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CENTRO RICERCHE PER LA SALUTE DELL'UOMO E DELL'AMBIENTE

HUMAN AND ENVIRONMENTAL HEALTH RESEARCH CENTER

2HE CENTER FOR HUMAN HEALTH AND ENVIRONMENT

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OR0 Buildings & Construction

OR0.1 - Construction of the Center 2HE

OR0.2 - Strengthening of Acquatina plant

OS1 Human Health and the Environment

OR1 – Metabolomics and System Biology

OR2 – Advanced analytical and environmental techniques

OR3 – Advanced diagnostics

OS2 Product and Process Sustainability

OR4 - Sustainability in chemical and technological processes

OR5 – Sustainable production of marine origin food

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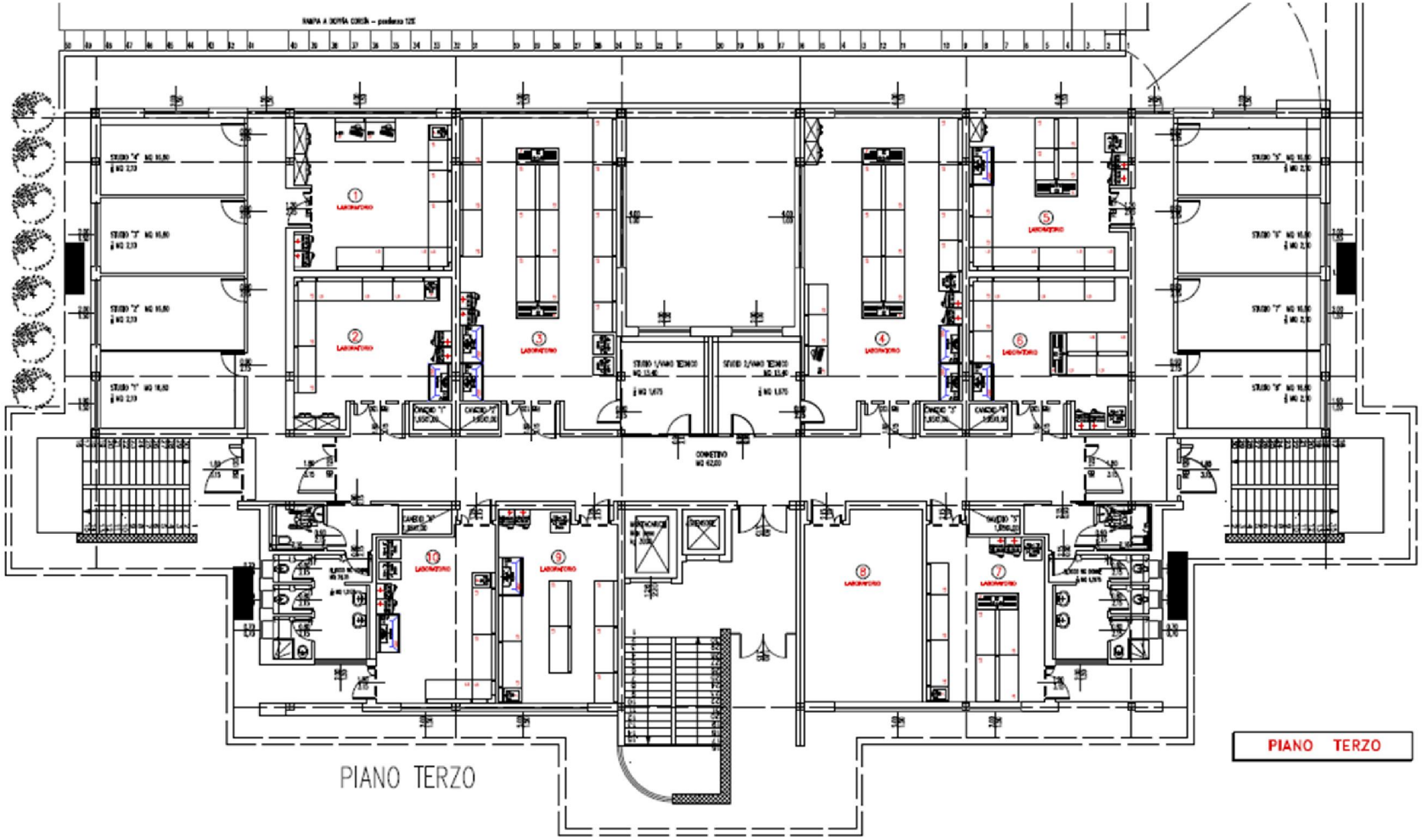

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Project facts and figures: the Budget

Project name:
Strengthening of a "HUMAN AND ENVIRONMENTAL HEALTH RESEARCH CENTER“
Project acronym: 2HE
12.200.047,12 euro

Training project:
Project acronym: TRAIN2HE
799.952,88 euro

Start 01.01.2012
End 31.05.2015

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Project facts and figures: the Budget

Building construction + Acquatina: 4,3 M€
Scientific instruments: 7,9 M€
Training activities: 0,8 M€

~ 3000 m² of NEW RESEARCH LABORATORIES

4 Instrument facilities
Nuclear Magnetic Resonance
Mass Spectrometry
Electron and confocal Microscopy
Surface techniques

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Project facts and figures: the People

Dipartimento di Ingengeria dell'Innovazione

Dipartimento di Scienze e Tecnologie Biologiche e Ambientali

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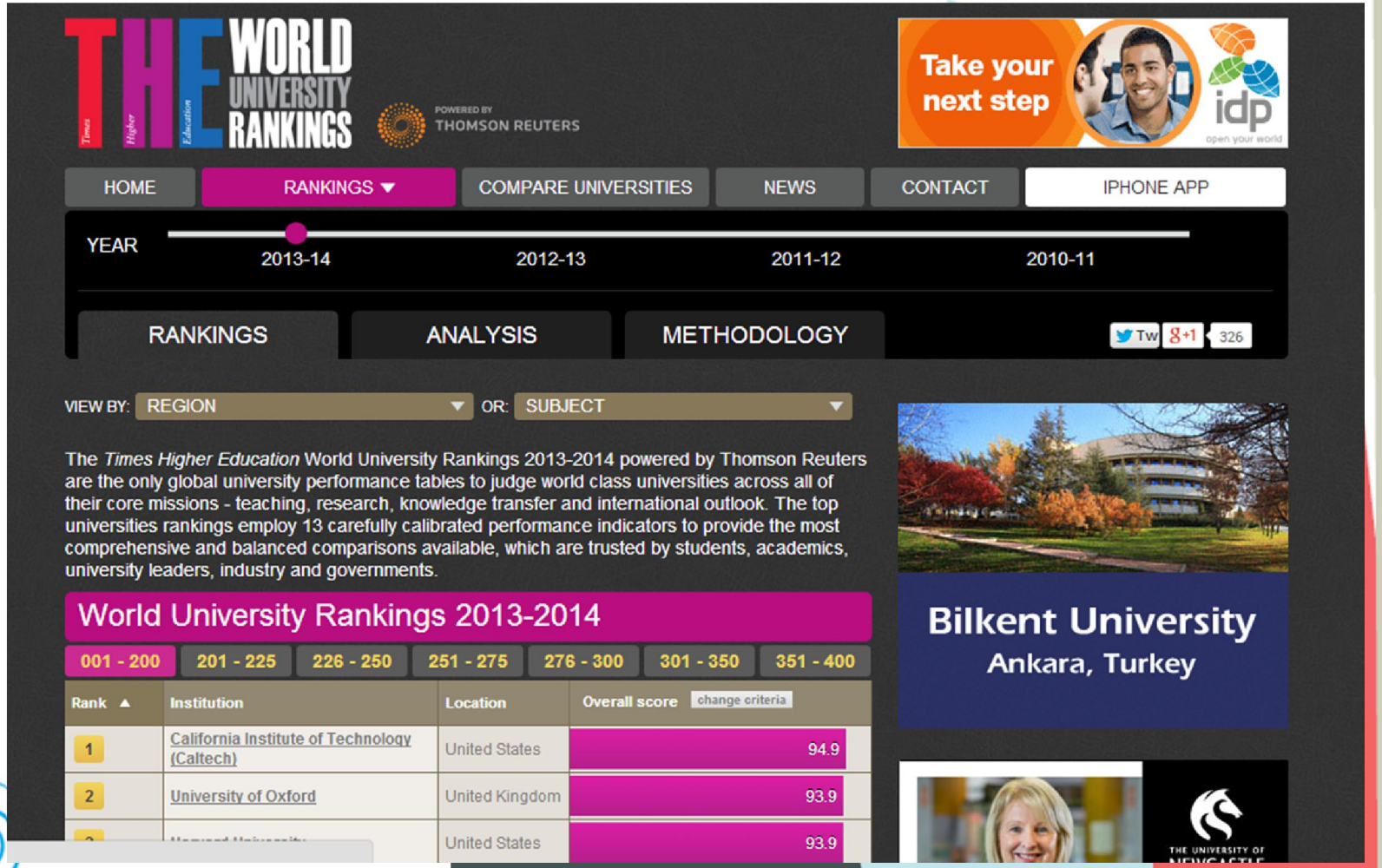
Project facts and figures: the University Ranking



Project facts and figures: the University Ranking

001 - 200 | 201 - 225 | 226 - 250 | 251 - 275 | 276 - 300 | 301 - 350 | 351 - 400

Rank ▲	Institution	Location	Overall score (change criteria)
1	California Institute of Technology (Caltech)	United States	94.9
2	University of Oxford	United Kingdom	93.9
2	Harvard University	United States	93.9
4	Stanford University	United States	93.8
5	Massachusetts Institute of Technology (MIT)	United States	93.0
6	Princeton University	United States	92.7
7	University of Cambridge	United Kingdom	92.3
8	University of California, Berkeley	United States	89.8
9	University of Chicago	United States	87.8
10	Imperial College London	United Kingdom	87.5
11	Yale University	United States	87.4
12	University of California, Los Angeles (UCLA)	United States	86.3
13	Columbia University	United States	85.2
14	ETH Zürich – Swiss Federal Institute of Technology Zürich	Switzerland	84.5
15	Johns Hopkins University	United States	83.7

Project facts and figures: the university ranking

251-275	Technische Universität Darmstadt	Germany	Data withheld by THE
251-275	The University of Newcastle	Australia	Data withheld by THE
251-275	University of Bremen	Germany	Data withheld by THE
251-275	University of Hawaii at Manoa	United States	Data withheld by THE
251-275	University of Iceland	Iceland	Data withheld by THE
251-275	University of New Mexico	United States	Data withheld by THE
251-275	University of Otago	New Zealand	Data withheld by THE
251-275	University of Pavia	Italy	Data withheld by THE
251-275	University of Salento	Italy	Data withheld by THE
251-275	University of South Florida	United States	Data withheld by THE
251-275	University of the Andes	Colombia	Data withheld by THE
251-275	University of Trento	Italy	Data withheld by THE

2014-2015
251-275
(268)

2013-2014
301-350

2012-2013
350-400

2011-2012
350-400

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Innovative Chemistry

for Energy Efficiency of Buildings in Smart Cities

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Review of Europe's building stock

Europe contains some **160 million buildings**, as estimated by experts of the ECTP (European Construction Technology Platform).

Only some **65.000** are presently estimated to be so called Passive House buildings, this represents a mere 0,04% of the total stock.

Only part of the Passive House buildings actually incorporate one or more of the proposed technologies.

Review of Europe's building stock

Today, annually about 1% of the existing building stock is built new (which represents 1,6 million buildings in the EU27 member states).

At the same time, some 1,7% of the existing building stock is refurbished annually (including all kinds of refurbishments from 'light' to 'deep' interventions).

Most policy supporting studies of recent years put the required (to reach EU objectives) refurbishment rate at 3% of building stock, which would mean doubling the present rate of 1,7%.

Multiplying refurbishment rates will not only require substantial regulatory streamlining but also selection of **easy-to-implement technologies** such as some of the ones proposed here.

Review of Europe's building stock

With average energy consumption of 280 kWh per m^2 in non-residential buildings (with a floor space of 6,25 billion of m2 in Europe) and residential buildings (with a 18,75 billion m2 of floor space) consuming some 40% less (170 kWh/m2/y) one can easily calculate how much energy is consumed, and also how much would be saved if we could shave off 40% of that amount across Europe.

In general, buildings have improved over the years in terms of energy efficiency; which means that:

older buildings (if not renovated before) have more potential for improvement than newer buildings.

Review of Europe's building stock

Conclusion here is that the vast majority of the building stock dates from before 1990, which is now 22 years ago.

Some 40-50% of the building stock is pre-1960, and would benefit substantially from relatively feasible energy efficiency measures.

Added costs must be not more than 8% the costs of 'normal' building

Presentation Of The Key Innovation

1. Reflective indoor coatings
2. High reflectance and durable outdoor coating
3. Phase Change Materials (PCM)
4. Advanced insulation foams
5. Other insulation modules

1. Reflective indoor coatings (- 20%)

By reflecting light better than normal paints, these coatings maximize the feeling of space and illumination.

This in turn allows reducing the amount of energy used for artificial lighting and/or increases the perceived illumination by natural light. These coatings optimize the use of natural and artificial lighting (increased perceived light up 20%, or **20% energy reduction** for the same light perception) and can help keep sunshine radiation heat inside the building in wintertime.

life expectancy of 5-10 years without losing any performance

2HE Center for Human Health and Environment

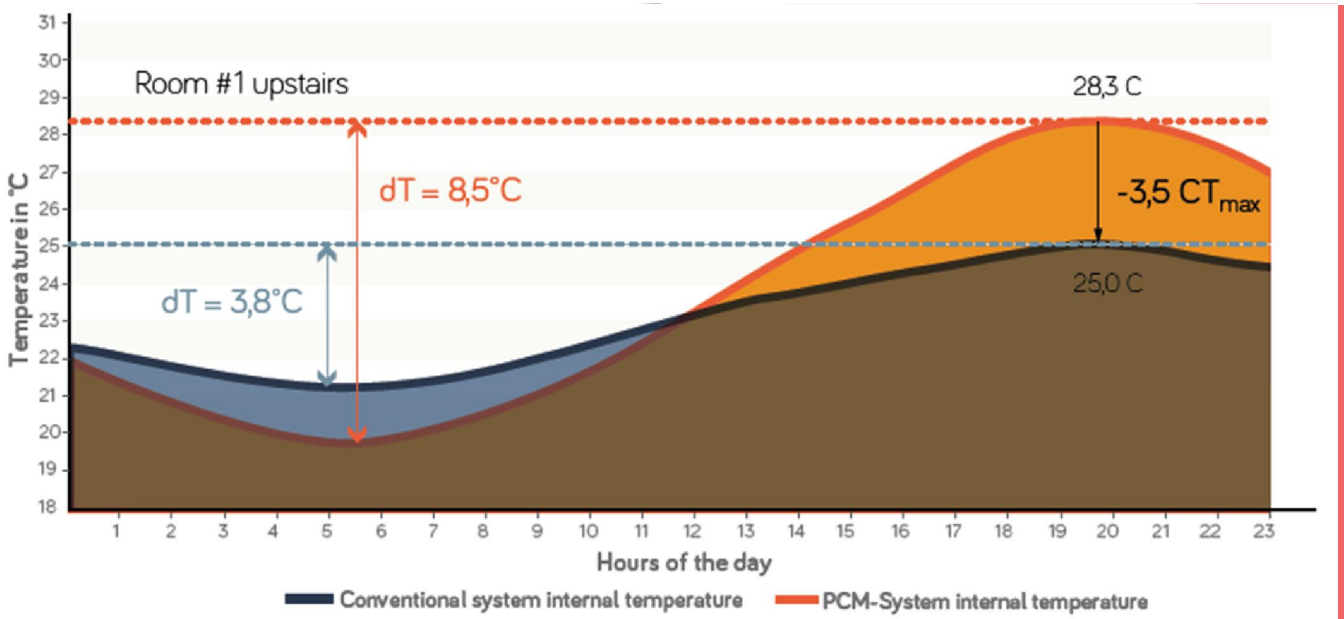
2. High reflectance and durable outdoor coating (-15%)

These coatings reflect sunlight radiation both in the visible and infrared parts of the spectrum. When applied to roofs and walls, the reflection of the sun's energy reduces roof and wall temperature and as a consequence also reduces the heating of spaces underneath the roof and inside the walls. High reflectance and durable outdoor coatings applicable on building roofs and walls in hotter climate regions can save up to 15% of air conditioning energy consumption while also allowing for downscaling the size of the air conditioning system.

life expectancy of 12-15 years without losing any performance

3. Phase Change Materials (PCM) (-10%)

PCM are available on the market as an active ingredient of a range of semi-finished materials: plaster, cement, plasterboard and multifunctional wall and roof modules. When used in (interior) walls and/or ceilings, the PCM enables such walls and ceilings to absorb and store excessive heat during the day, in order to dissipate that excessive heat during the night when air temperatures have gone down. PCM basically increase the thermal inertia of the wall and ceilings, making them behave like the old-fashioned thick stone walls found in buildings of hundreds of years ago.

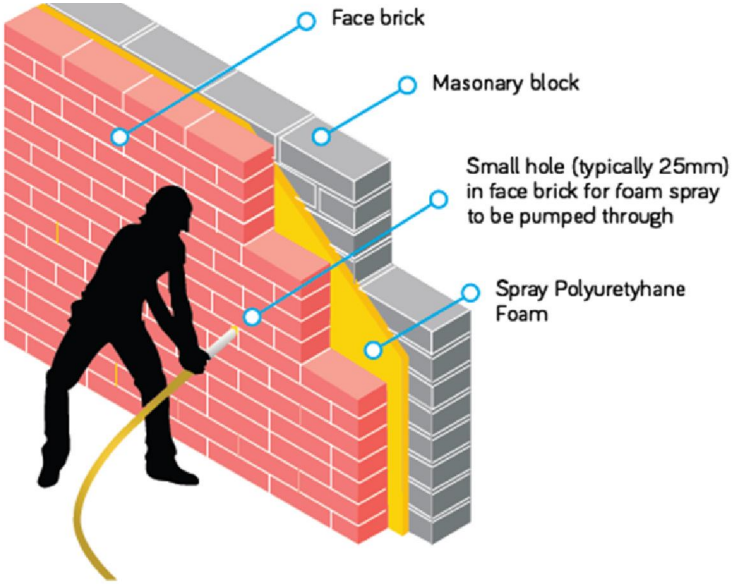


4. Advanced insulation foams (-20-80%)

Advanced insulation foams with high insulation performances allow significant energy savings and can be adapted to different building's configurations.

1. INSULATION IN WALL CAVITIES

Cavity wall insulation fills the space (cavity) between the two layers of the external wall of a building. As illustrated in Figure, an existing building's wall cavity can be injected with foam as part of an energy efficiency refurbishment. In case of new construction, normally the cavity is filled up using rigid pre-foamed panels attached to the wall.



4. Advanced insulation foams (-20-80%)

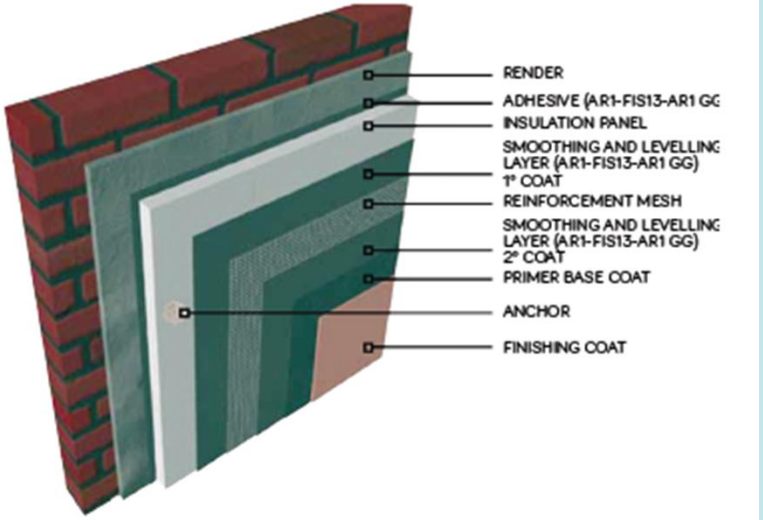
2. EXTERNAL/INTERNAL INSULATION

In cases where no wall cavity is present, one can opt to insulate the external/internal walls of the building from the outside/inside. This approach maintains the thermal storage capacity (thermal inertia) of the building external/internal walls, thus keeping temperature fluctuations at acceptable levels.

Each insulation 'stack' is composed according to the specific wall characteristics, climate and orientation of the building.

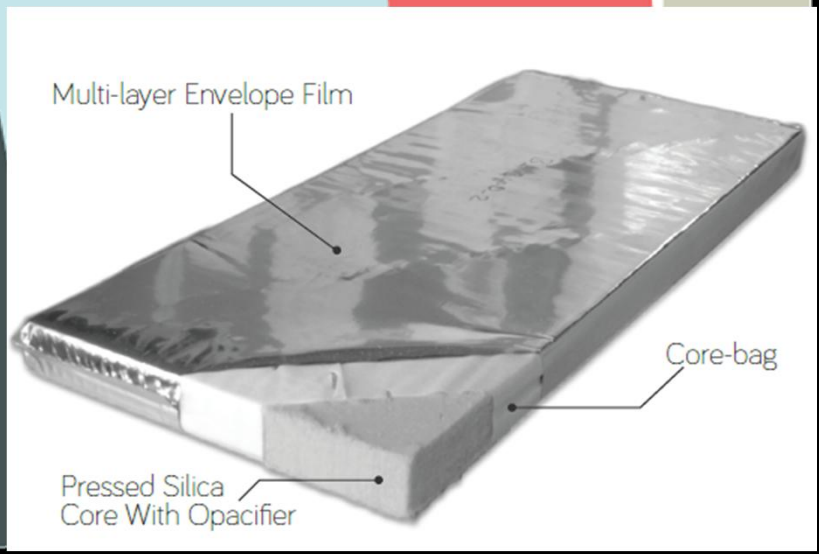
life expectancy of >20 years without losing any performance

Figure 2. External wall insulation



5. Vacuum insulation panel (VIP) modules (-20%)

Vacuum insulation panel (VIP) modules provide design freedom when refurbishing glass facade buildings.

Their insulation performance is some three times higher than conventional insulation materials. Until recently, VIP were seldom used in buildings due to their fragility and the risk of damaging the vacuum by perforation. However recent products encapsulate the vacuum inside a double glazing package, allowing their use in glass-intensive building facades that need a strong improvement of their thermal insulation performance.

life expectancy of >30 years
without losing any performance