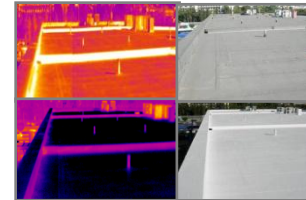
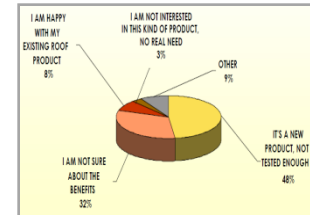


The European Cool Roof Council and the status of cool roof technology in Europe



Input data		Output data	
Country	Italy	Estimated annual energy savings in block rub	
City	Rome	10,000.00	
Roof	Pitched		
Energy sources	Electricity, Gas, Heating oil, District heating, Biomass, Solar thermal, Solar PV, Wind, Water, Geothermal, Other		
Energy costs and equipment efficiencies	<input checked="" type="checkbox"/>		
Use National Energy prices for 1990	<input checked="" type="checkbox"/>		
Details of components			
Component	Estimated annual savings in block rub		
Energy savings from insulation	10,000.00		
Energy savings from ventilation	0.00		
Energy savings from heating	0.00		
Energy savings from cooling	0.00		
Energy savings from hot water	0.00		
Energy savings from lighting	0.00		
Energy savings from appliances	0.00		
Energy savings from other	0.00		
Energy savings from total	10,000.00		

Dr. Afroditi Synnefa, Prof. Mat Santamouris

National and Kapodistrian University of Athens, Greece

Workshop: "Innovazioni nel campo delle proprietà antisolari dei materiali per l'edilizia"
Modena, Italy 22nd February 2012

Introduction

- **Energy efficiency in buildings is a well-established objective in the EU**
- **Studies conducted in the context of the EU funded project to promote the use of cool roofs in Europe point to a few key barriers:**
 - **lack of a legislative framework**
 - **lack of cool roof standards**
 - **lack of data**
 - **lack of knowledge and information**
- **Cool Roofs are part of the solution and link into the European green economy agenda.**

The Cool Roofs project

The Cool Roofs project

■ **Main objective:** the implementation of an Action Plan for the promotion, market transformation and changing behavior towards cool materials technology in the European Union.



Cool Roofs project : <http://www.coolroofs-eu.eu/>

The Cool Roofs project

TECHNICAL

- Lack of data
- Lack of standards

MARKETING

- Conduct research
- Understand barriers

POLICY

- Landscape and stakeholder assessment

END USERS

- Raise awareness
- Dissemination to stakeholders

Management – University of Athens

EU COOL ROOFS COUNCIL

- gather all interested target groups
- exchange of knowledge in technological developments and market penetration
- understand existing market, trends, dynamics to transform it
- promote EU technical standards
- explore policy & legislation in view of integrating cool roofs
- disseminate information to stakeholders

Database of cool roofing materials

Name of the product	Manufacturer	Country	Type of product	Colour	Roof slope	Substrate	SR (%)	IE (-)	ST (°C)	SRI (-)
DERBIBRITE NT	DERBIGUM	Belgium	membrane	white	flat and steep slope	cement, concrete, tiles, plaster, wood, metal	81	0,81	44,6	100
R-NOVA	SOPREMA	France	paint	White	flat and steep slope	cement, concrete, tiles, plaster, wood, metal	88	0,89	40,3	111
SOPRASTAR	SOPREMA	France	Membrane	White	flat and steep slope	cement, concrete, tiles, plaster, wood, metal	78	0,89	45,8	97
SOPRASTAR S	SOPREMA	France	Membrane	White	flat and steep slope	cement, concrete, tiles, plaster, wood, metal	78	0,89	45,8	97
Revsun antioo	Zolpan	France	WB antioorrosive coating	White	Flat and steep sloped roofs	Metallio clads, metal roof panels, corrugated panels, concrete, bitumen roofing	73	0,89	48,4	90
Revsun antioo	Zolpan	France	WB antioorrosive coating	Sand RAL 1015	Flat and steep sloped roofs	Metallio clads, metal roof panels, corrugated panels, concrete, bitumen roofing	64	0,93	52,8	78
Revsun antioo	Zolpan	France	WB antioorrosive coating	Grey RAL 7035	Flat and steep sloped roofs	Metallio clads, metal roof panels, corrugated panels, concrete, bitumen roofing	51	0,92	59,6	60
Revsun mempur	Zolpan	France	SB liquid waterproofing coating	White	Flat roofs	Concrete, bitumen roofing, shingles, metal roof panels, wood composite	82	0,92	43,4	103
Revsun metal	Zolpan	France	WB antirust paint	White	Flat and steep sloped roofs	Metallio clads, metal roof panels, corrugated panels, concrete, bitumen roofing	76	0,88	46,9	94
Revsun metal	Zolpan	France	WB antirust paint	Sand RAL 1015	Flat and steep sloped roofs	Metallio clads, metal roof panels, corrugated panels, concrete, bitumen roofing	63	0,91	53,5	76
Revsun metal	Zolpan	France	WB antirust paint	Grey RAL 7035	Flat and steep sloped roofs	Metallio clads, metal roof panels, corrugated panels, concrete, bitumen roofing	50	0,9	60,4	58
Revsun roofing	Zolpan	France	WB liquid waterproofing coating	White	Flat and low sloped roofs	Concrete, bitumen roofing, shingles, metal roof panels, wood composite	70	0,91	49,9	86
Revsun roofing	Zolpan	France	WB liquid waterproofing coating	Sand RAL 1015	Flat and low sloped roofs	Concrete, bitumen roofing, shingles, metal roof panels, wood composite	62	0,92	54	75
Revsun roofing	Zolpan	France	WB liquid waterproofing coating	Grey RAL 7035	Flat and low sloped roofs	Concrete, bitumen roofing, shingles, metal roof panels, wood composite	50	0,92	60,1	59
Woryl 284 Reflect Finish	Westwood KUNSTSTOFFTECHNIK GmbH	Germany	coating	white	flat roof	cement, concrete, tiles, plaster, asphalt, PVC, FPO	90	0,89	39,2	114

- >200 products (initial version 100)
- List of European labs able to perform cool roof measurements
- Constantly updated (now its management is transferred to the ECRC)

- 5 case studies: maximum geographical and building typology coverage
- 10-40% energy savings & 1.5-2 °C reduction of the indoor temperatures, depending on the climatic conditions.



Cool Roofs toolkit

Calculator of energy savings (cooling-heating) for low-slope roofs (relative to a "black" roof)

Input data		Output data	
Country	Hellas	Calculate annual savings relative to black roof	
City	Herakleion		
Roof			
R-value (high=3.5; avg=1.5; low=0.5)	2 K·m²/W	Net savings	4.631 €/m² per year
Solar reflectance, SR (high=80; avg=50; low=10)	80 %	Cooling savings	11.3619 €/m² per year
Infrared emission, IE (high=90; avg=60; low=10)	90 %	Heating savings (heating penalty if negative)	-6.7306 €/m² per year
Energy costs and equipment efficiencies		Insulation in black roof to yield same annual energy savings:	
(visit Europe's Energy portal for help)		Upgrade from R- 2 to R- 6.7 K·m²/W	
Summertime cost of electricity (high=0.30; medium=0.15; low=0.08)	0.1 €/KWh		
Air conditioner efficiency (cooling COP) (high=4; avg=3; low=1.5)	3	Details of comparison	
Energy source for heating (choose one)	<input checked="" type="radio"/> Electricity <input type="radio"/> Fuel	Heating degree days for location chosen	1188.6 annual °C-day
If electricity, wintertime cost (high=0.30; avg=0.15; low=0.08)	0.1 €/KWh	Cooling degree days for location chosen	715.98 annual °C-day
If fuel, cost (Natural gas: high=0.15; avg=0.09; low=0.03)	€/Kwh	Solar load for location chosen	4.21 annual average KWh/m² per day
Heating system efficiency (heating COP) (Furnace or boiler: high=0.8; avg=0.7; low=0.5) (Electric heat pump: high=2; avg=1.5) (Electric resistance: 1)	1	Cooling load for black roof (SR=5%; IE=90%)	15.24 KWh/m² per year
		Heating load for black roof (SR=5%; IE=90%)	13.65 KWh/m² per year
		Cooling load for proposed roof	3.61 KWh/m² per year
		Heating load for proposed roof	15.95 KWh/m² per year

- Developed in the framework of EC's "CoolRoof" project.

- The accuracy of this calculator depends on the supplied data. [CLICK HERE](#) to get **help** in figuring out the best input values.

- The model used for estimating savings is adapted from the paper of Petric *et al.*, "Effect of solar radiation control on energy costs - A radiation control fact sheet for low slope roofs", Proceedings, *Performance of the exterior envelopes of whole buildings VIII: Integration of Building envelopes*, Atlanta, December 2001, American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc.

Cool Roofs handbook



Intelligent Energy  Europe

COOL ROOFS

PROMOTION OF COOL ROOFS IN THE EU

Contract N°: EIE/07/475/SI2.499428

WP3: Technical aspect of cool roofs

Technical Guidelines Handbook

DRAFT 2

Edited by:

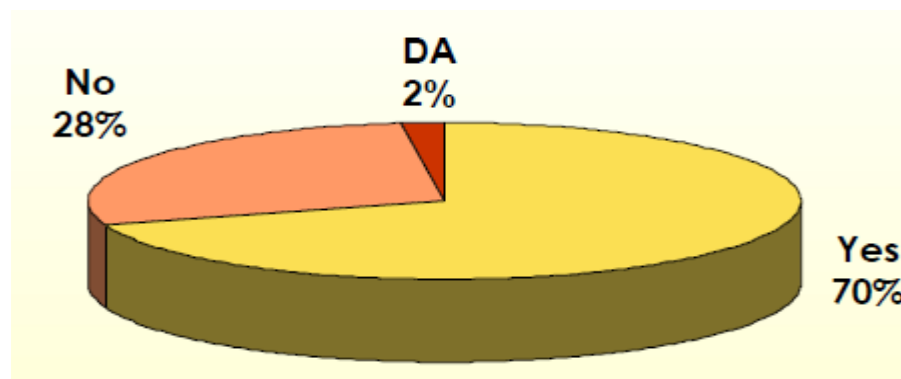
Maria Kolokotroni, Brunel University

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Cool roof market study

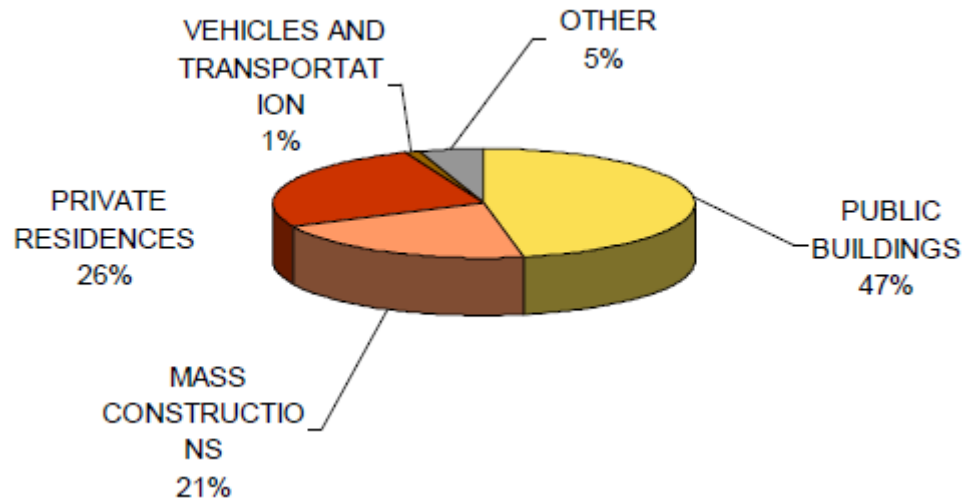
- EU Cool roofs market survey was based on interviews of major stakeholders in the field and on an on line survey – 519 questionnaires analysed
- 18 questions on a) current status, b) potential marketing c) Quality Certification, d) communication and promotion e) distribution & market channeling

The majority of the key market players claim to be aware of the cool roof technology (70%), but not all that familiar with the term “cool roofs” (57% unaware of it).

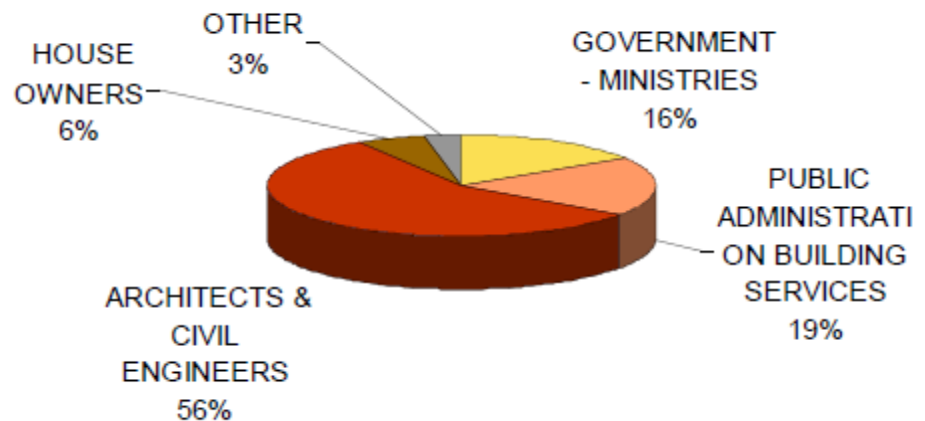


Cool roof market study

**More
promising
cool roof
application**

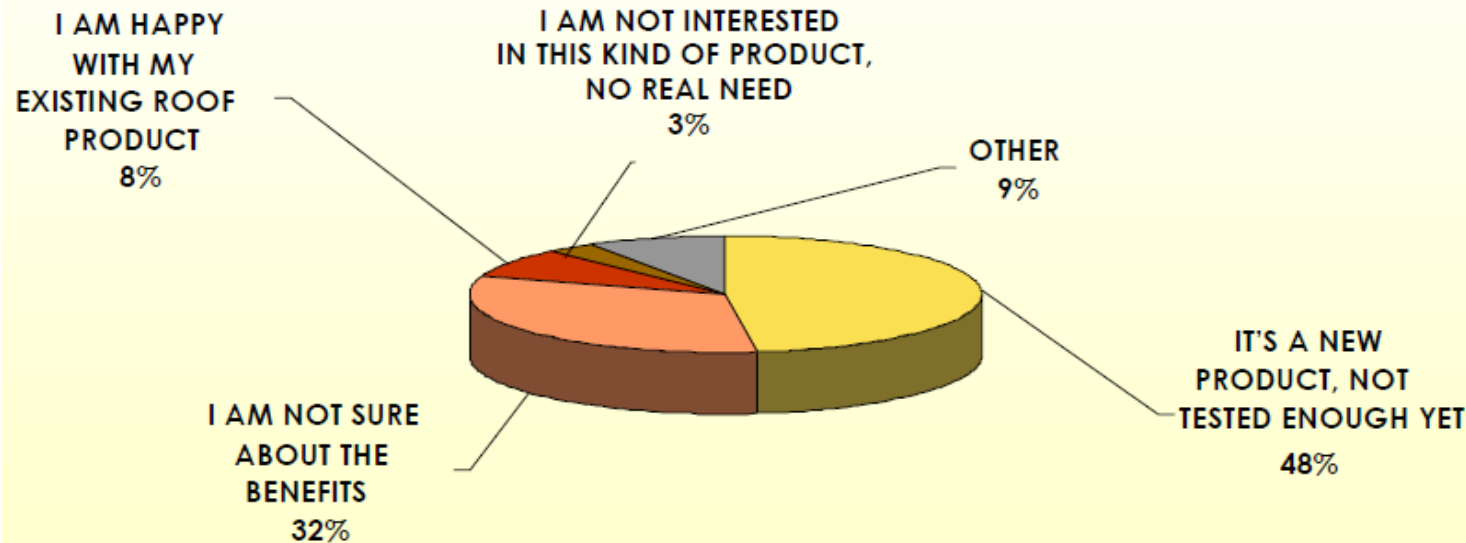


**The most crucial
strategic partner for
the promotion of cool
roofs is “architects &
engineers”**

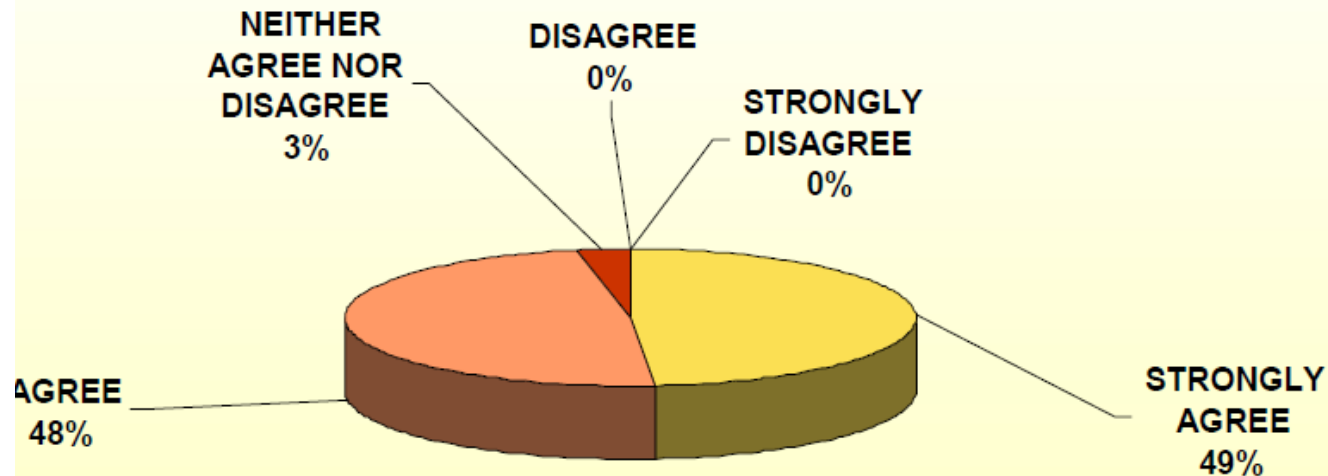


Cool roof market study

Main barrier



"QUALITY CERTIFICATION" is a must



Cool Roofs policies and programs

- ◆ In Italy and Greece there are directives promoting the use of cool materials as energy efficiency measures.
- ◆ In Greece a program called “Building the future” has been announced and gives incentives for the application of 20,000 cool roofs on residential buildings as a means to improve their energy performance.
- ◆ In the UK (BREEAM Communities) and Germany (German Sustainable Building Certificate) certification standards on ecological quality and sustainability include cool materials as a heat island mitigation strategy



BREEAM®



The European Cool Roof Council

The European Cool Roofs Council

- The main aim of the ECRC is to develop scientific knowledge and research in relation to cool roof technology and to promote the use of cool roof products in Europe, including developing a product rating program.
- The important participation and support from the European industry underlines the great interest in Cool Roofs technology and has led to the legal establishment of the ECRC as an international non profit organisation based in Brussels with 23 members.
- Contacts with the U.S. Cool Roof rating council and other related institutions have been made and their experience is being transferred.



ECRC's mission

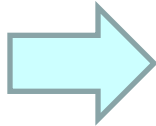
The ECRC believes that Cool Roof products can make an important contribution to mitigating climate change through reducing the urban heat island effect and increasing the sustainability of buildings. For this reason, the ECRC promotes the certification of Cool Roof products and their use across Europe.

This is achieved through:

- Developing and advocating sound science relating to cool materials for a range of building types in different European climates**
- Working with standards organizations to design accurate and credible methods for evaluating the radiative properties of roofing products**
- Promoting the benefits of Cool Roof products**
- Proactively engaging with stakeholders and developing partnerships throughout the value chain**
- Maintaining transparency and integrity in all our business relationships**

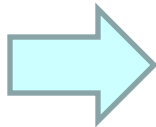
ECRC Committees

Legal &
organizational
Committee



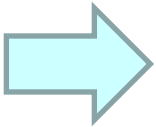
Legal and administrative management of ECRC, and on its value proposition & mission

Technical &
Documentation
Committee



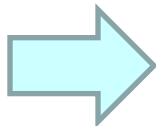
Testing, standards & certification, rating scheme and database

Marketing &
policy
Committee



Promoting CR to key markets & decision-makers and the definition of “Cool Roof”

Membership &
Outreach
Committee



Dissemination to stakeholders, boost memberships, fee structures

Technical & Documentation Committee

■ Working Group 1:

- Propose measurement procedures
- Write ECRC internal standard documents & certification scheme document & licences
- Work with CEN/national bodies to integrate CR into existing or upcoming standards and calculation methods and/or create a full European CR standard
- Appoint Certification Board, Appoint Accreditation Body, Approve first Test Lab
- Specify form of product database

■ Working Group 2:

- Specify weathering sites

■ Working Group 3:

- Specify accelerated ageing test methods

➤ A working group on the impact of cool roofs on global warming mitigation is also going to be formed

Marketing & Policy Committee

■ Working Group 1:

- Develop a marketing plan – where are we now, and where do we want to be and how to get there

■ Working Group 2:

- Develop a logo and cool roof labeling plan

■ Working Group 3: Policy sub -committee

- Develop a Policy Plan: Finalize CR value proposition and messages, Re-establish priority policies, Create awareness and build credibility for CR

ECRC membership

- Only the organisations and associations active in the field of manufacturing, selling, marketing, research or promotion of cool roof products can become members of the ECRC.
- The members shall not be personally liable for any commitments entered into by the Association.
- Members are exclusively reserved to organisations and associations (excluding natural persons) active in the field of Cool Roof technology as stated above.

➤ If you are interested in becoming a member of the ECRC please contact:
ECRC's secretariat: Ms. Julie Kolokotsa
ecrc@coolroofcouncil.eu

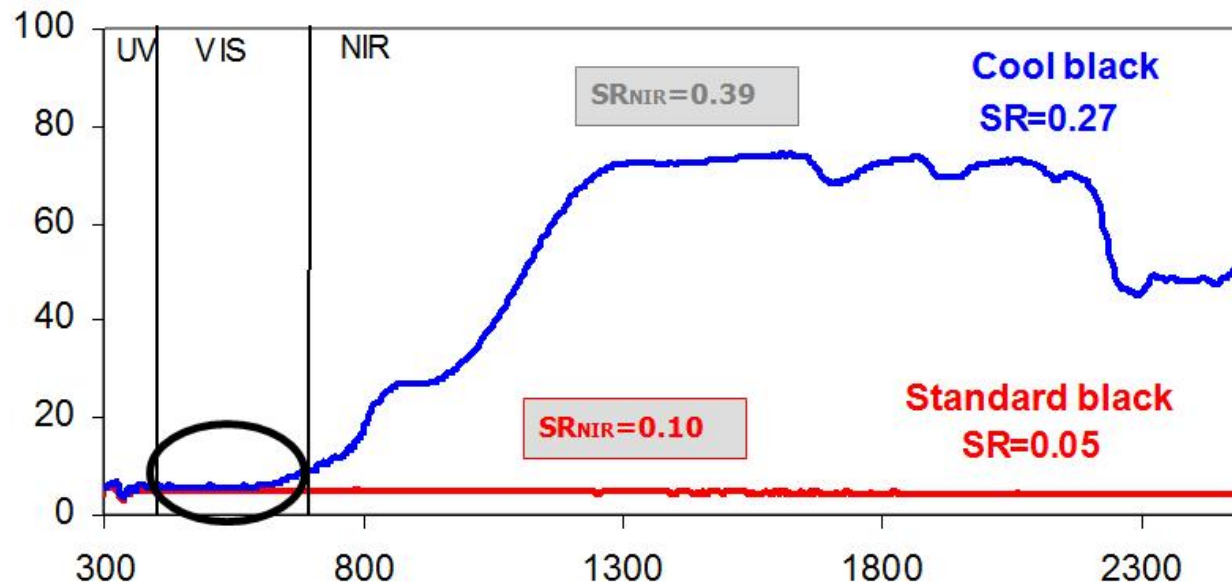
Recent research in the development of cool materials

Development of cool colored coatings

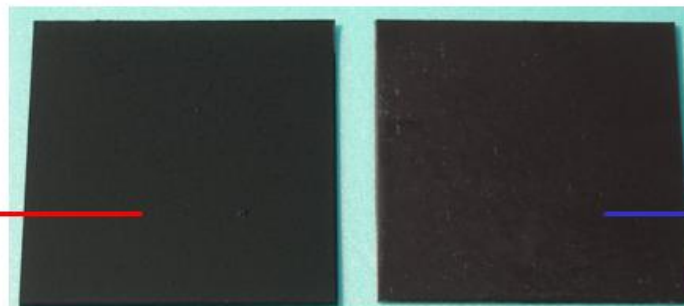


■ The optical properties and the thermal performance of 10 prototype cool colored coatings, prepared at the University of Athens using near-infrared reflective color pigments are tested in comparison to color-matched, conventionally pigmented coatings in an effort to investigate the ability of the cool colored coatings to maintain lower surface temperatures than conventionally pigmented color-matched coatings under sunlight and during the night during both summer and winter

Development of cool colored coatings

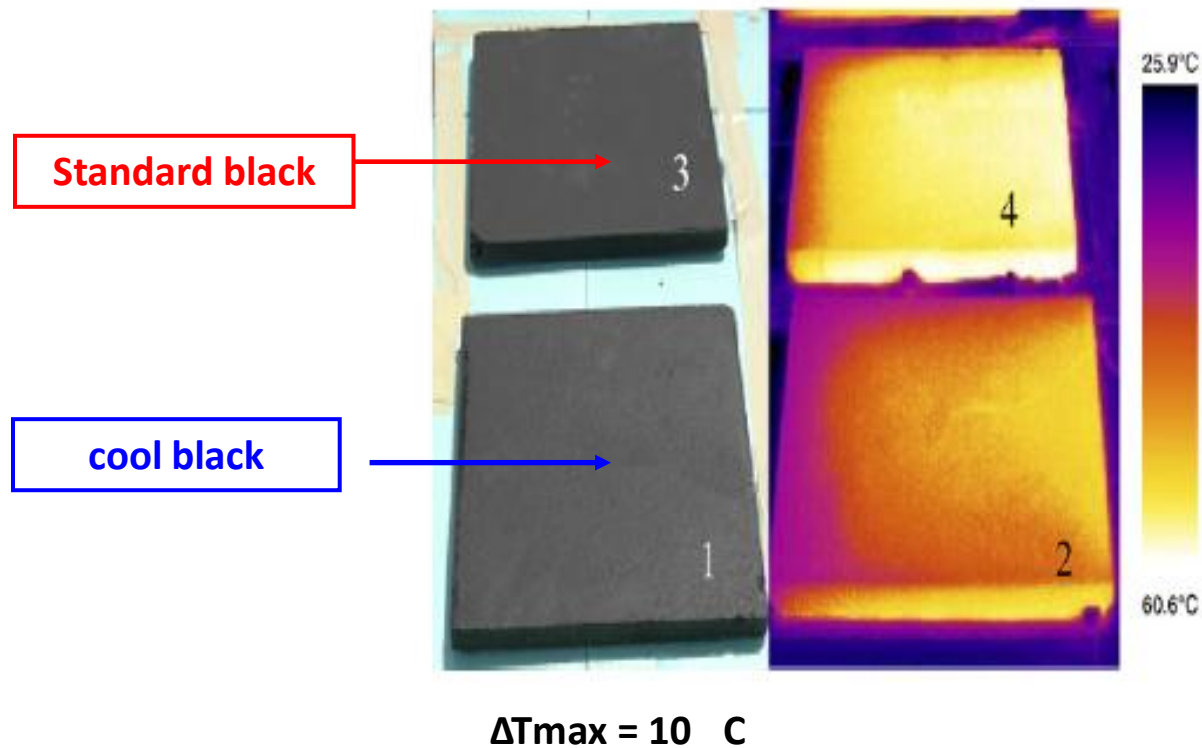


**Standard
black**

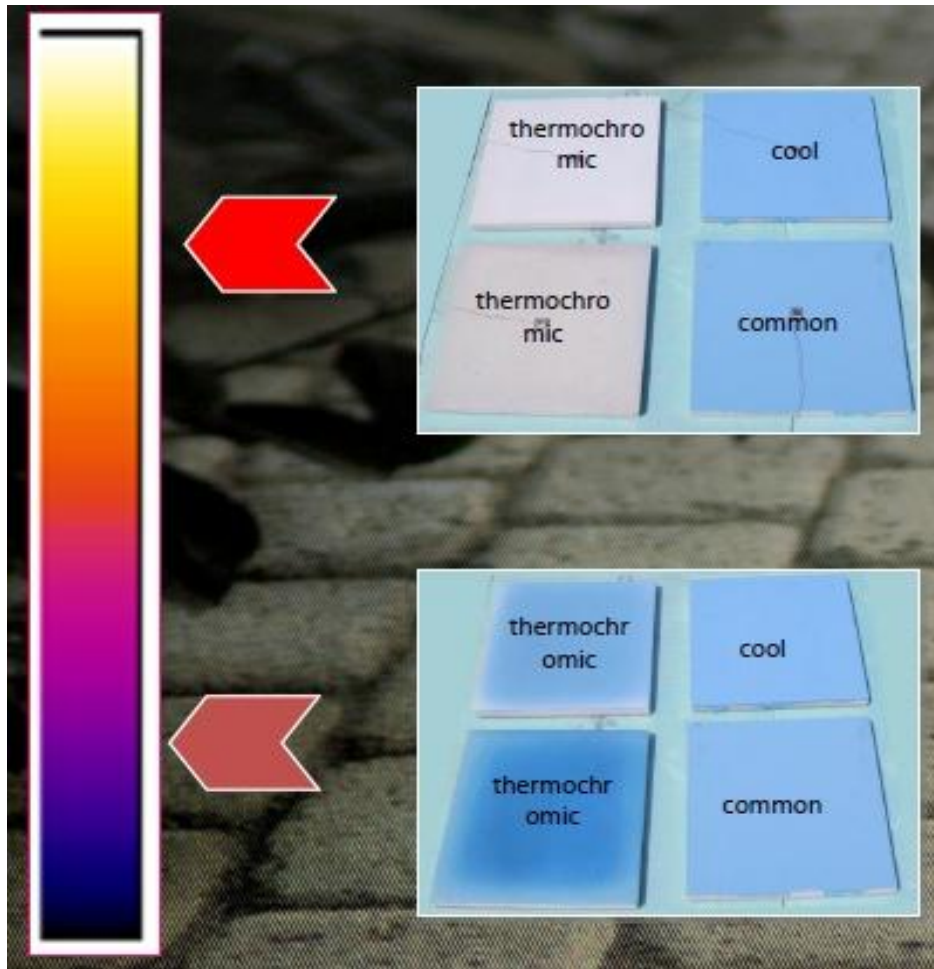


Cool black

Development of cool colored coatings

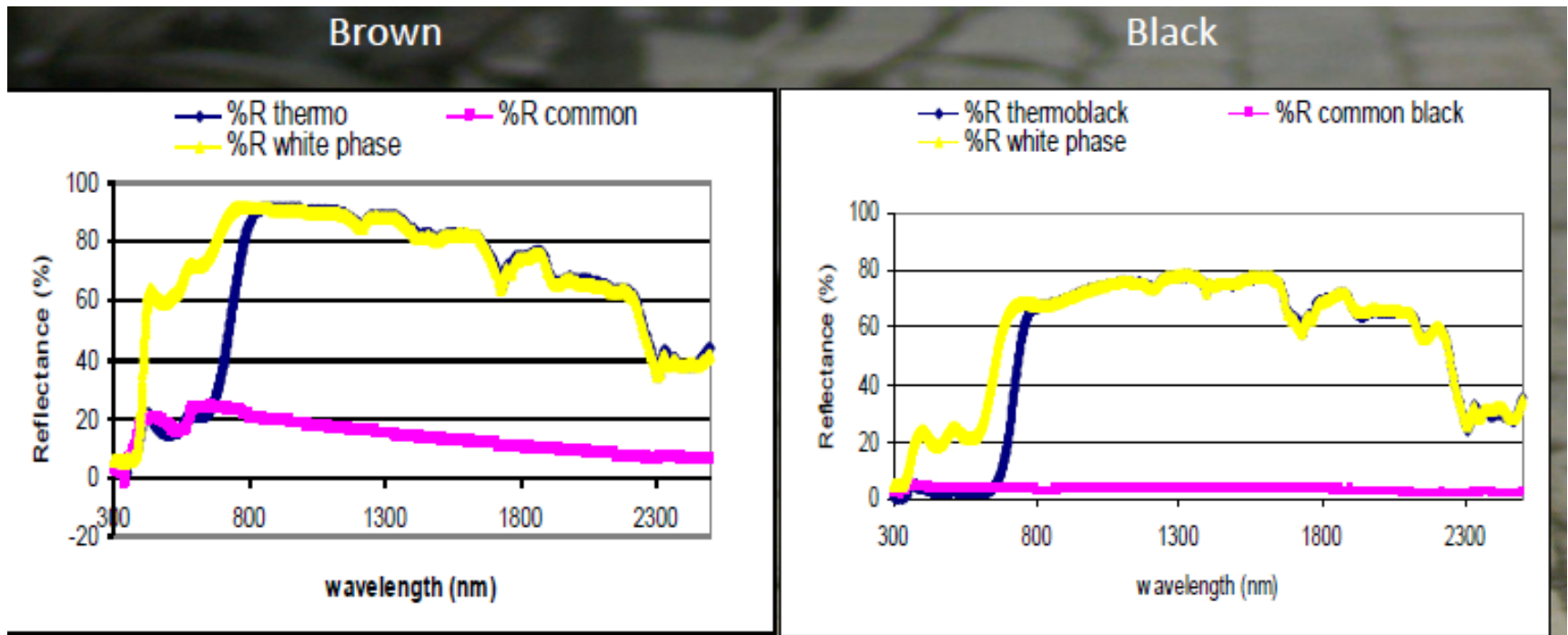


Development of thermochromic materials



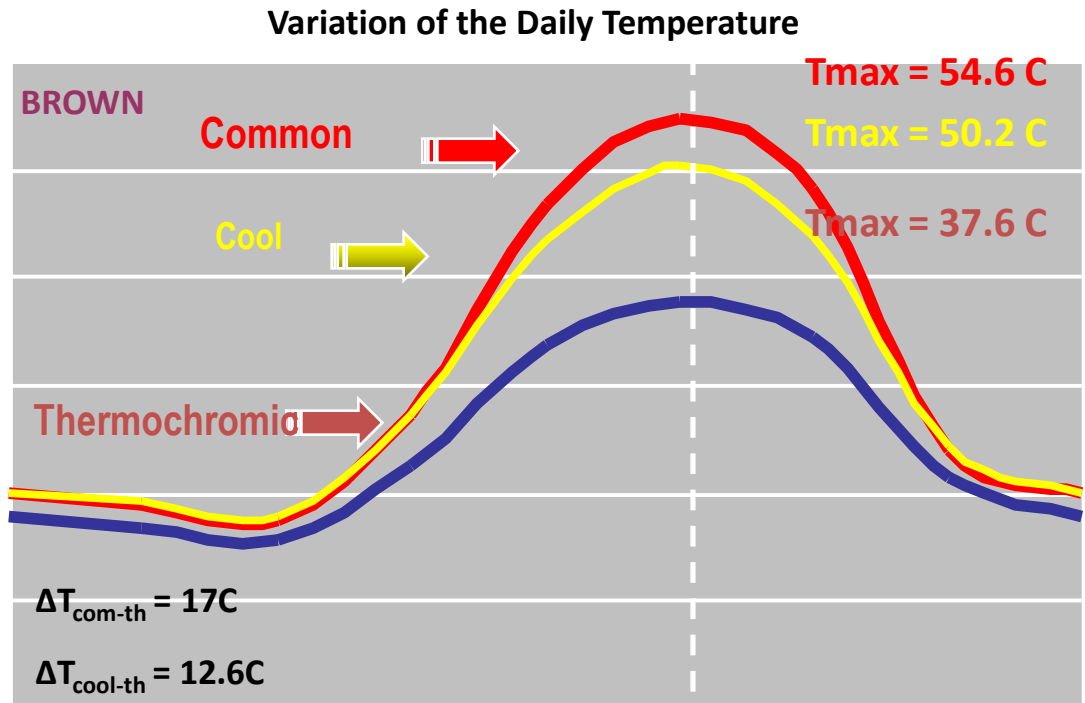
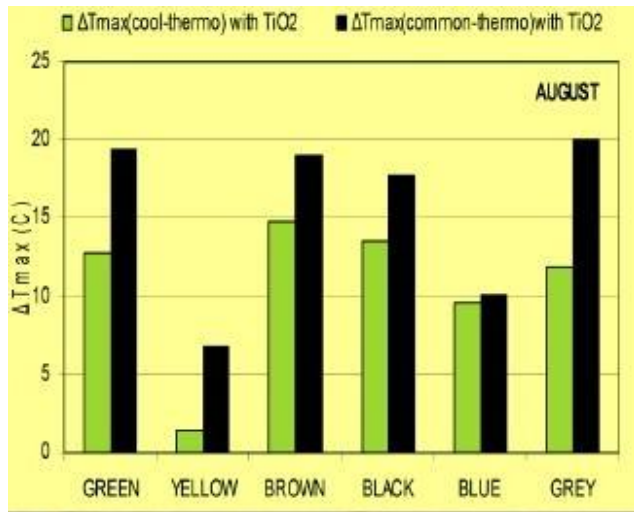
- **Thermochromic coatings change color as a function of the ambient temperature. For low outdoor temperatures, the coatings may be dark presenting a high absorptivity. For higher ambient temperatures the coating becomes white presenting a high reflectivity.**
- **When applied on roofs or walls they may present the best performance all year round.**

Development of thermochromic materials



- Thermochromic coatings present a high reflectivity both in the visible and infrared spectrum, while they present very strong absorption in the near-ultraviolet range of the spectrum.

Development of thermochromic materials



■ Thermochromic coatings exhibit higher solar reflectance values and lower temperatures compared to common and cool coatings of the same colour

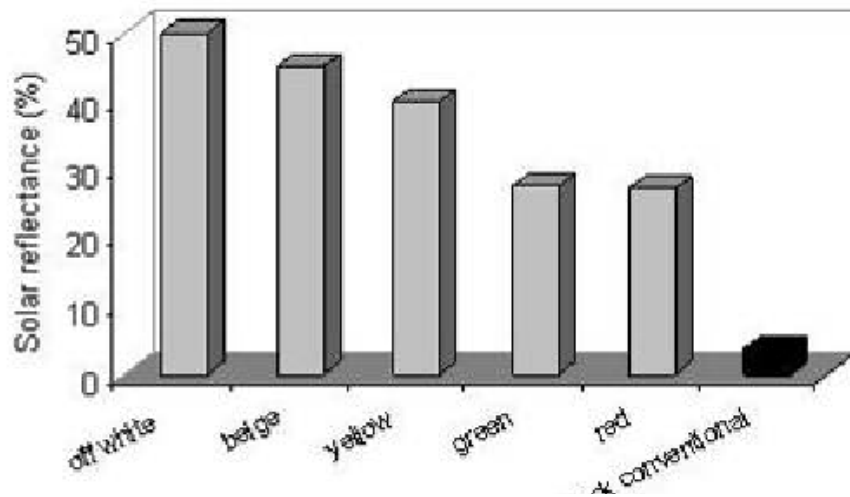
Development of cool asphalt materials



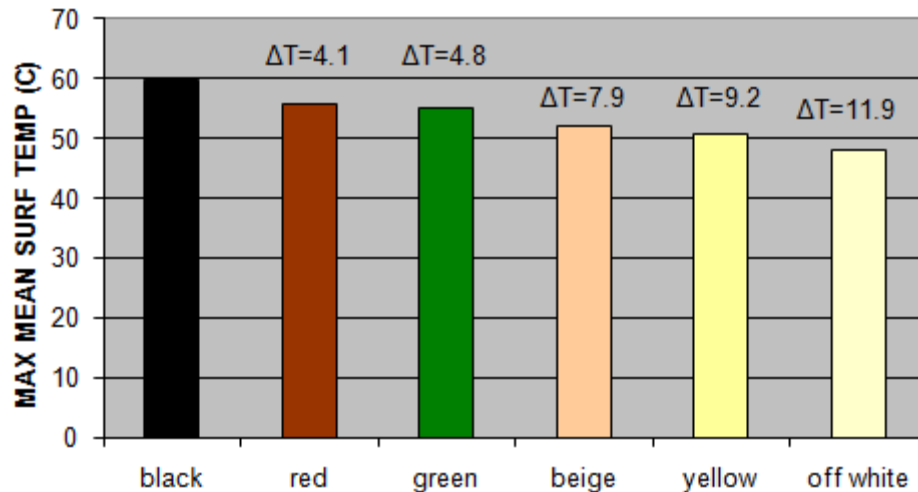
■ Cool Asphaltic materials have been developed and tested. The materials can replace conventional asphaltic materials and are available at different colors.

■ The color thin layer asphalt samples were developed by mixing an elastomeric asphalt binder (colorless) and adding special pigments and aggregates of special sizes and colors.

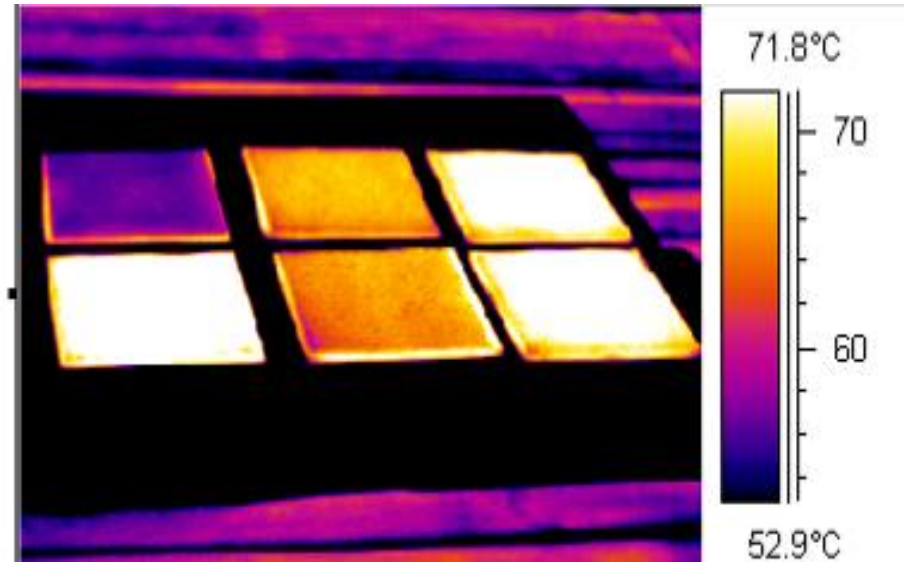
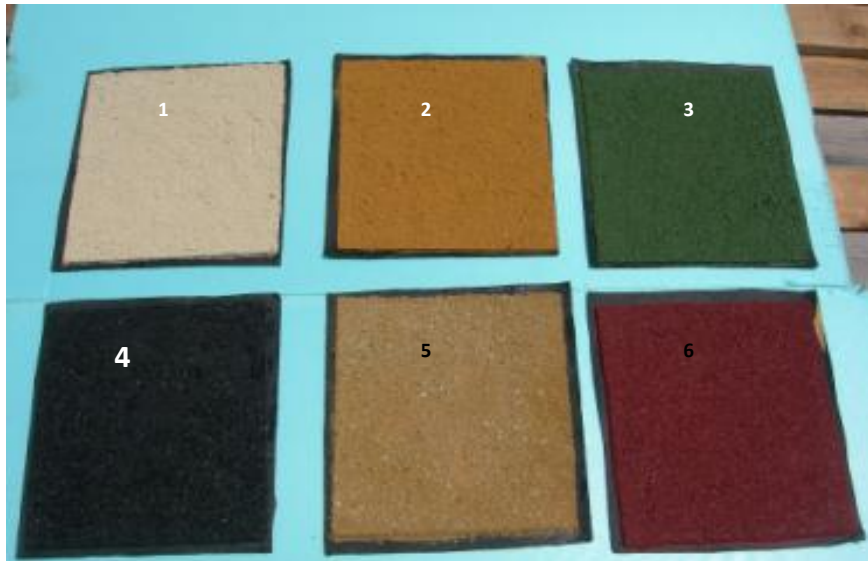
Development of cool asphalt materials



Cool Asphaltic materials present a much higher reflectivity and also a lower surface temperature compared to conventional asphalt materials.



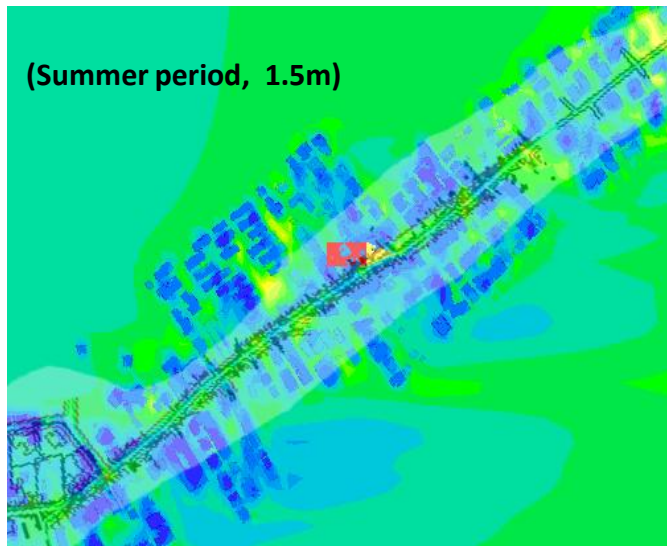
Development of cool asphalt materials



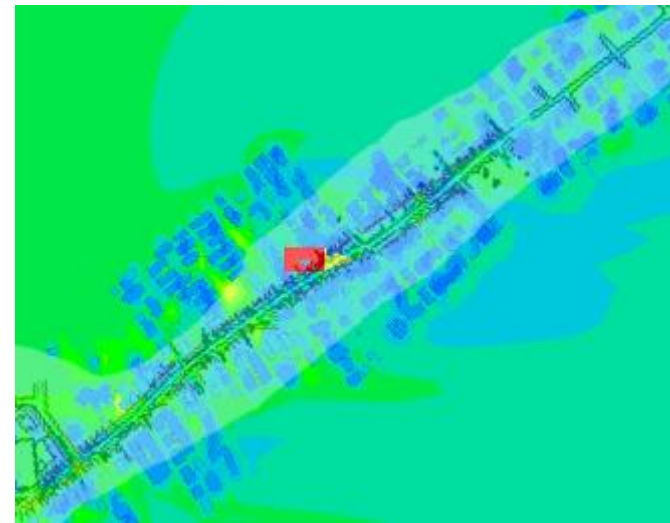
Development of cool asphalt materials



$\Delta T_{amb.} \cong 5C$



SR = 0.04



SR = 0.55



Thank you for your attention!

For any questions please email me: asynnefa@phys.uoa.gr

Cool Roofs project: <http://www.coolroofs-eu.eu/>

European Cool Roofs Council: <http://coolroofcouncil.eu>

ECRC Contact: ecrc@coolroofcouncil.eu