SAVE MONEY, SAVE THE PLANET

CALIFORNIA

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Cool Roof Solutions

> Waterproofing

> Reduction of heat island effect

> Energy saving

ISOVER SAINT-GOBAIN

“Cool Roofs”

COOL ROOF

Origins

California is one of the first places in the world to discover the importance of high emissivity reflecting surfaces, especially for roofs. The concept, called “COOL ROOF, was from the outset considered an important environmental tool, both as an answer to the “HEAT ISLAND” effect and as a vehicle for saving energy.

Starting from 1st January 2010, the California Energy Commission updated the energy efficiency standards of all the buildings in the American state, both residential and non-residential.

Previously, a residential “COOL ROOF” was an optional measure of energy efficiency.

Now, in most cases, roof products must be certified as such.

Today

Many other American states and Canada are increasingly sharing the interest in “cool roofs” and authorities have now been officially set up to assess the performances of the roofs.

The regulatory provisions supporting cool roofs now include: the ASHRAE 90.1 and 90.2 standards, various state energy efficiency regulations in the USA, the International Energy Conservation Code, the Cool Roof Rating Council in the USA and the EU, the Energy Code for offices in India and other continually increasing initiatives. The Green Building Council also acknowledges the impact of cold roofs.

LEED certification contributes to the SS 7.2 Credit “Heat island effect: roofs” according to the LEED Protocol NC 2009 Italy).

The phenomenon definitely came out of American universities’ research laboratories. In New York, the citizen services and buildings departments have embraced an initiative by about 1300 volunteers, NYC °CoolRoofs” which was set up to paint the roofs of the Big Apple white and has already painted over 150 buildings.

What is the problem?

- Who has never burnt their fingers touching a dark surface in summer?
- Who has never noticed the different sensation of heat in a dark car compared to a white one?
- Who has never noticed the high temperature that asphalt can reach during a hot day, and its negative effects in the evening?

The same thing happens on our roofs: a flat roof with a traditional black bituminous membrane easily reaches 80° C on an balmy sunny summer day.

Other types of traditional surfaces are equally dark and behave no differently.

This causes two types of problems.

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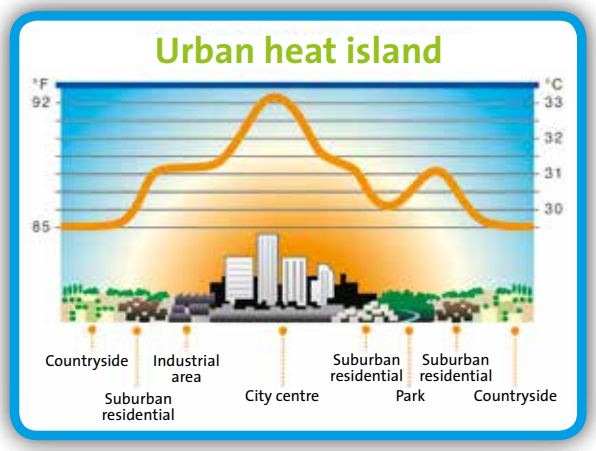
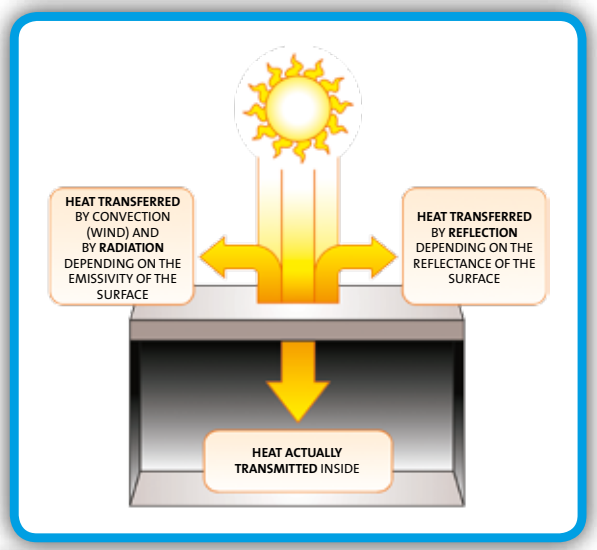
The collective problem:
the heat island

This is the phenomenon of the temperature increase in urban areas compared to rural areas measured between 1° and 6° C. This creates a vicious circle of air conditioning and heating of the surrounding environment which increases the risk of a black-out, raises consumption and atmospheric pollution.

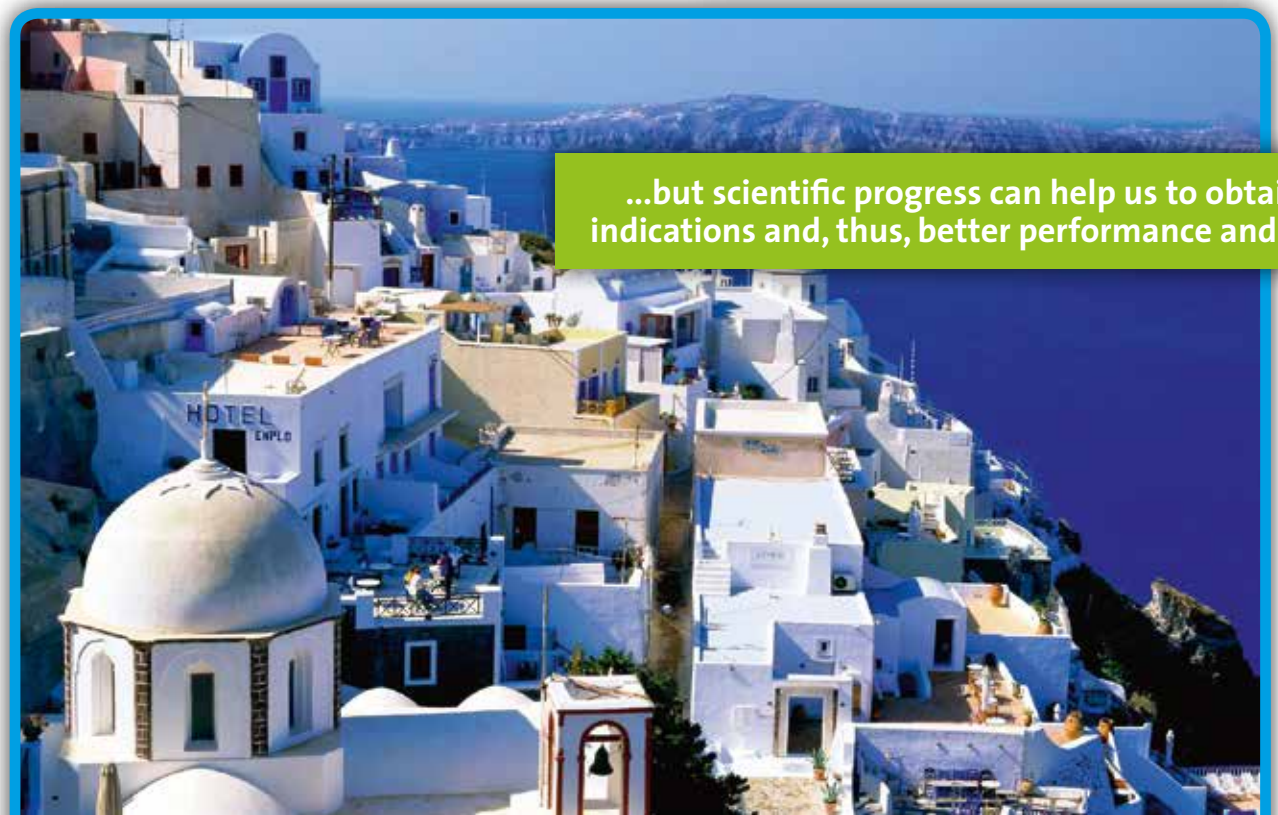


The individual problem:
energy consumption

Black roofs reflect only a very small part of the heat received from the sun and, therefore, transmit it to the internal environment underneath, with high air conditioning costs and poor dwelling comfort.
The greater the incidence of roof cover compared to the total surface cover, the greater the impact of this phenomenon.
The importance of this problem is obvious for the roofing of shopping malls, supermarkets, hypermarkets and also residential buildings.



And the solution...
Clear suggestions come from the Mediterranean...



...but scientific progress can help us to obtain more precise indications and, thus, better performance and lasting results.

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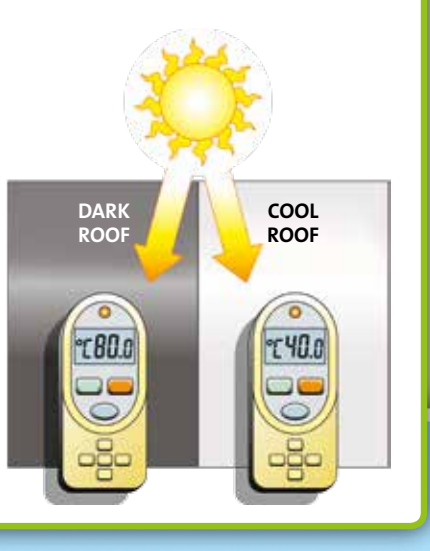
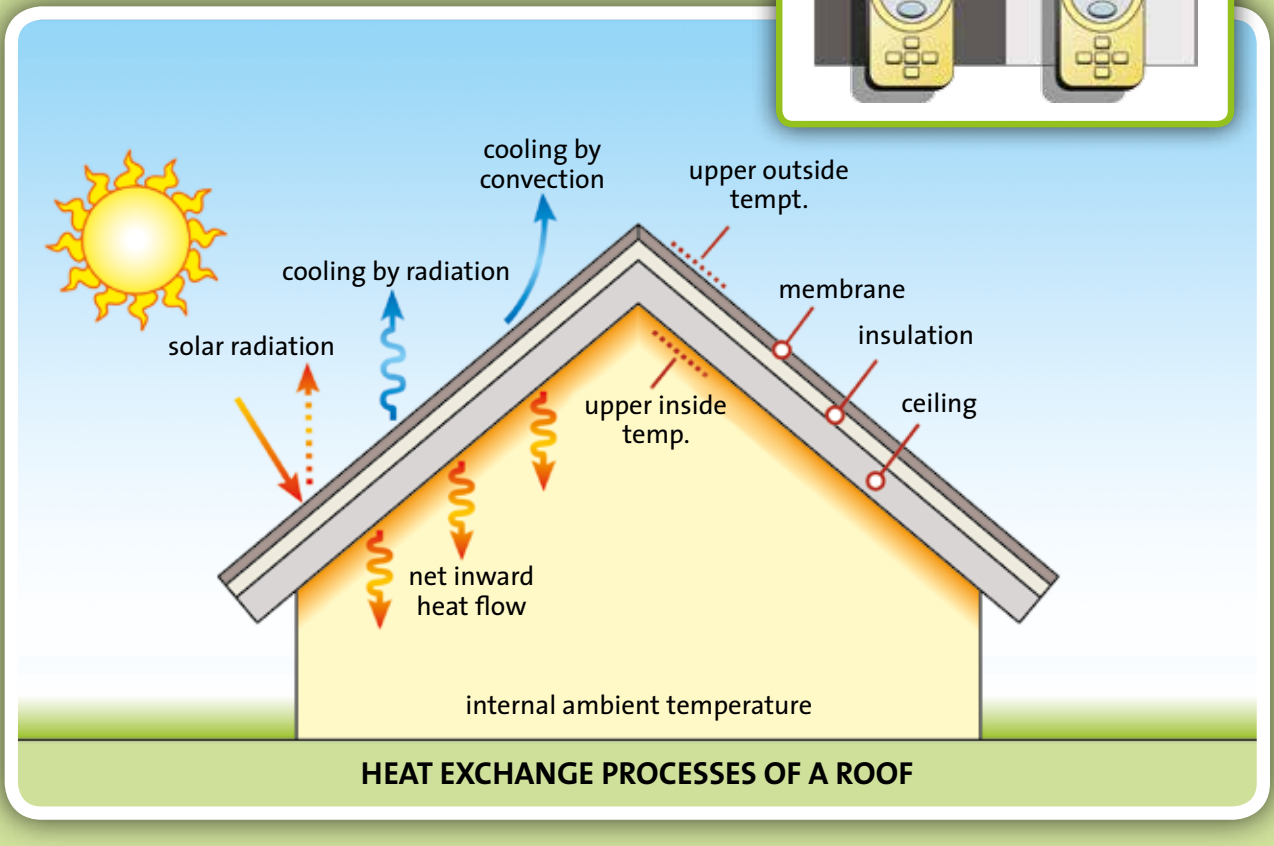
The key concepts





HEAT EXCHANGE PROCESSES OF A ROOF

Solar reflectance

Reflectance (usually indicated with ρ) indicates the proportion of incident light that a given surface is capable of reflecting.
It can have a value of between 0 and 1. The higher the value, the higher the reflectance of the roof.

Emissivity in the infra-red

The emissivity of materials (usually indicated with ε) is the fraction of energy radiated by that material compared to a black body at the same temperature.
It is the measurement of a material's capacity to radiate energy. A true black body would have $\varepsilon = 1$, whilst any real object has $0 < \varepsilon < 1$ (grey body). The higher the value, the higher the roof's emissivity.

"Cool" roofs are surfaces with:

- High reflectance and, thus, low absorption of solar radiation
- High thermal emissivity

High SRI
(Solar Reflectance Index)

SRI Limits provided for by LEED NC 2009 Italy		
Type of roof	Slope	SRI
Slight	≤ 2:12	≥ 78
Steep	> 2:12	≥ 29

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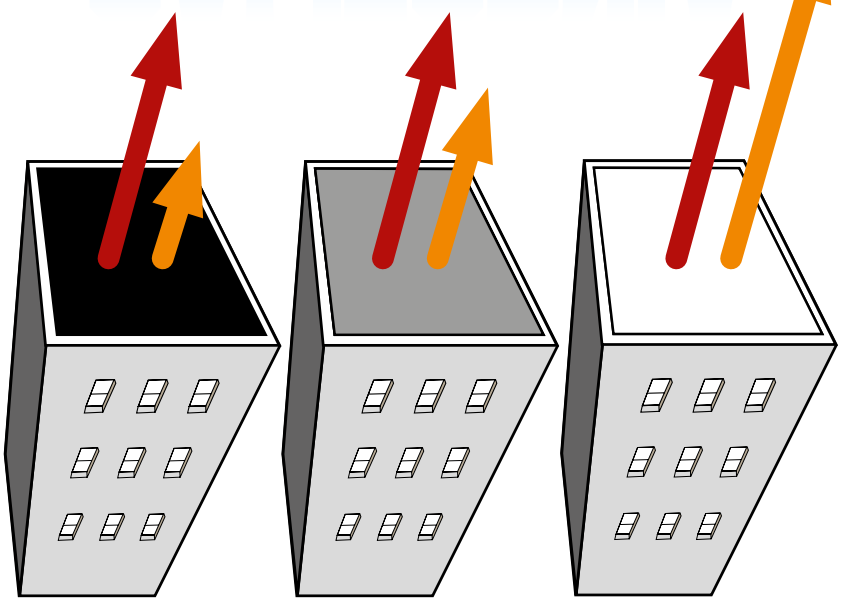
The solution

Download the video to your Smartphone and Tablet!

SAVE MONEY, SAVE THE PLANET

CALIFORNIA



Black membrane Surface Temp. 80°C - 176°F	Aluminium painted Surface Temp. 65°C - 149°F	Bituver CALIFORNIA 40°C - 104°F
Very low reflectance	Low reflectance	Very high reflectance
High emissivity	High emissivity	High emissivity

Ambient temperature = 32°C - 89,6°F

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BITUVER

Megaver California

Membrane made with special bitumen modified with new generation elastomeric polymers (BPE), with cold flexibility of -25°C. The reinforcement consists of fiber glass fabric and glass veil. The fire-resistant membrane, certified "B_{ROOF} (t2)", is coated with embossed reflective aluminium sheet, subjected to treatment with high technology aimed at improving its adhesion and durability. MEGAVER CALIFORNIA guarantees a sharp reduction in the surface temperature and indirect light from the roof, thanks to the very high reflectance and thermal emissivity that last over time.
This characteristic gives important benefits, both for people living in the structure and for the surrounding environment.
MEGAVER CALIFORNIA membranes are particularly recommended as a finishing layer in roofs of high aesthetic value where it is necessary to reduce maintenance operations to a minimum.

Save money

Benefits for the user

- **Reduction in the surface temperature of the roof**
- **Reduction in summer air conditioning costs of up to 30%**
- **Better living comfort, particularly for the top floor**
- **Protection of the load bearing frames from day-night and seasonal temperature variations**
- **Increase in the yield of the photovoltaic modules placed on the roof**
- **Very high durability compared to other reflecting surfaces***
- **Appreciable aesthetic solution, highly improving compared to finishes with traditional membranes**
- **Protection from UV rays and considerable lengthening of life of waterproofing**

Save the planet

Benefits for the environment:

- **Reduction of the heat island effect and, consequently, the temperature of the surrounding area**
- **Reduction in electricity consumption for air conditioning**
- **Pleasant visual impact**
- **Fire resistance "B_{ROOF} (t2)" according to UNI EN 13501-5**

* Surface strength tests
corrosion: absence of bubbles after 1500 h of "salt spray test" (ASTM B117) UV rays: 1500 h exposure cycle = gloss delta at 60° < 30% - delta E > 2

Solar reflectance (R) [1] ASTM E903	77 %
Thermal emissivity (E) [1] ASTM C1371	90 %
Solar Reflectance Index (SRI) [1] ASTM E1980	h_c= 5 W/(m² K) = 95%
	h_c=12 W/(m² K) = 96%
	h_c=30 W/(m² K) = 96%

1 Test Report, Department of Mechanical and Civil Engineering EELab - University of Modena and Reggio Emilia

BITUVER

California-P

High performance mono-component paint, designed to cover walkable concrete, cement fibre, wooden, metal surfaces and, in particular, bitumen-polymer membranes, because, by covering and protecting them from UV rays, it prolongs their life.
The main benefit, compared to traditional protective paints, is the high reflectance and high emissivity, obtained thanks to the particular composition of the ceramic paint. This characteristic offers important benefits for summer living comfort and energy saving in buildings.
It is a watery dispersion based on special modified copolymers, inert fillers, colouring pigments, suspensive materials, thickeners and various additives.

Save money

Benefits for the user:

- **Reduction in the surface temperature of the roof**
- **Reduction of summer air conditioning costs**
- **Better living comfort, particularly for the top floor**
- **Protection of the load bearing frames from day-night and seasonal temperature variations**
- **Increase in the yield of the photovoltaic modules placed on the roof**
- **Easy-to-apply solution**
- **Economical solution among the "Cool Roofs"**
- **Protection from UV rays and considerable lengthening of the waterproofing's life**

Save the planet

Benefits for the environment:

- **Reduction of the heat island effect and, consequently, the surrounding area's temperature**
- **Reduction in electricity consumption for air conditioning**
- **Pleasant visual impact**

Solar reflectance (R) [1] ASTM E903	83 %
Thermal emissivity (E) [1] ASTM C1371	90 %
Solar Reflectance Index (SRI) [1] ASTM E1980	h_c= 5 W/(m² K) = 105%
	h_c=12 W/(m² K) = 104%
	h_c=30 W/(m² K) = 104%

1 Test Report, Department of Mechanical and Civil Engineering EELab - University of Modena and Reggio Emilia

Megaver California

Specifications for high SRI insulated walkable flat roofs

- In the case of flat roofs, form a sloping screed (2-4%) on the load bearing element so as to ensure effective water run-off. This screed must be suitable for securing any mechanical clamps for the insulating panels.

- Make sure the laying level is perfectly dry and remove any unevenness that may compromise the adhesion or cause puncturing of the waterproof cloak.

- Given that the metallic coating behaves as a vapour barrier, it is essential to ensure that the elements which permit the aqueous vapour to disperse from the inner layers of the roof to the atmosphere (e.g. aerators or vents) are suitably sized. Failure to do this can lead to the **MEGAVER CALIFORNIA** detaching from the first layer or the de-lamination of the metallic sheet from the bitumen support.

- Except for areas where the vents will be positioned in a geometrically correct manner, spread by spray or brush a coat of **BITUVER ECOPRIVER** bituminous primer in quantities not less than 300g/m² with the following characteristics:
  - bitumen gel based primer in aqueous emulsion, free of solvent substances
  - consumption between 0.25 to 0.40 Kg/m² based on the porosity and evenness of the surface
  - surface drying time of about 60 min. at 20° C.

- Dry lay a vapour diffusion layer made up of **BITUVER BITUMAT** V12 perforated bitumen glass tissue weighing 1.2 kg/m² and with the following characteristics:
  - suitable for torch application by heating with propane gas blowlamp
  - regular 40 mm diameter holes, number of holes not less than 100/m²
  - softening temperature = 110° C
  - longitudinal dimensional stability ensured by the UNI EN 1107-1 standard.

- Arrange the aerators at a rate of between 15-40 m² depending on thermo-hygrometric conditions of the layer underlying the roof, placing them above the diffusion layer.

- Apply a vapour barrier consisting of a **BITUVER ALUVAPOR TENDER** bituminous membrane strengthened with glass tissue and aluminium sheet, torching it onto the roof's functional layer and taking care to secure the membrane in total adhesion near the holes in the diffusion layer.

- Lay the thermal and sound insulation layer, consisting of rigid panels in **Isover SUPERBAC Roofine®G3** mineral insulation, which have the characteristics specified in the Isover Technical Building Manual.

- Glue the panels with **BITUVER BITUMOX** hot oxidized bitumen (in quantities not less than 1.2 kg/m²) or **BITUVER BITUMASTIC** bituminous mastic, in watery emulsion free of solvent substances (in quantities not less than 1.5 kg/m²).

- Apply the first waterproofing layer, comprising a **BITUVER MEGAVER 4 MM P** bitumen-polymer elastoplastomeric membrane reinforced having the following characteristics:
  - 4 mm thickness with maximum tolerance of 0.2 mm
  - reinforcement with non-woven polyester fabric and strengthened with fibreglass
  - cold flexibility = 25° C
  - flow resistance = 100° C
  - tear resistance L/T = 140/140 N
  - tensile strength at breaking L/T = 500/400 N/5 cm

  The membrane must be laid in full adhesion by torching with a propane gas blowlamp, overlapping the sheets by 10 cm and torching the overlaps. The sheets must be folded and torch applied on the vertical functions at least 20 cm beyond the maximum level expected for rainfall.

- After making sure the first layer of waterproofing is completely dry, apply the second layer comprising a **BITUVER MEGAVER CALIFORNIA** elastomeric membrane for energy saving with the following characteristics:
  - coated with BITUVER type pure aluminium embossed sheet
  - weight 4.5 kg/m2
  - long-lasting industrial painting
  - Solar Reflectance Index (SRI) certified according to the ASTM E1980 standard: h_c = 5 W/(m² K) = 95%; h_c= 12 W/(m² K) = 96%; h_c = 30 W/(m² K) = 96%
  - Reduction of surface temperature of a bituminous membrane on flat roof of about 40° C
  - tensile strength at breaking L/T = 1100/950 N/5 cm
  - tear resistance L/T = 200/200 N

  The membrane has the following functions:
  - guarantees of perfect waterproofing
  - brings a very long life cycle to the whole roof without the need for unscheduled maintenance
  - assures fire resistance
  - increases the production of electricity from the photovoltaic modules by preventing excessive raising of their operating temperature

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- gives the roof an excellent aesthetic and distinction
- protects against UV rays
- protects the whole roof from hot-cold cycles
- considerably reduces energy consumption due to summer air conditioning
- improves living comfort.

This layer will be fully stuck through torching with propane gas blowlamp to sheets offset by 50 cm to those in the first layer.

In all cases mentioned below, the sheets must have a maximum length of 5 m and must be overlapped along the overlap bands (width 10 cm) and torched at the overlaps.

In the case of flat roofs (slopes between 2-4%) it is recommended to lay the **BITUVER MEGAVER CALIFORNIA** parallel to the direction of the eaves.

In the case of slopes between 4-20% it is recommended to lay the **BITUVER MEGAVER CALIFORNIA** parallel to the pitch slope.

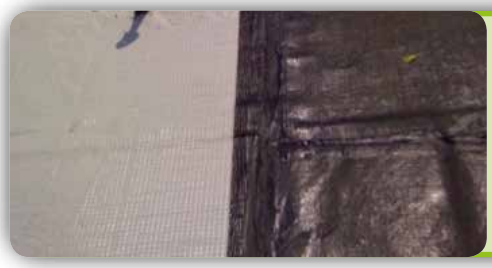
In the case of slopes over 20%, it is recommended to lay the **BITUVER MEGAVER CALIFORNIA** parallel to the pitch slope and – ensure at the top of the roll - 4 mechanical securing points.

The membrane must be folded and torch applied on the vertical functions at least 20 cm beyond the maximum level expected for rainfall.

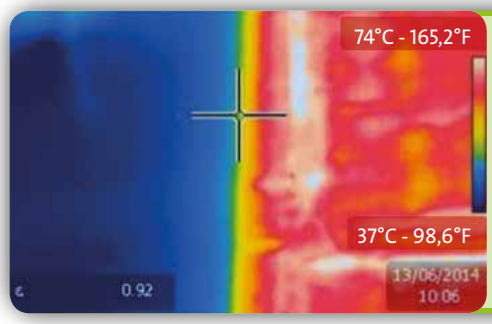
Read the warnings in the product documentation carefully. For further clarification and information contact the ISOVER SAINT-GOBAIN Technical Service

Results of an internal test carried out on the roof of a residential building

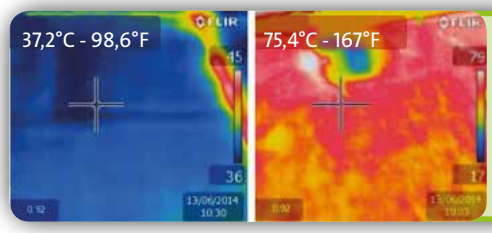
Florence, 06/13/2014
10 am - 10,40 am
Outside temperature: 32°C - 89,6°F



Junction between Bituver Megaver California and previous traditional membrane.



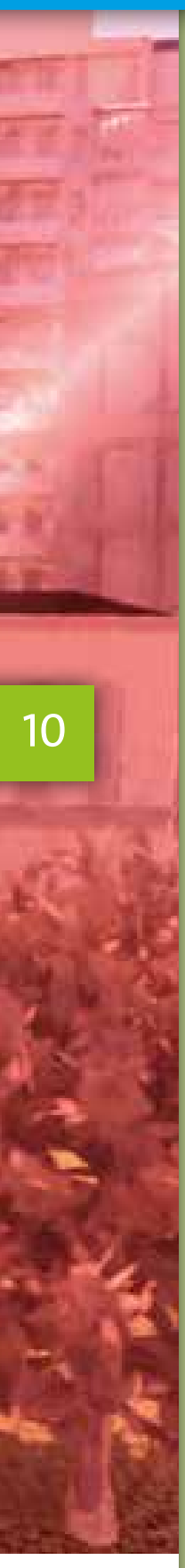
Same picture above taken by infrared thermal camera: the temperature difference is evident.



Two measurement by the thermal camera: the temperature difference is 38,2°C -100,4°F, as much as 50% less!

California-P

Specifications for high SRI insulated walkable flat roof



- Form a cement mortar screed on the load bearing floor with a slope of 2-4% so as to ensure effective disposal of the water. This screed must be suitable for securing any mechanical clamps for the insulating panels.

- Except for the areas where the vents will be positioned in a geometrically correct manner, spread by spray or brush a coat of **BITUVER ECOPRIVER** bituminous primer in quantities not less than 300g/m² with the following characteristics:
  - bitumen gel based primer in aqueous emulsion, free of solvent substances
  - consumption between 0.25 to 0.40 Kg/m² based on the porosity and evenness of the surface
  - surface drying time of about 60 min. at 20° C.

- Dry lay a vapour diffusion layer made up of **BITUVER BITUMAT V12** perforated bitumen glass tissue weighing 1.2 kg/m² and with the following characteristics:
  - suitable for torch application by heating with propane gas blowlamp
  - regular 40 mm diameter holes, number of holes not less than 100/m²
  - softening temperature = 110° C
  - longitudinal dimensional stability ensured
  - by the UNI EN 1107-1 standard.

- Arrange the aerators at a rate of between 15-40 m² depending on thermo-hygrometric conditions of the layer underlying the roof, placing them above the diffusion layer.

- Apply a vapour barrier consisting of a **BITUVER ALUVAPOR TENDER** bituminous membrane strengthened with glass tissue and aluminium sheet, torching it onto the roof's functional layer and taking care to secure the membrane in total adhesion near the holes in the diffusion layer.

- Lay the thermal and sound insulation layer, consisting of rigid panels in Isover **SUPERBAC Roofine®G3** mineral insulation, which have the characteristics specified in the Isover Technical Building Manual.

- Glue the panels with **BITUVER BITUMOX** hot oxidized bitumen (in quantities not less than 1.2 kg/m²) or **BITUVER BITUMASTIC** bituminous mastic, in watery emulsion free of solvent substances (in quantities not less than 1.5 kg/m²).

- Apply the first waterproofing layer, comprising a **BITUVER MONOFLEX 4 MM P** prefabricated elastoplastomeric membrane strengthened with polyester and having the following characteristics:
  - 4 mm thickness with maximum tolerance of 0.2 mm
  - strengthened with continuous thread non-woven polyester fabric and reinforced with fibreglass threads
  - cold flexibility = -15° C
  - flow resistance = 130° C (120° C after ageing)
  - tear resistance L/T = 170/170 N
  - dynamic puncture strength = 1000 mm

  torch glued in total adhesion on the insulation panels. Fold the sheets on the vertical contours at least 20 cm beyond the maximum level expected for rainfall.

- Apply the second layer of waterproofing consisting of a prefabricated **BITUVER MONOFLEX 4 MM P TEX** prefabricated elastoplastomeric bituminous membrane strengthened with polyester, with the characteristics equivalent to the membrane used in the first layer, as well as DECOTEX non-woven fabric finishing, with the following characteristics:
  - ecological (it does not release dusts or dirty the site)
  - non-slip, hence safer
  - protective paint can be applied immediately after laying, avoiding the traditional 40/60 days of wait
  - greater duration of the paintwork
  - reduces stickiness and risk of marks with high temperatures
  - less wear on the membrane's weave
  - excellent aesthetic impact.

- Torch glue the sheets in total adhesion, folding them on the vertical contours at least 20 cm beyond the maximum level expected for rainfall.

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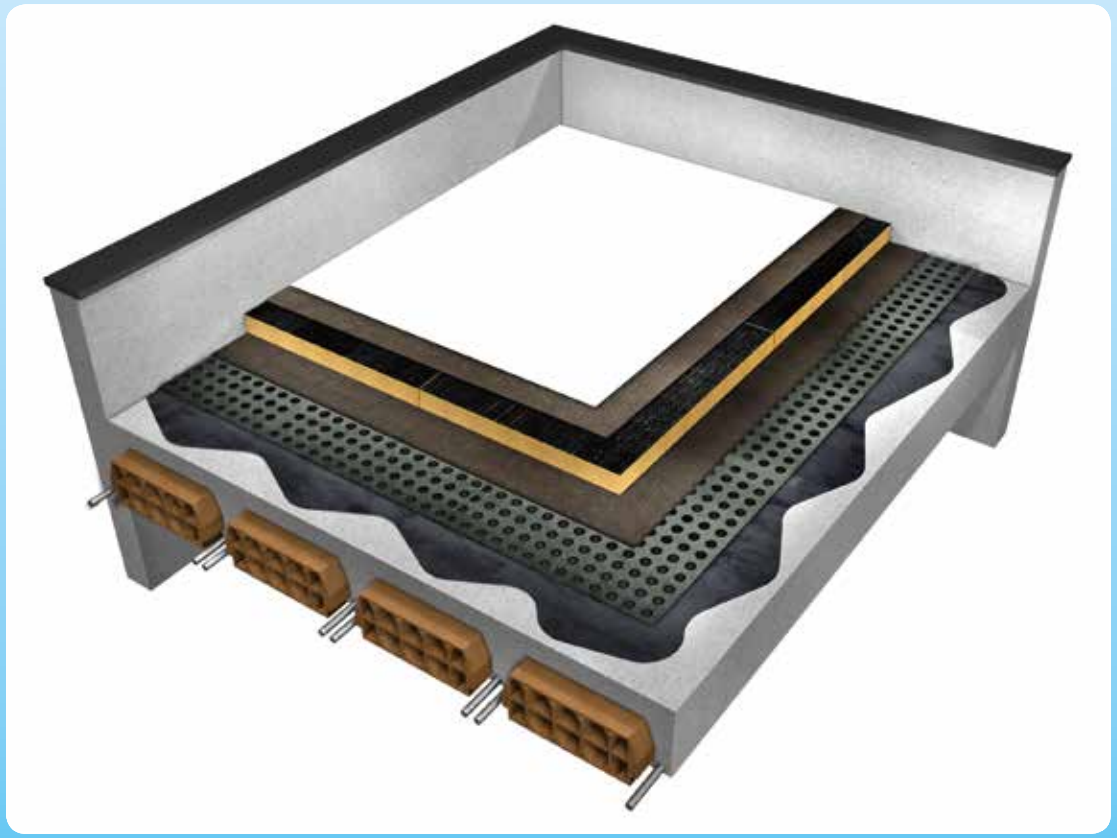
Apply the **BITUVER CALIFORNIA - P** high solar reflectance index paint for saving energy; it is high performance single component and has the following characteristics:

- Solar Reflectance Index (SRI) certified according to the ASTM E1980 standard: h_c = 5 W/(m² K) = 105%; h_c = 12 W/(m² K) = 104%; h_c = 30 W/(m² K) = 104%
- Reduction of the surface temperature of a bituminous membrane covering on a flat roof by about 40° C
- Elongation to break at 20° C according to the UNI 8202 standard = 100%
- Water based paint, no solvent substances.

The paint has the following functions:

- considerably reduce energy consumption due to summer air conditioning
- increase the production of electricity from the photovoltaic modules by preventing excessive raising of their operating temperature
- give the roof an attractive visual impact
- protect the bituminous cloak from UV rays
- protect the whole roof from hot-cold cycles.



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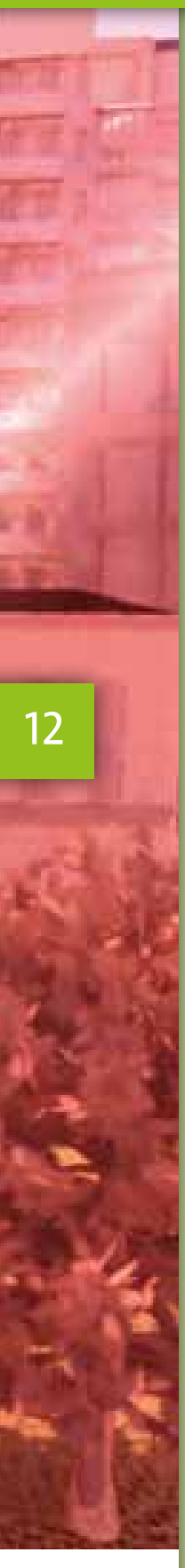
Save money

BENEFITS FOR THE USER



Here we will give an example and illustrate some basic scenarios in order to be able to present a numerical analysis:

- waterproofed flat roof
- air-conditioned building
- pre-set internal air temperature, such as supermarkets, warehouses for perishable goods, etc.

To provide a rough estimate we will use the "air-sun temperature" concept, to evaluate the combined effects of solar radiation and external air temperature on the roof surface.

When we know the quantity of thermal energy that passes through the roof during summer air conditioning, we can calculate the electricity actually consumed, bearing in mind that air conditioning systems act as a heat pump.

Thus with 1 kWh it is possible to transfer a much higher quantity of heat than the equivalent energy.

Result:

Q electric = Q thermal / F

For example, with large systems the value of F can be around 2.5.

The main electricity consumption, and therefore management costs reduction initiatives are:

- use of high reflectance and high emissivity treatment on the surface exposed to solar radiation
- reduction of the roof's transmittance H, by using an adequately thick good insulating material
- improvement of the system's output.

Costs/benefit ratio

There are substantial differences between one energy saving project and another and, therefore, management costs, not just in terms of the size of the savings, but also in terms of the cost of the project. A detailed analysis of the costs/benefit ratio must therefore be made.

Given cost C (€/m^2) and management saving B (€/m^2 year), financial mathematics suggests various methods for this type of valuation, including:

- PBS = Pay Back Simple - the time for the return on the capital outlay without taking into account interest liabilities (years)
- IRR = Internal Rate of Return - the receivable interest rate yielded by operating savings on the capital used (I%/ year).

This valuation takes into account:

- the conventional life of the roof (years)
- any residual value after said life (e.g. €/m^2)
- the cost of any maintenance operations (e.g. €/m^2)
- the increase in the cost of energy over the years (%/year).

It should be noted that cost C is considerably reduced in the following circumstances:

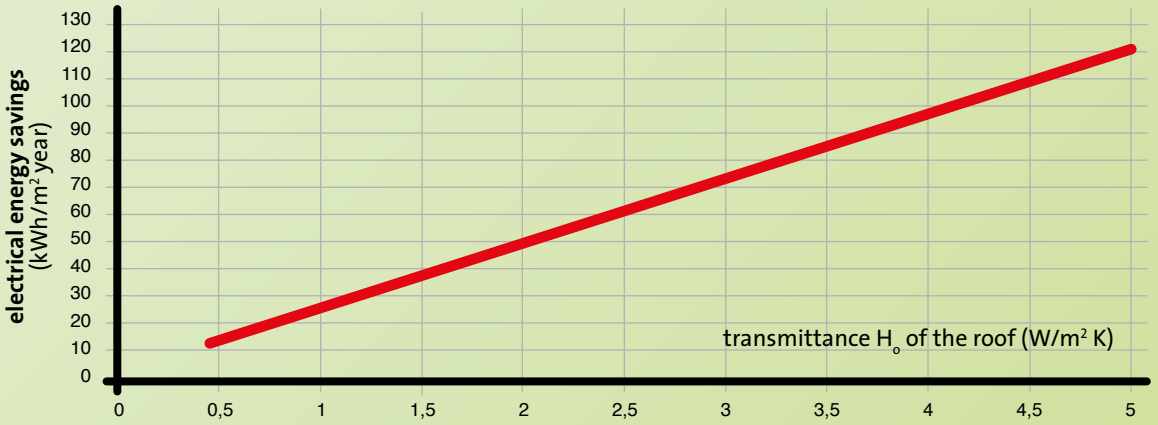
- combining with maintenance job that cannot be put off, such as, for example, an operation to restore the deteriorated shroud of the roof (in this case the cost to be considered is slightly more than the difference in cost between a membrane with a reflecting surface and a traditional one)
- state incentives in the form of tax relief for energy restructuring operations.

Application of the concepts shown

For a first estimate of the energy savings that can be obtained in three cities, Milan, Rome and Palermo, the monthly average values for incident solar radiation (direct and indirect) on a horizontal surface and the external air temperature were used.

Taking into account the transformation of the energy savings into electricity, the unit electricity savings over the period in which air-conditioning is used (kWh/m² year) at a constant temperature of about 22 °C, calculated in an averagely recurring scenario, are shown in a graph against the transmittance Ho of the roof before the operation (figs. 1,2 and 3).

Energy savings = f (H_ot) • MILAN



Energy savings = f (H_ot) • **ROME**

Energy savings = f (H_ot) • **PALERMO**

Save money

BENEFITS FOR THE USER

The operation considered was the restoration of a deteriorated waterproof shroud using 2 layers of Bituver membranes, one of which was the Bituver **MEGAVER CALIFORNIA** finishing with reflecting treatment. No insulation of the roof was envisaged, so the thermal transmittance remains Ho.
The energy savings, and hence the management savings, are therefore due solely to the Bituver **MEGAVER CALIFORNIA** membrane, which drastically reduces the heat flow that can be attributed to the solar radiation absorbed compared to the same type of waterproof shroud without a reflective finish.
Assuming an electricity cost of € 0.15/kWh and a greater intervention cost of about € 10/м² - compared to a traditional type that uses a membrane finish with low reflectance - the costs/benefit analysis, for a roof with thermal transmittance Ho = 1 W/m² K, gives the following results:

	MILAN	ROME	PALERMO
PBS Pay Back Simple (years)	3,8	2,6	2,2
IRR Internal Rate of Return (% year)	23,0	36,4	43,7

To calculate the IRR, a life of 10 years and a residual value of zero for the intervention were assumed.
The results do not take into account:
- future increases in the cost of electricity
- state incentives, in the form of tax relief, provided for by current legislation (Law Decree 83/2012)
- the cost of any maintenance
- the small penalty for winter conditioning linked to the lesser contribution from the sun.

For the multiple simplified assumptions made, the data shown above must considered of general and non-binding and for buildings conditioned at 22°C 24 h/day (e.g. supermarkets).

The winter season

The Cool Roof treatment on the roofs shown above can slightly increase the winter heating costs because , in this period, it reduces the contributions of free heat from the sun.
This winter penalty is however limited for the following reasons:
- the days are shorter
- the angle of the sun, on the roof, is smaller
- the sky is cloudier
- the greater energy consumption for heating occurs in the early morning and evening, i.e. when there is no sun.
- the roofs can be covered in snow and therefore white in any case.

In any case, this penalty can be reduced by improving the roof's thermal insulation, an operation to be carried out before laying the new waterproofing.
By reducing the roof's thermal transmittance H with insulation, the global energy savings differences (summer+winter) are narrowed between the colder cities (e.g. Milan) and the hotter cities (e.g. Palermo).

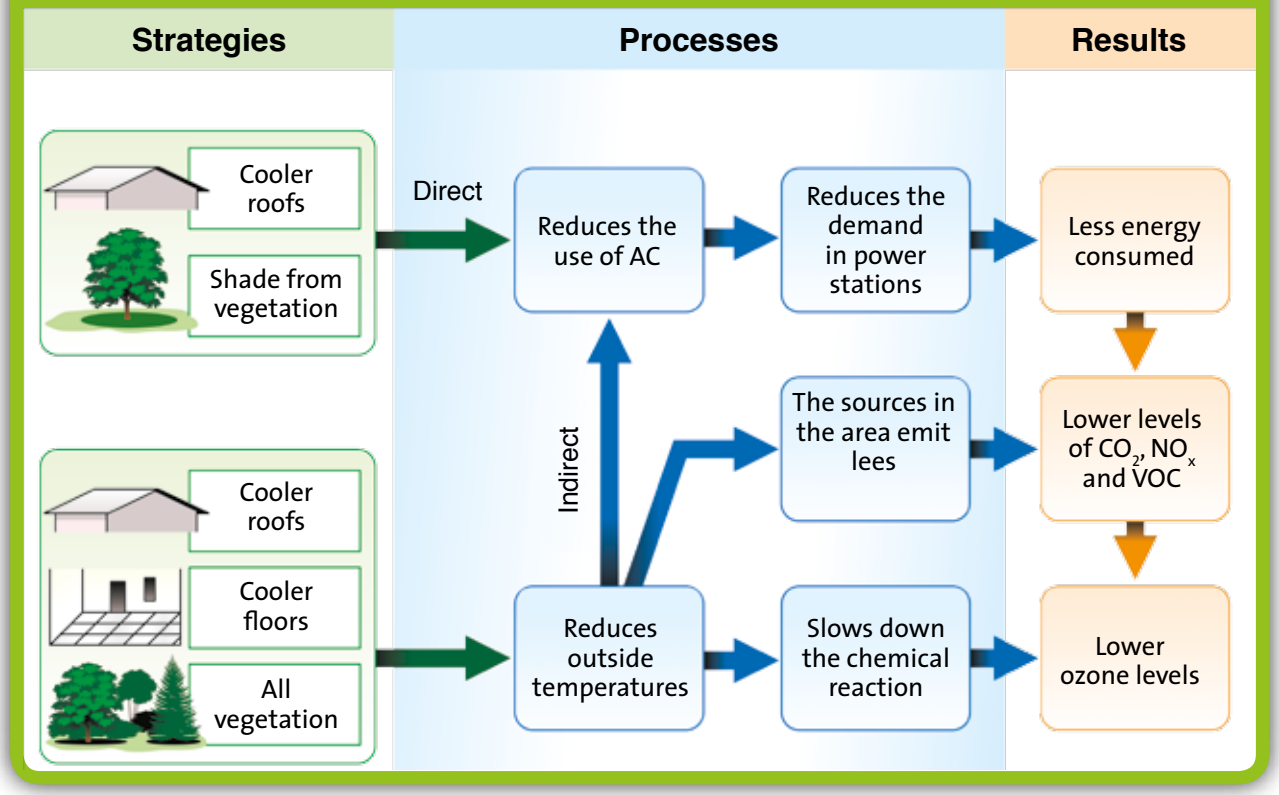
Savings on a national scale

Significant economic results emerge from a test carried out in 11 American cities with different climates.
The estimated savings, if the "cool roof" technology is adopted on a national scale for residential and non-residential buildings, are shown in the graph on the right.
The total savings due to "cool roofs" reaches $ 195 million a year. Moreover, monitoring conducted on 10 buildings located in the states of California and Florida has shown a reduction in energy for air conditioning of between 20% and 70%.

Save the planet

THE BENEFITS FOR EVERYONE

Analysis of energy and air quality



The Bituver California range of products is a sustainable answer to global warming, as the products reduce the need for air conditioning with ensuing lower consumption of electricity and also reduce the temperature of the surrounding external air thanks to the mitigation of the heat island effect. Moreover, there is also the beneficial effect on Planet Earth's energy balance.

The albedo is the portion of solar radiation reflected into space by the Earth's surface. This is estimated at 9%.

The aim of the "Albedo Control" project is to increase that amount. Even a slight improvement of that value is capable of significantly reducing the Earth's temperature. Researchers recognised at a world level affirm that, by adopting "cool roofs" on a vast scale, it is possible to reduce the average global temperature, thus contributing to compensating for the increase in temperature caused by the increase of greenhouse gases in the atmosphere.

This produces an effect similar to extracting CO_2 from the atmosphere.

bituver

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SAINT-GOBAIN

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