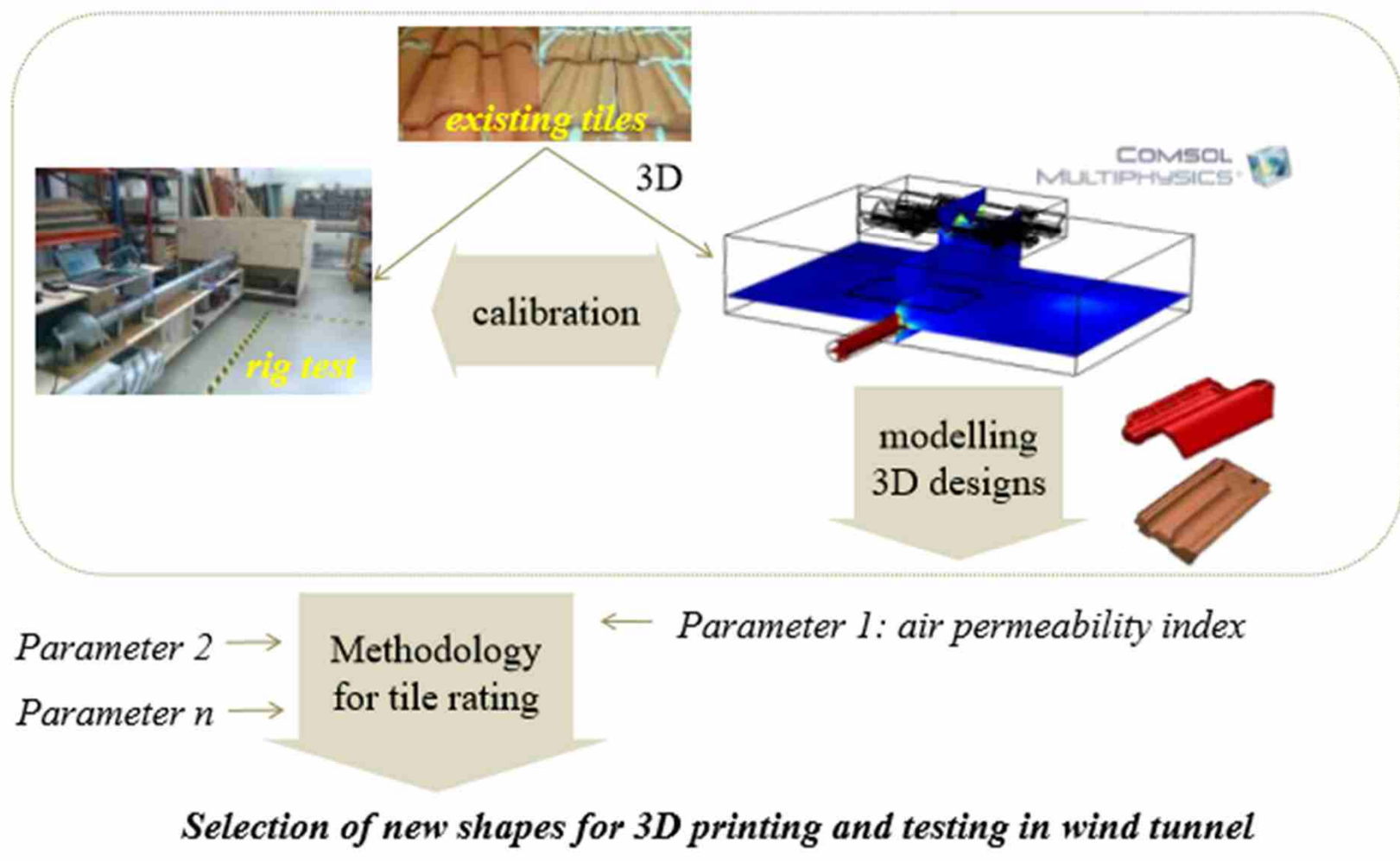
Consequences

The results have substained the application of such basis on a funding of the UE project, or that part of the project which aims to improve the permeability of the ventilated roof's air in warm and mild climates to increase the insulation of the passive buildings.



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Action 1



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Action 1- PROTOTYPES



**Monier Technical Center
Driving rain wind tunnel**

**Tested driving rain
performance Herotile tiles.**



Life-Herotile – Action 3

Construction of two demonstrative roofs:
Ferrara (Italy) and Yerucham (Israel).

PORTUGUESE TILES +27%
252 kWh

PORTUGUESE HEROTILE
198 kWh

MARSEILLAISE TILES +26%
250 kWh

METAL +52%
300 kWh

Guard chamber

Guard chamber



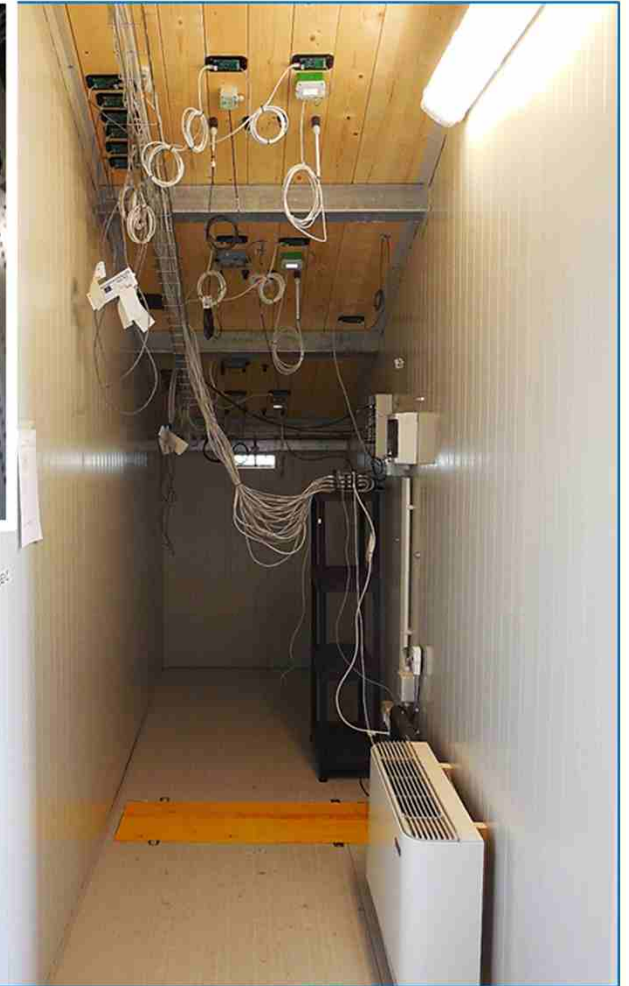
**REAL SCALE TEST BUILDINGS
- FERRARA**

Energy consumption for cooling
(to maintain a intern temp. of
25°/26°C)

15/04/2017-14/10/2017

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Action 3



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Action 3

Room	Type	Roof	kWh / m ³
F2	STANDARD Roof tile Portuguese	pitched	9,70 +21%
F3	HEROTILE Roof tile Portuguese	pitched	8,00
F5	STANDARD Roof tile Marseille	pitched	9,30 +16%
F6	Metal	pitched	14,70 +85%
P2	Plane	flat	26,00 +225%

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Life-Herotile – Action 4



Verification of the collected data on two real buildings, one in Zaragoza (Spain) and the other in Ca' del Bosco (Italy).

-50%

Reduction of the **inlet watts to be cooled** in comparison with a non-ventilated roof

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2.2 Obtained results

The outcome of the LIFE Hero Tile project are:

THE NEW MARSEILLAISE AND PORTUGUESE TILES

characterized by a higher air permeability, able to halve the energy requirement for space cooling from an average value of 30 to 15 kWht/m².



The above table shows an average heat gain reduction of 58.1% by substituting the various existing roofs with the new HEROtile. That allows to consider verified the forecasted value of 50% as reduction of the energy requirement for space cooling from an average value of 15 kWht/m².



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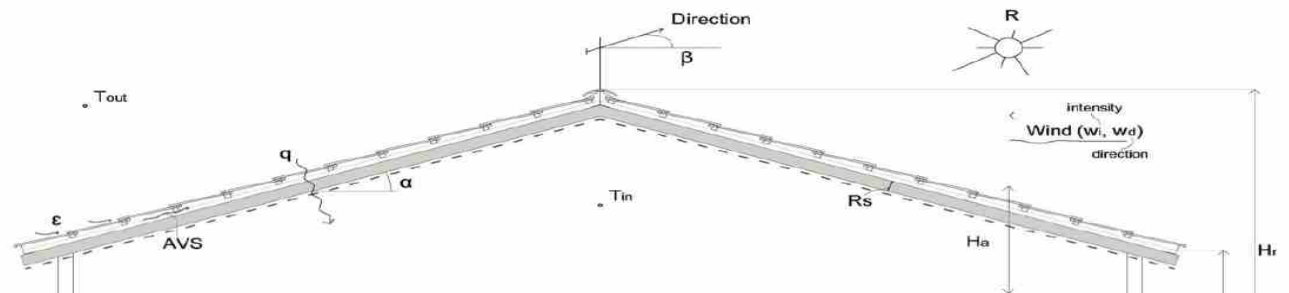
Action 5 – SENSAPIRO

Developing a software to **predict the global energy performance of a pitched roof** covered with Portuguese and Marsigliese HEROTILE in comparison with products already present in the market.



PARAMETERS:

- **Air permeability** (ventilated, micro-ventilated, not ventilated)
- **Pitch slope**
- **Climate zones** (CDD; wind)
- **Roof insulation** (thickness; material)
- **Building energy label**

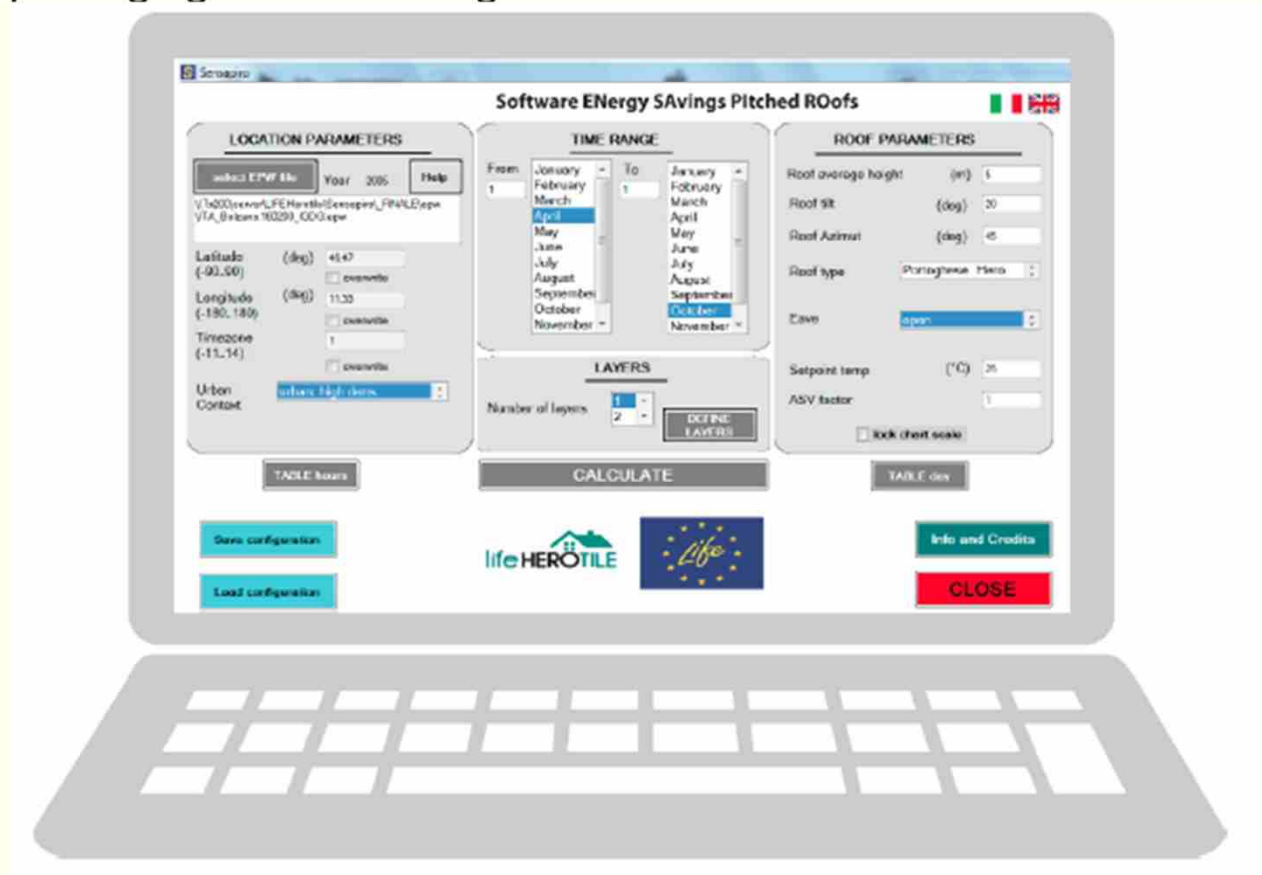


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2.2 Obtained results

SENSAPIRO free-license software

After collect 320.000.000 data a very simple tool to check the energy performance of the same building by changing the roof configuration.



Action 5 – SENSAPIRO *input data*



- Period: 1st May – 30th September
- Roof made by 6 layers

Layers	Thickness (mm)	Thermal conductivity (W/mK)	Density (kg/m3)	Specific heat (J/Kgk)
Plaster	30	0.9	1800	1000
Hollow flooring block	200	0.7	600	840
Low reinforced concrete	40	1.6	2300	1000
Reinforced concrete	40	1.8	2500	1000
Linoleum	1	0.22	670	1400
XPS	60	0.036	30	1200

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SENSAPIRO	Existing roof (roof tit of of 20°)			Replaced by HEROTile	HEROTile vs		
	Trad. tile	Metal	Flat		Trad. tile	Metal	Flat
Capitals	Heat gain KWht/m ²			% heat gain reduction			
Tel Aviv	13.1	20.4	35.2	9.7	-26%	-52%	-72.6%
Bucarest	11.1	16.6	26.2	8.1	-27.5%	-51.3%	-69.2%
Atene	14.2	21.4	34.8	10.2	-28.5%	-52.6%	-70.8%
Sofia	7.6	11.7	18.2	5.3	-30.0%	-54.5%	-70.8%
Madrid	8.8	15.9	21.2	5.7	-35.4%	-64.0%	-73.1%
Belgrado	10.2	15.4	24.3	6.6	-35.6%	-57.4%	-73.1%
Roma	10.8	15.8	25.1	6.6	-38.5%	-58.0%	-73.6%
Monaco	7.4	11.6	18.1	4.5	-39.0%	-61.0%	-75.1%
Francoforte	7.0	10.9	17.2	3.9	-45.0%	-64.6%	-77.5%
Parigi	6.9	11.0	16.9	3.7	-46.6%	-66.5%	-78.3%
Bruxelles	6.1	9.4	15.2	3.2	-48.3%	-66.2%	-79.2%
Vienna	7.6	12.0	18.7	2.7	-65.2%	-77.7%	-85.8%
Aver. values	15.4			5.8	-38.8%	-60.5%	-74.9%

-58.1%



3.2 Environmental impact

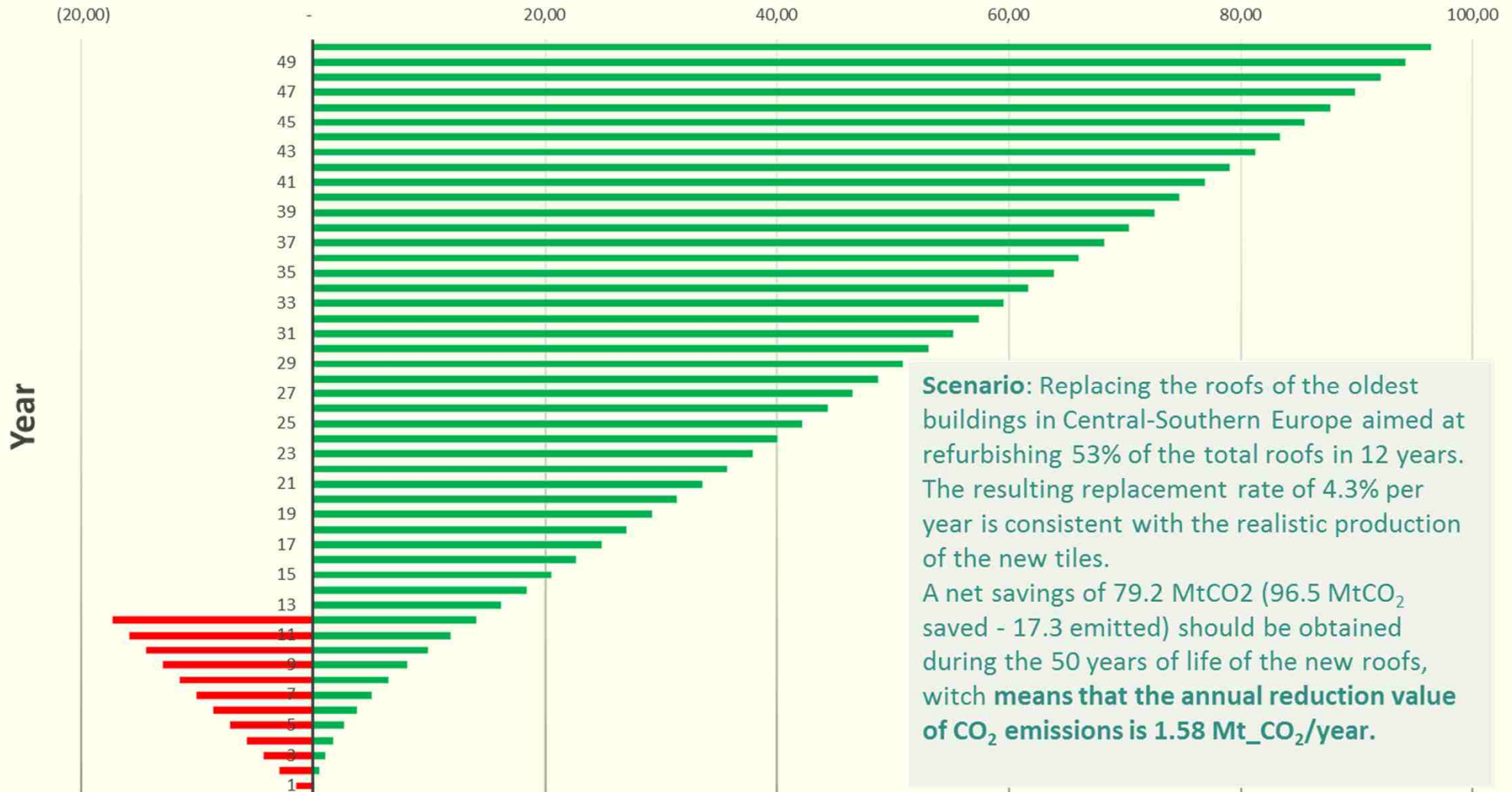
According to the outcomes of the Life Herotile Project, the new designed tiles are actually able to save up to 50% of the energy in cooling mode, while the average value of energy requirement in cooling is 15 kWh/m². Based on the realistic scenario of replacing the roofs of the oldest buildings in Central Southern Europe aimed at refurbishing 53% of the total roofs in 12 years, a replacement rate of 4,3% per year happens, Anyway, the requirement of roof tiles for that is consistent with the realistic production of the new tiles. Therefore, a net savings of 57,5 MtCO₂ should be obtained during the 50 years of life of the new roofs; the annual reduction value of CO₂ emissions is 1,5 Mt_CO₂/year.



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CO2 saved - refurbishment rate 4.3%/Y

Mt CO2



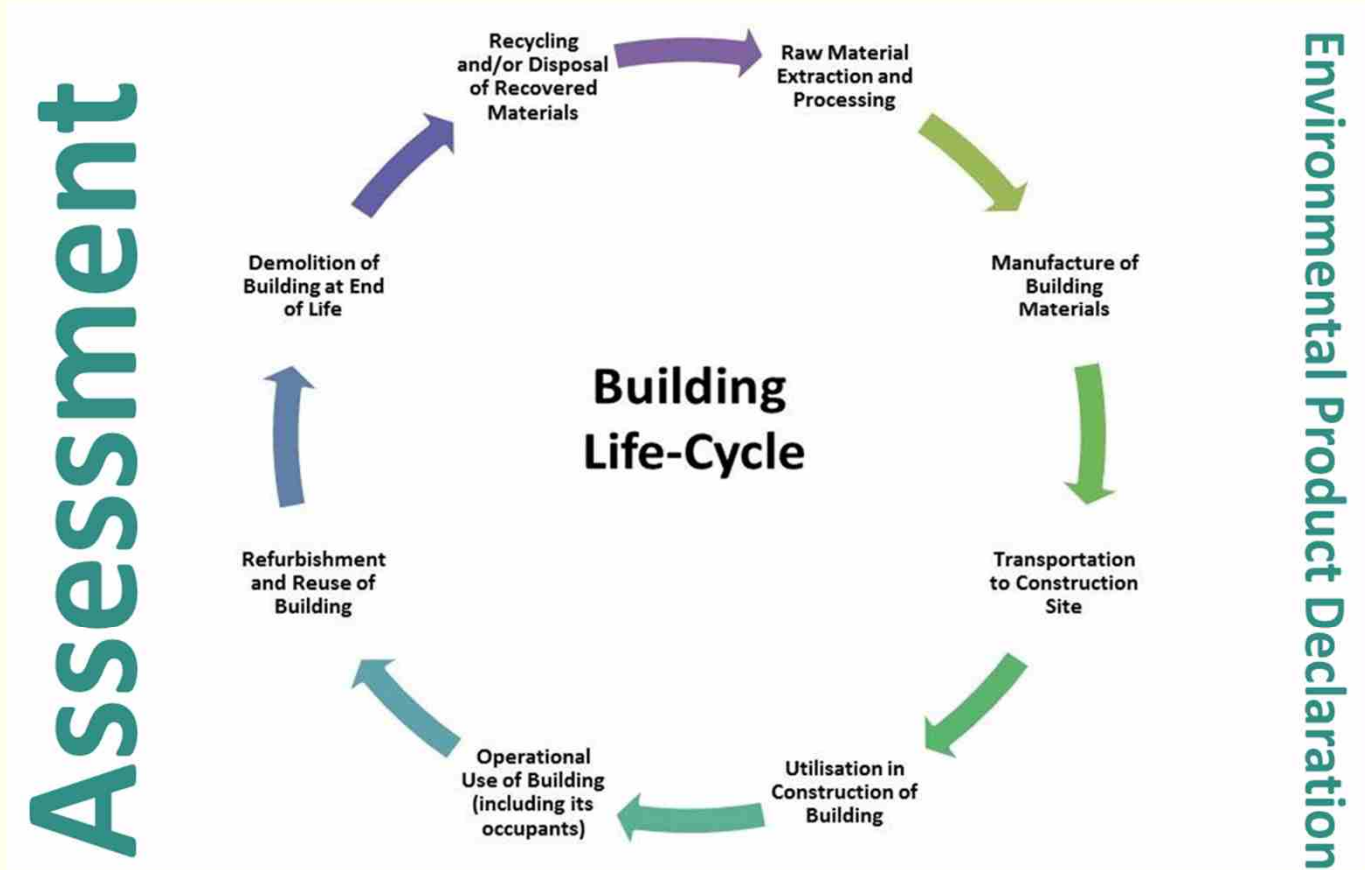
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■ Saved	0	0	1	1	2	3	5	6	8	9	11	14	16	18	20	22	24	27	29	31	33	35	37	40	42	44	46	48	50	53	55	57	59	61	63	66	68	70	72	74	76	79	81	83	85	87	89	92	94	96
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Life

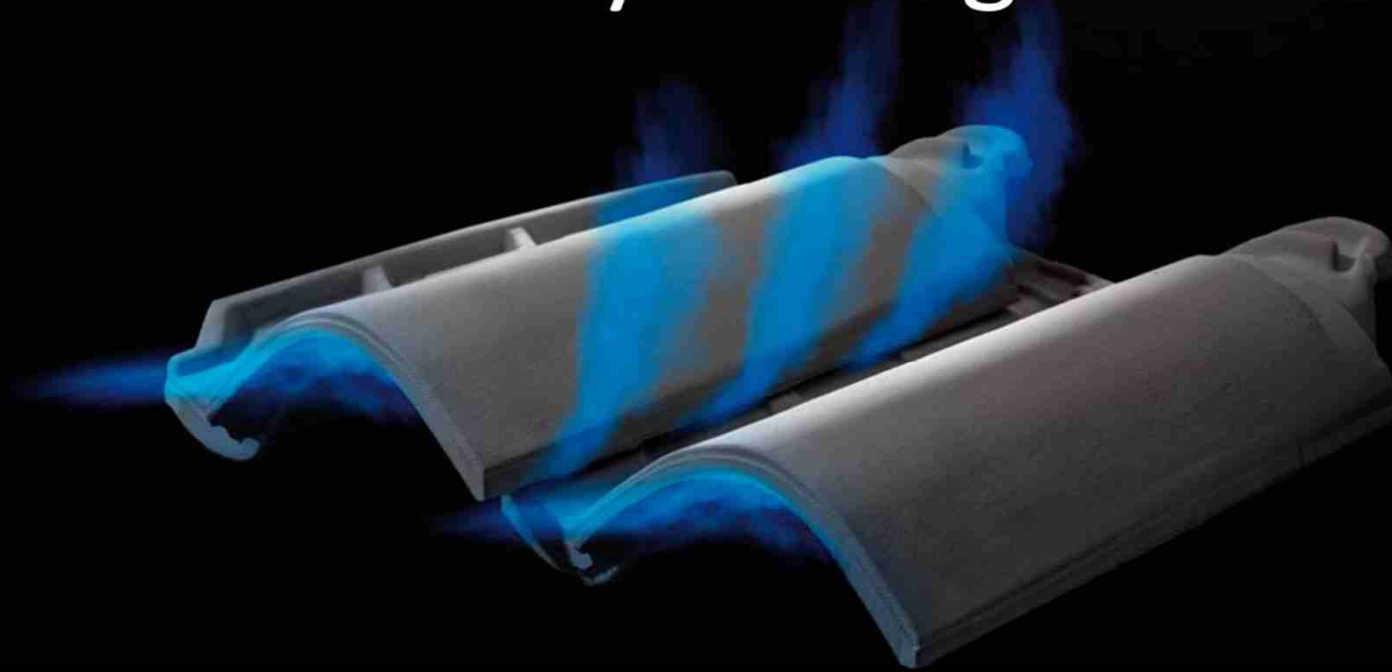
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Life Cycle

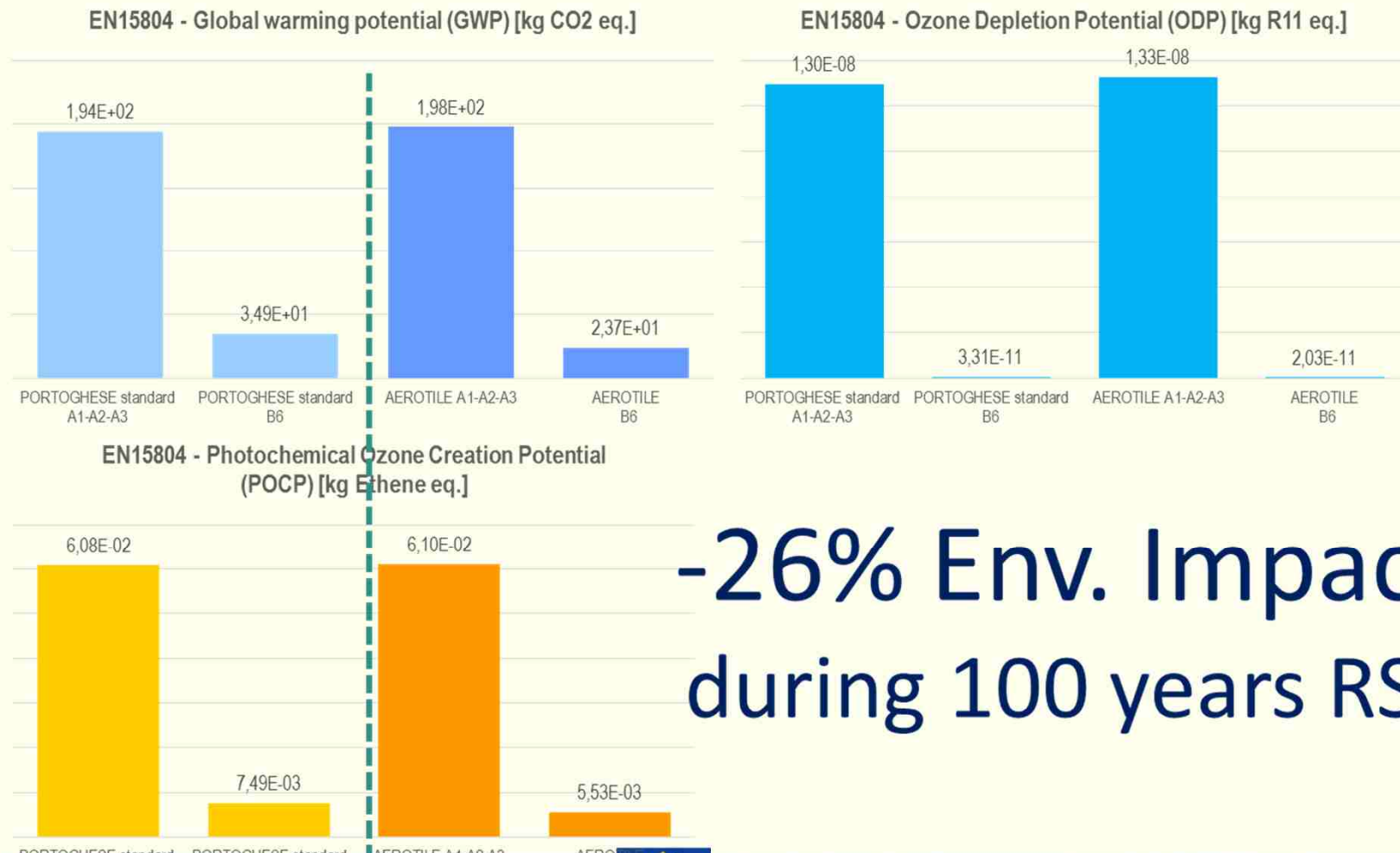
Assessment



-40% kg CO₂eq.
emitted during production
Life Cycle stage



HEROTILE Use stage B6



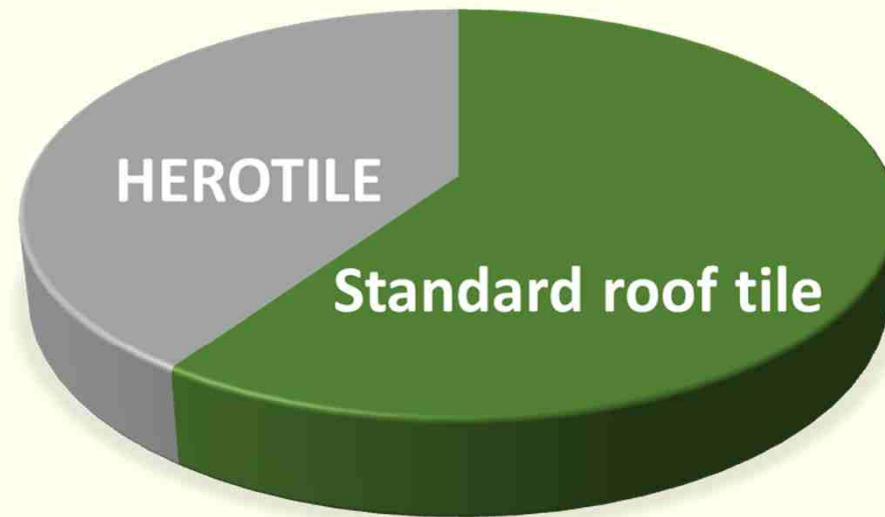
-26% Env. Impact during 100 years RSL

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HEROTILE Use stage B6

-30% GWP kg CO₂ eq. emissions



Global warming potential



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HEROTILE Use stage B6

-38% ODP kg R11_{eq.} emissions



Ozone Depletion Potential

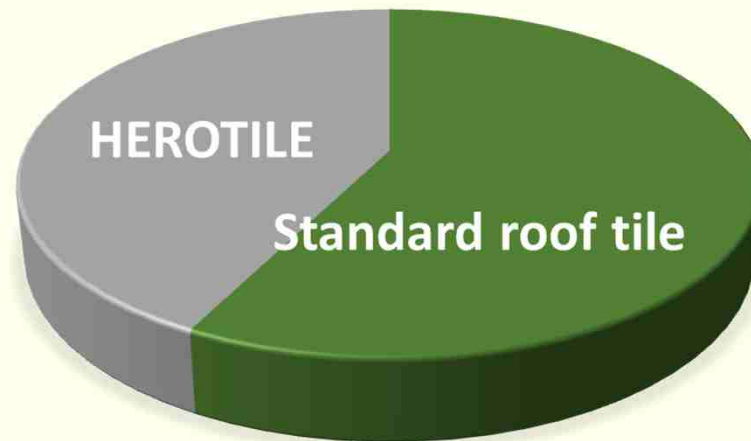


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HEROTILE Use stage B6

-26% POCP kg Ethene_{eq.} emissions

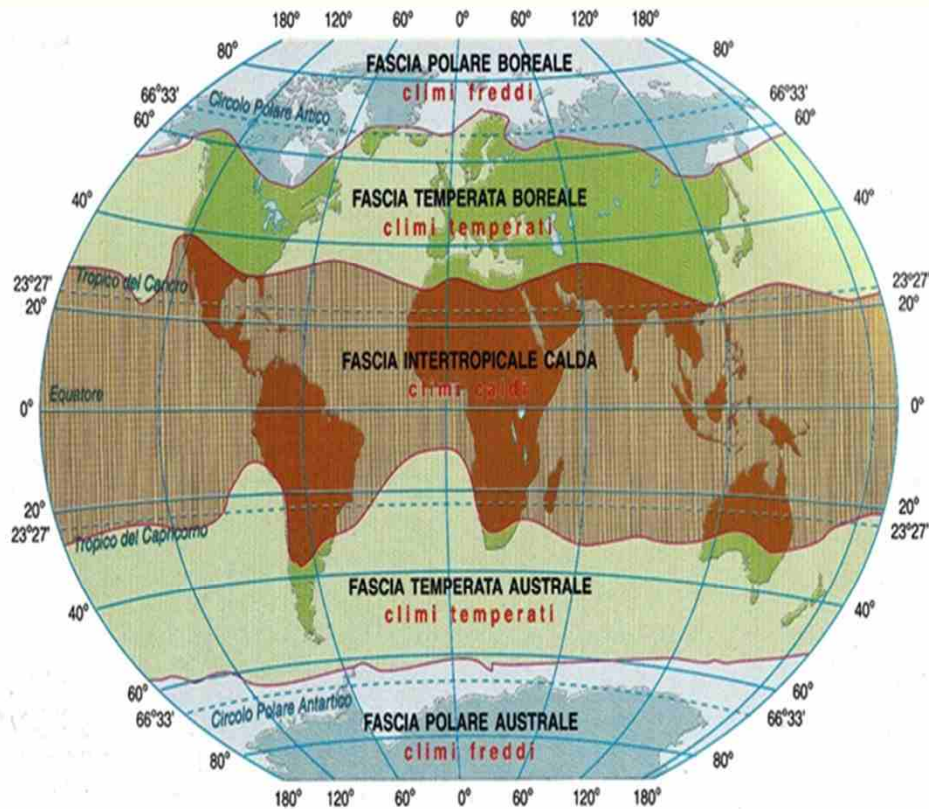


Photochemical Ozone Creation Potential



The CO2 emissions of buildings in the world is constantly and worryingly increasing

- About 6 billion people live in warm and temperate areas.
- Assuming a surface area with a roof of only 100 m², if 500 million roofs used the new HEROTILE transpiring tiles, it would allow an annual reduction of CO₂ emissions to 40 million tons, without taking into account the beneficial effect of reducing the phenomenon island of heat in the cities.

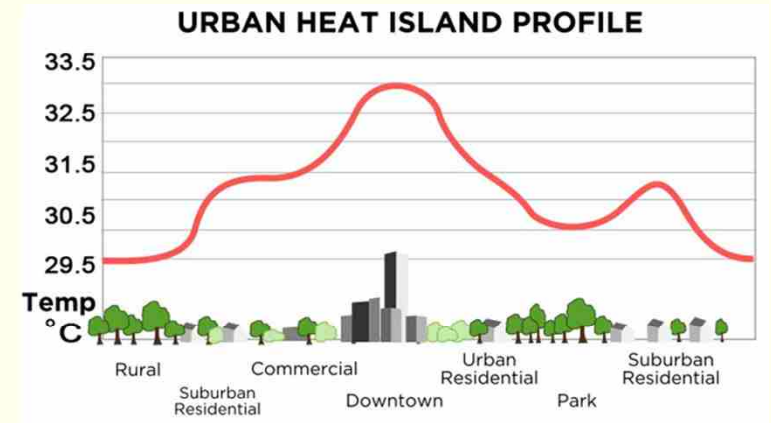


HEROTILE

- reduction of electricity and/or gas consumption necessary to have adequate indoor thermal environment
- reduction of fluorinated gases used for air conditioners
- reduction of the radiative exchanges between external surfaces

BETTER

than well known technologies as «cool roofs» suggested, for their reflectivity as the primary action on the roofs to reduce temperature in the inhabited centers (UHI)



BUT

HEROTILES are not recognized by UE technical rules and by national energy codes, because until today there weren't simple physical parameters to describe their behaviour and their effect on the indoor environment and on the climate



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*"It's not easy being
green"
Kermit the Frog,
1972.*



I think that with **HEROTILE
CONCEPT** has been opened in the
world.

a new more sustainable way of
designing roofs and facades of
buildings, **Thank you for your
participation and attention**

Mario Cunial

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