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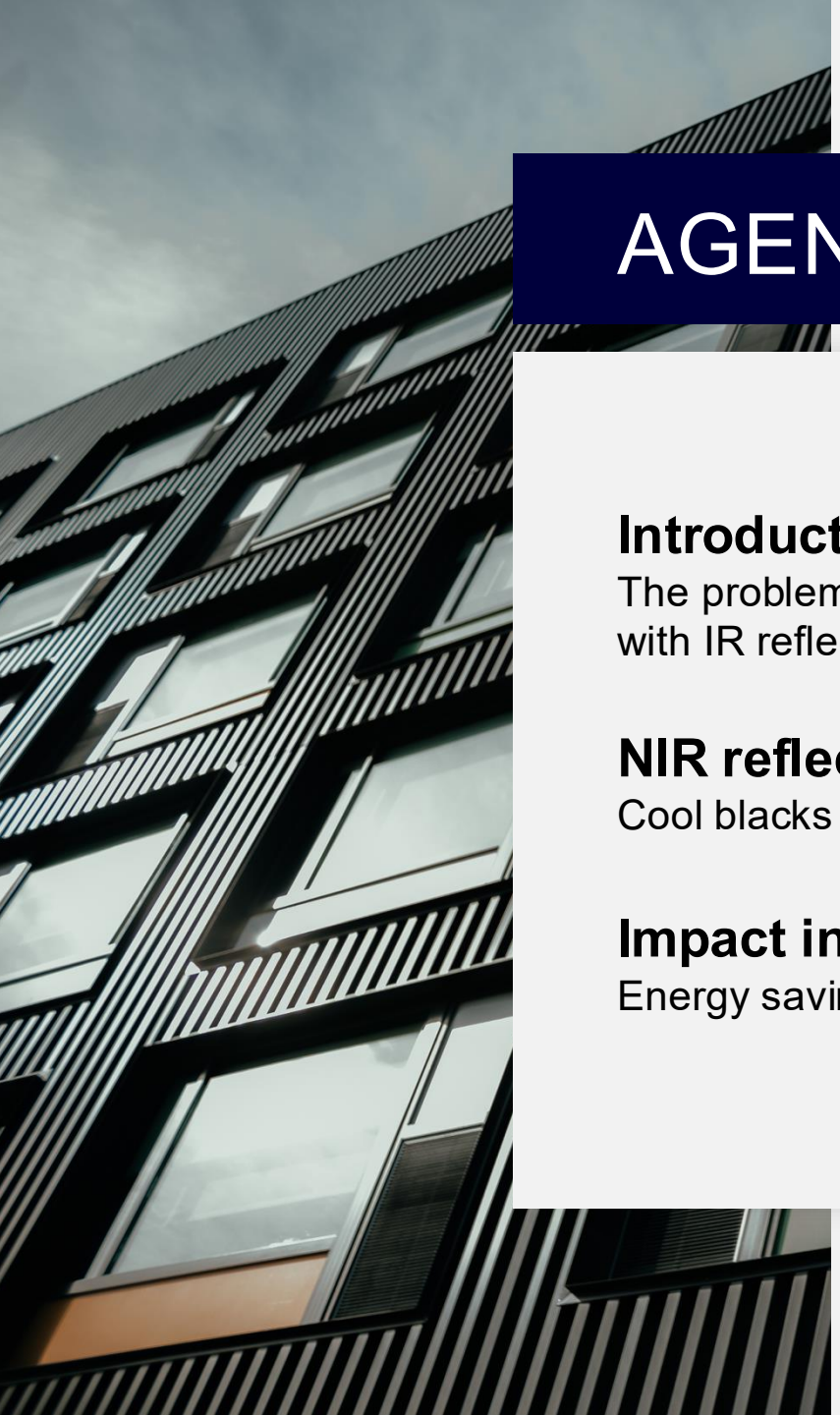
Cooling energy savings with IR Reflecting pigments

Patricia Perez – CICP Global product manager

Pants & Coatings (Milan), October 2025

We bring color, performance and vibrancy to life.



AGENDA

Introduction
The problem of UHI effect and a cost-effective solution with IR reflecting technology

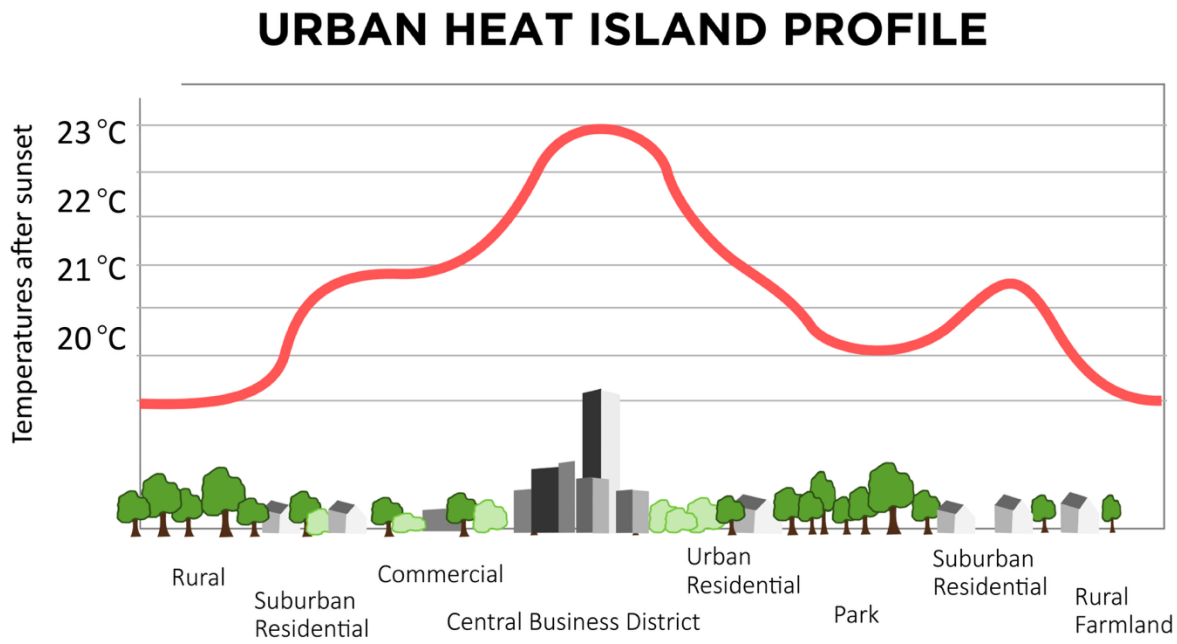
NIR reflecting color pigments
Cool blacks challenge & non-chrome-based alternative

Impact in real buildings
Energy savings case studies

The problem

Growing temperatures in cities due to the Urban Heat Island effect

- An **urban heat island** is a metropolitan area which is significantly warmer than its surrounding rural areas.
- There is little bare earth and vegetation in urban areas. This means that less of the Sun's energy is reflected and that **more heat is stored by buildings and the ground in urban than in rural areas**.
- Notably, of the roughly 10,000 cities in the world, nearly half faced an increasing trend in heat exposure between 1983 and 2016. For example, recent studies revealed that **potential exposure to extreme heat among urban dwellers exceeded 1.7 billion people**.



Sources:
- https://www.metlink.org/fieldwork-resource/urban-heat-island-introduction/
- https://publications.jrc.ec.europa.eu/repository/handle/JRC137891

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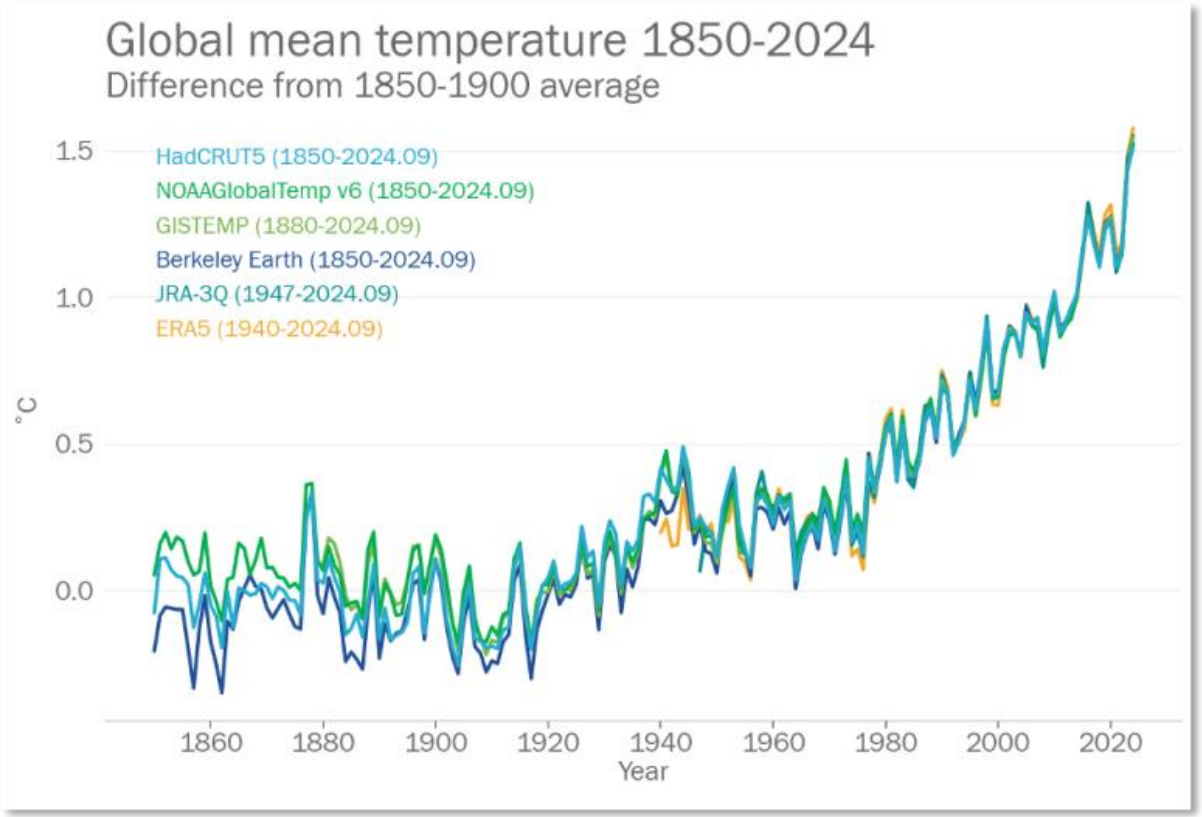
The problem

Climate change, and energy consumption to stay cool

- **Climate change increases heatwaves**, becoming more frequent and intense, and projected to continue. Extreme heat is particularly alarming in cities, where it leads to the Urban Heat Island effect.

- **AC contributes to substantial energy consumption and CO2 emissions, exacerbating the urban heat island effect**. Energy demand for space cooling will more than triple by 2050.

- In response to the Urban Heat Island effect, both **mitigation** (reducing emissions) and **adaptation** (increasing overall resilience) actions are needed.



Sources:
- https://wmo.int/news/media-centre/2024-track-be-hottest-year-record-warming-temporarily-hits-15degc
- https://www.iea.org/reports/the-future-of-cooling

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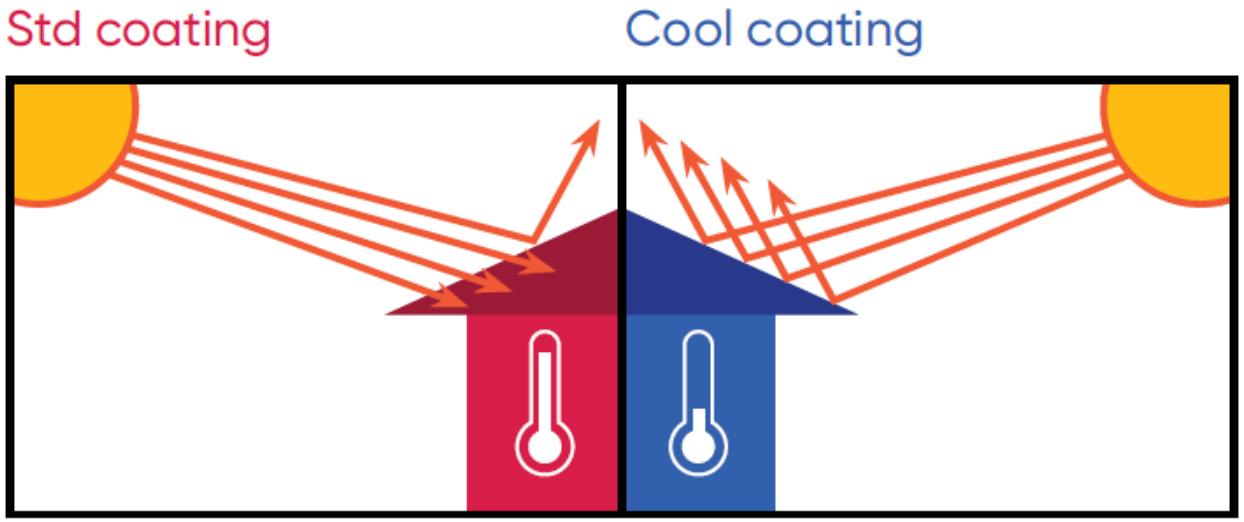
A cost-effective solution

Infrared reflecting technology “Cool” surfaces

The use of Infrared Reflecting materials reduce surface temperature by decreasing Sun’s energy absorption



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A cost-effective solution

For use in a variety of surfaces

Asphalt

Architectural - Roofs & Façades

Outdoor elements & furniture

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A cost-effective solution

With sustainability contribution

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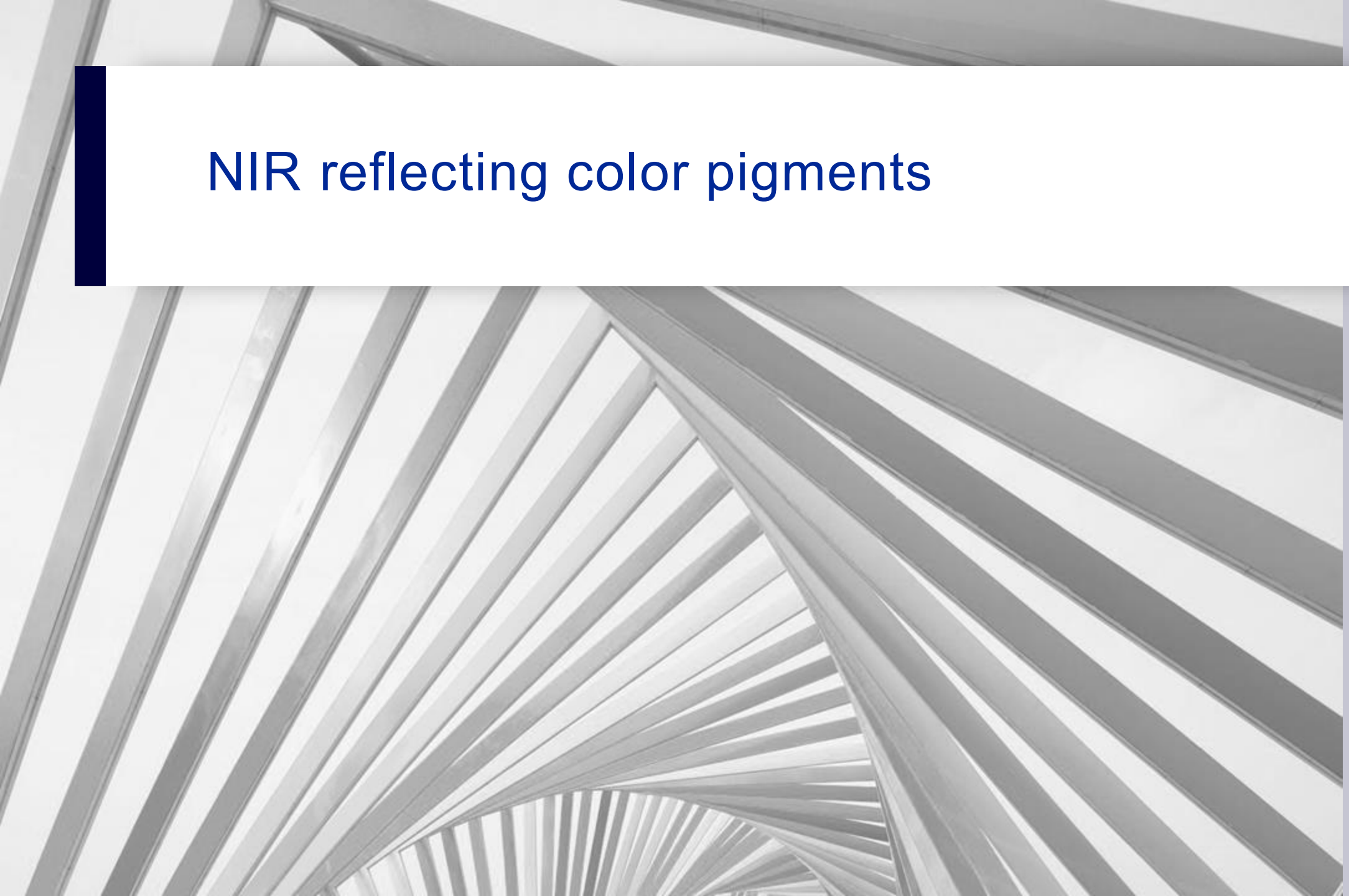
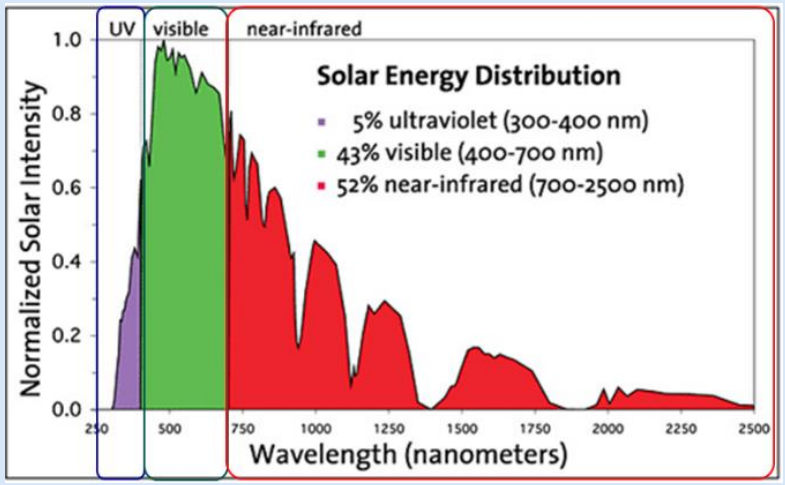
NIR reflecting color pigments

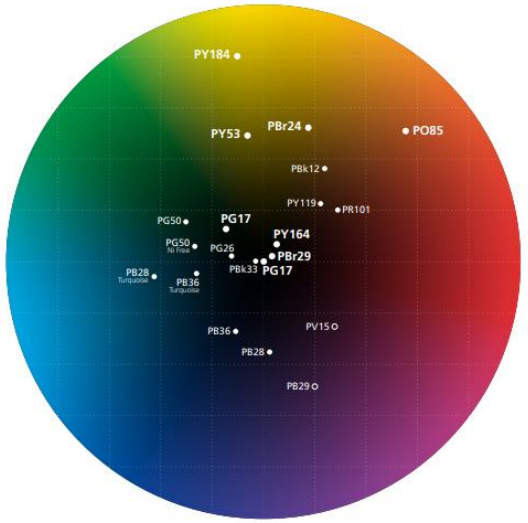


NIR reflecting color pigments

Color pigments absorbs visible, but also NIR



Use of NIR Reflecting pigments



Color space	Color Index	NIR Reflectance
Black	PBr29	High
	PG17	High
	PBk33	Moderate
Brown	PY164	High
	PBr24	High
	PY119	Moderate
Yellow	PY53	High
	PY184	High
Orange	PO85	High
Red	PR101	Moderate
Green	PG17	High
	PG26	Moderate
	PG50	Moderate
Blue	PB28	Moderate
	PB36	Moderate
	PB29	Transparent
Violet	PV15	Transparent

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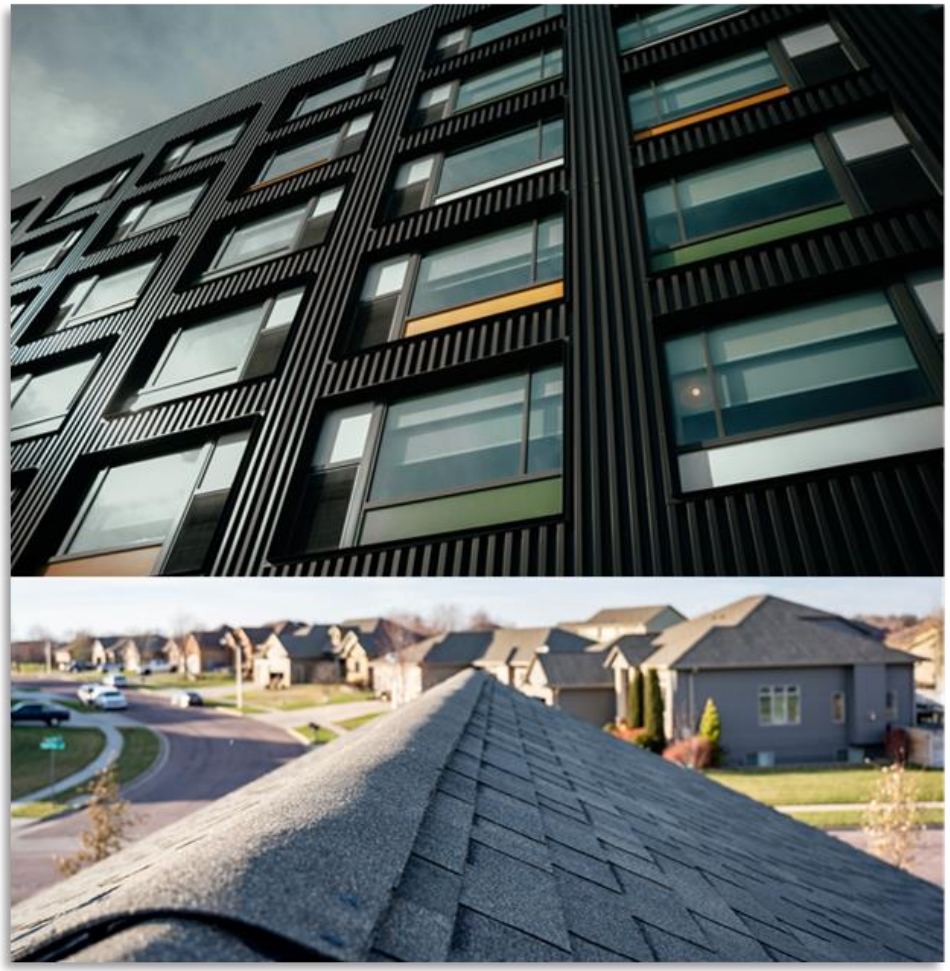
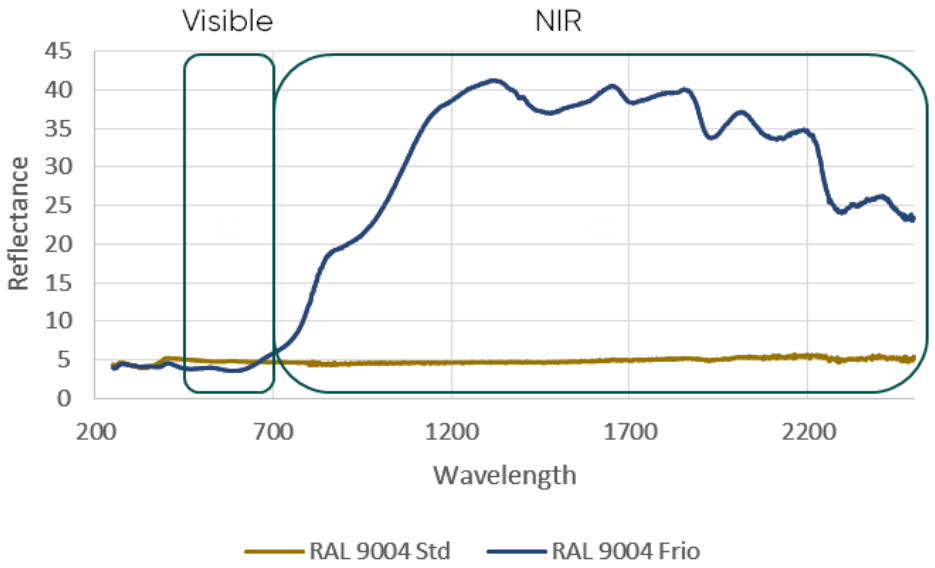
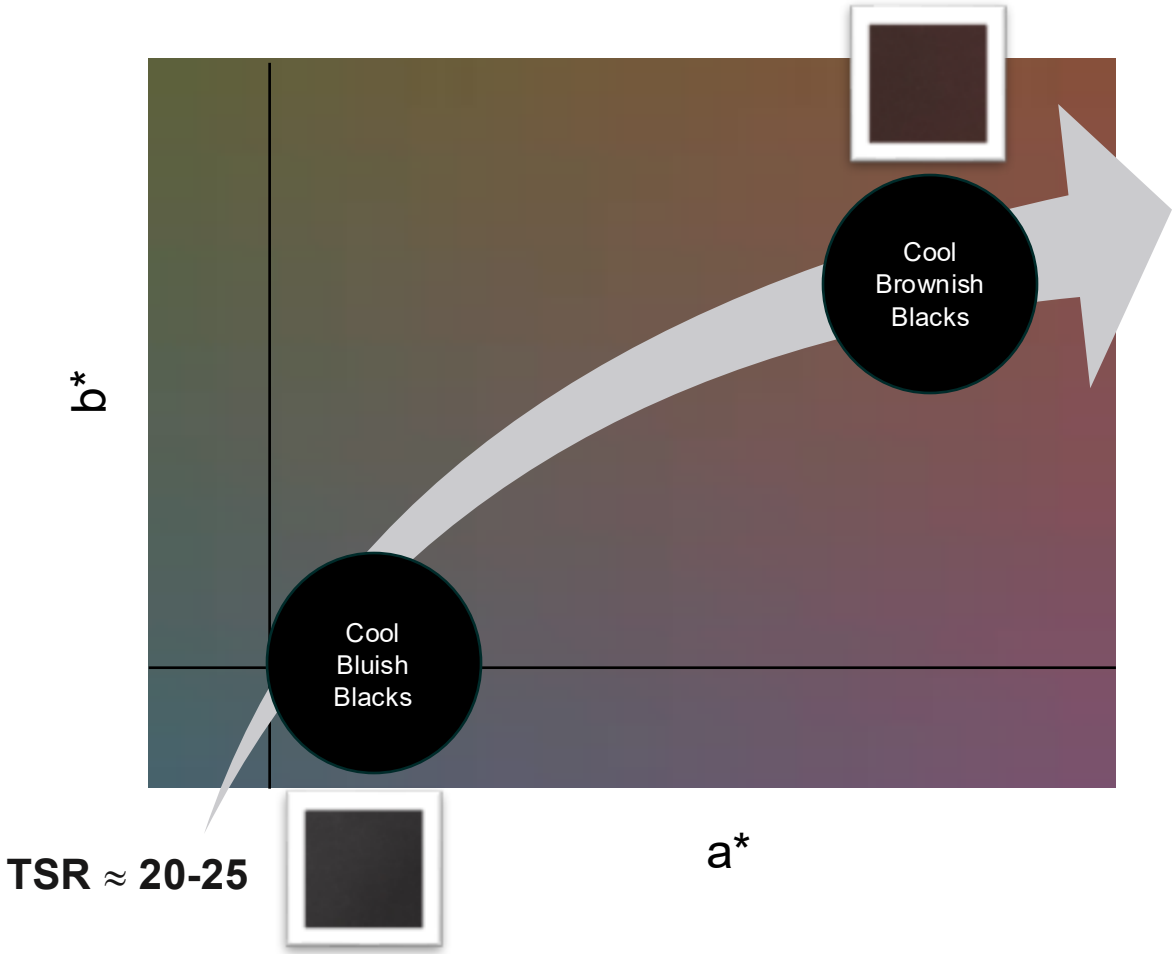
Dark surfaces can achieve highest surface temperature





- Carbon Black (PBk 7) and Black Iron Oxide (PBk 11) absorb in all spectrum
- **NIR Reflecting Black pigments:**
  - PBr 29: Chrome Iron Brown Hematite
  - PG 17: Chromium Green-Black Hematite

Challenge for common cool blacks



Black NIR Reflecting pigments based on Chrome Iron (PG17/PBr29):

- Highest TSR with brownish shades
- Bluish shades has lower TSR

Challenge: **Bluish shades with high TSR**

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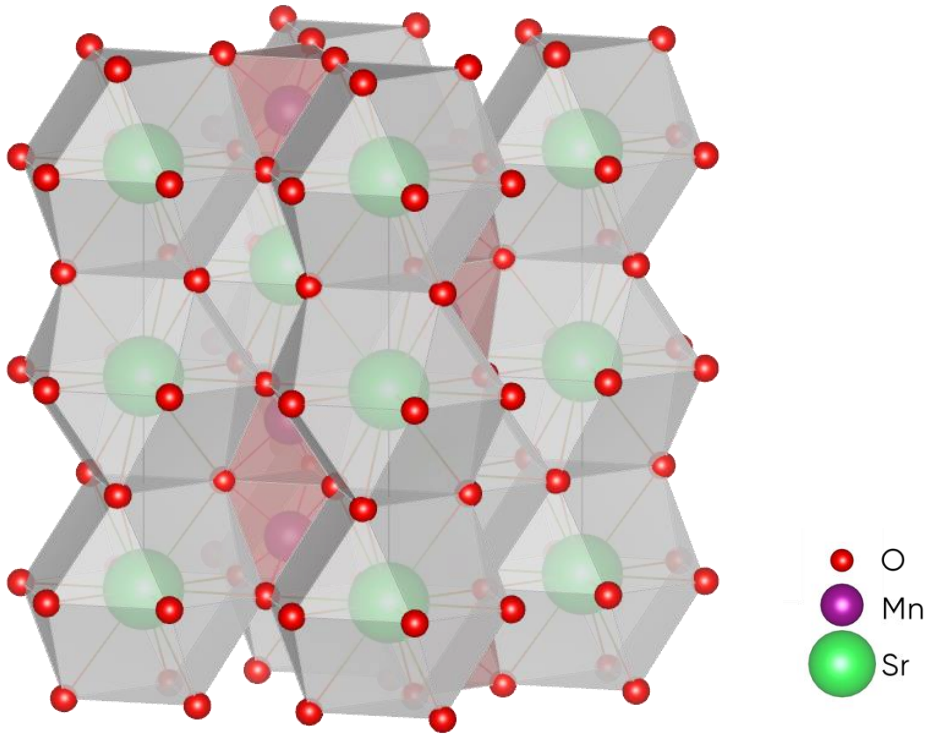
Alternative non-chrome-based pigments

Strontium Manganese oxide ($SrMnO_3$)

"Eclipse Black 372"

- Cr-free inorganic pigment
- CAS nº: 12163-45-0
- Specific gravity: 5,3 g/cm^3
- Mean Particle Size: 2 µm
- Oil Absorption: 12 g/100 g



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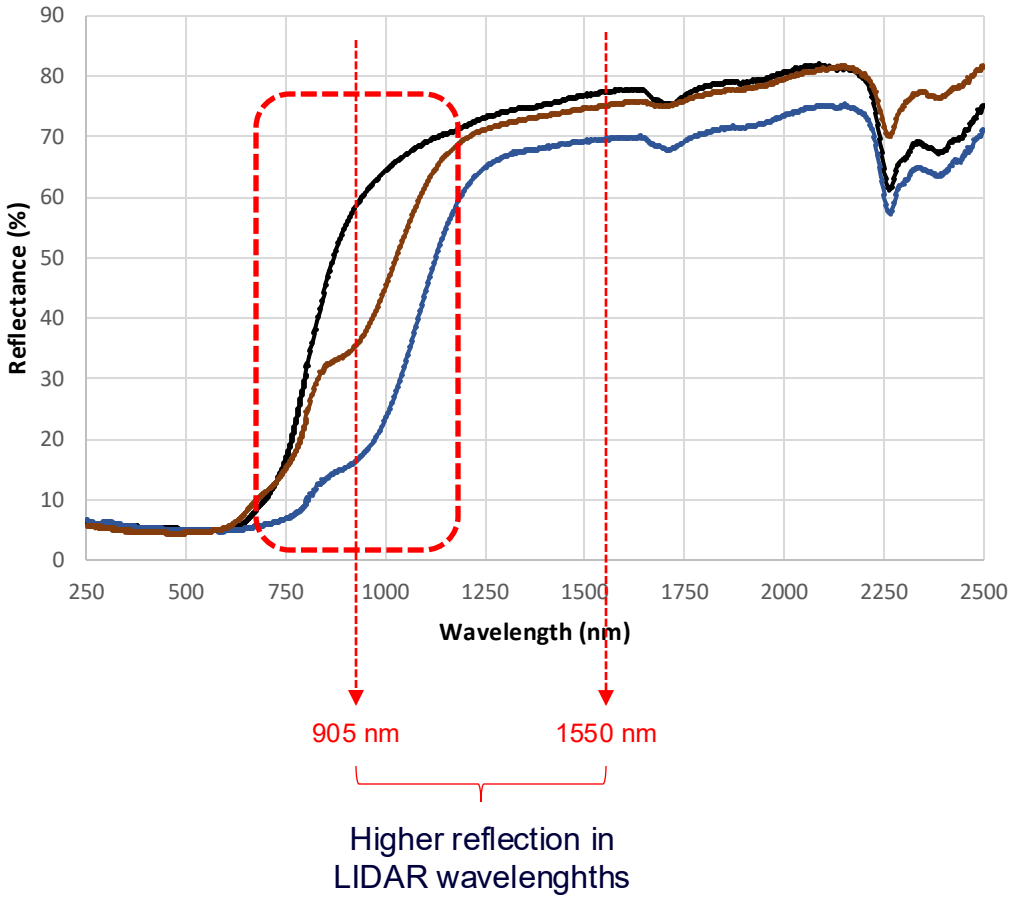
Total Solar Reflectance (TSR)

PVDF Coil coating (Masstone, DFT = 18µ)



Strontium Manganese oxide shows much higher TSR than references Cool Bluish Black and Cool Brownish Black.

	L	TSR	TSR UV	TSR VIS	TSR NIR1	TSR NIR2	TSR NIR3
Cool SrMn Oxide Black	26.8	31.2	0.3	2.8	9.6	10.6	7.9
Cool Bluish Black	26.6	20.2	0.3	2.9	3.1	7.3	6.6
Cool Brownish Black	26.6	27.2	0.2	2.9	6.7	9.5	7.8

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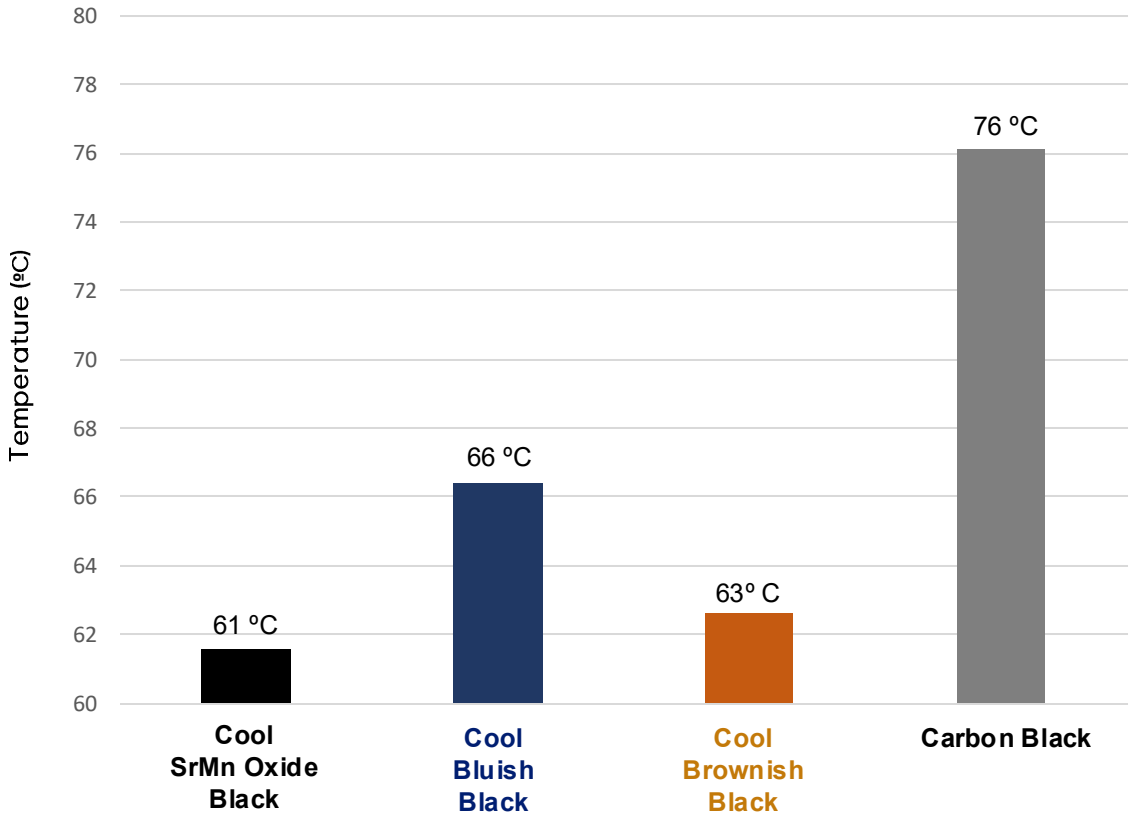
Heat Build Up (HBU)

PES coil coating (Masstone, DFT = 25µ)



Strontium Manganese oxide shows the lowest surface temperature vs other Cool Blacks.

It reduces Heat Build Up by:

- Approx -5ºC vs a benchmark Cool Bluish Black
- Approx -15ºC vs Carbon Black.

ASTM D-4803

Heat build-up (HBU) tests are used to measure how much heat a surface absorbs when exposed to an IR lamp, simulating effects caused by sunlight IR absorption.

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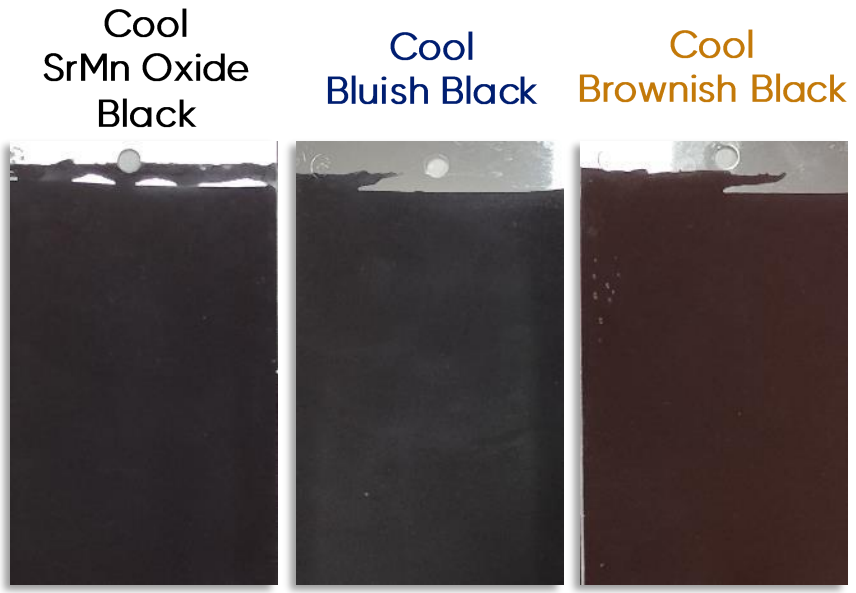
Color Space

PVDF Coil Coating (DFT = 18µ)



Mass Tone	L*(D65)	a*(D65)	b*(D65)	dL*(D65)	da*(D65)	db*(D65)	dE*(D65)
Cool SrMn Oxide Black	26.8	2.0	-0.7	------	------	------	------
Cool Bluish Black	26.6	0.8	-0.6	-0.2	-1.2	0.1	1.3
Cool Brownish Black	26.6	4.7	2.5	-0.3	2.7	3.2	4.2

Tint Tone	L*(D65)	a*(D65)	b*(D65)	dL*(D65)	da*(D65)	db*(D65)	dE*(D65)	K/S (%)	Color
Cool SrMn Oxide Black	72.7	-0.7	-2.8	------	------	------	------	100.0	
Cool Bluish Black	72.7	-1.2	-4.6	0	-0.5	-1.7	1.8	104.1	
Cool Brownish Black	62.5	1.3	-4.0	-10.2	2.0	-1.2	10.5	209.4	

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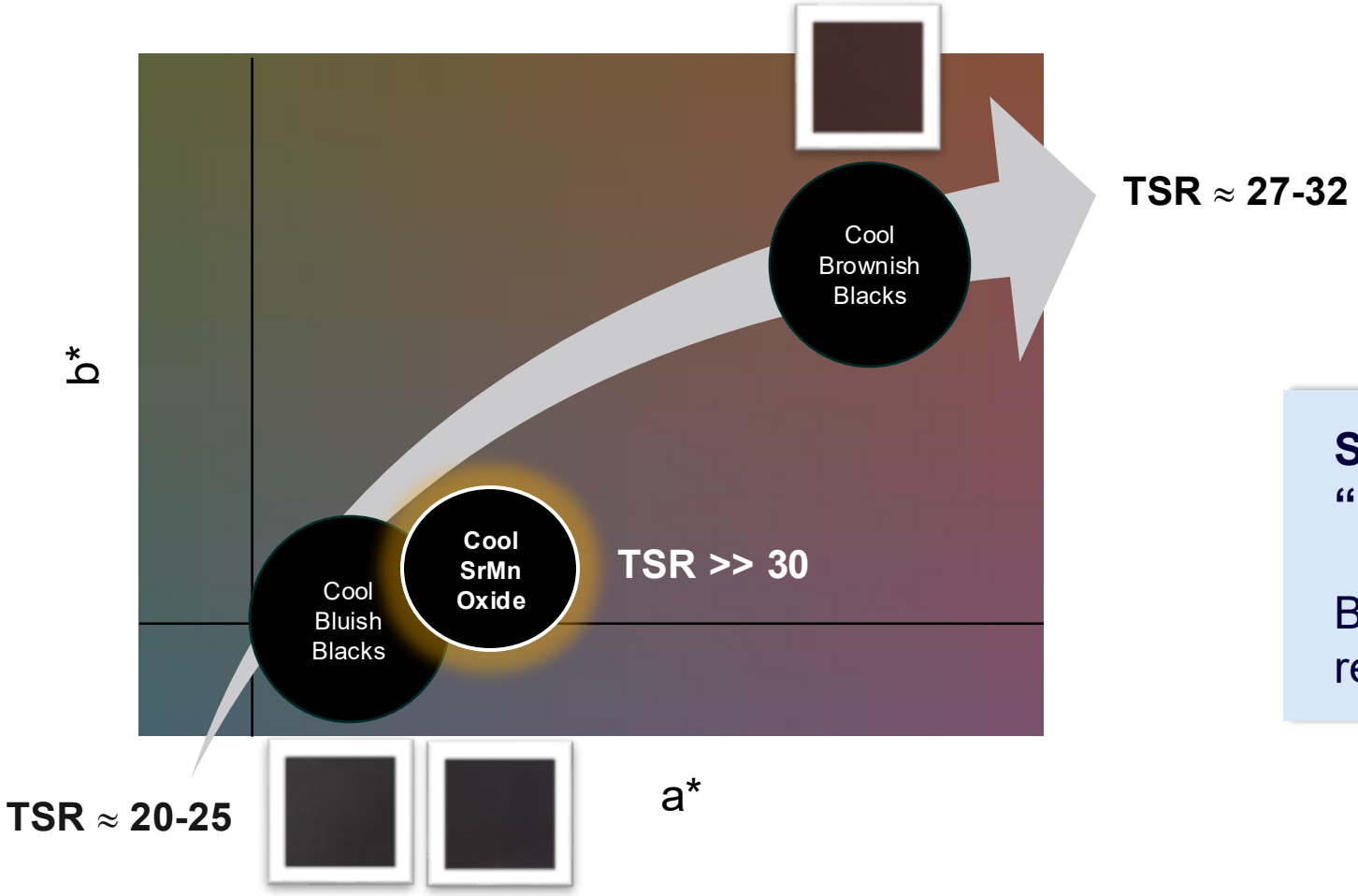
Strontium Manganese oxide solution



Strontium Manganese oxide "Eclipse Black 372"

Bluish black pigment with the highest IR reflecting performance in the market

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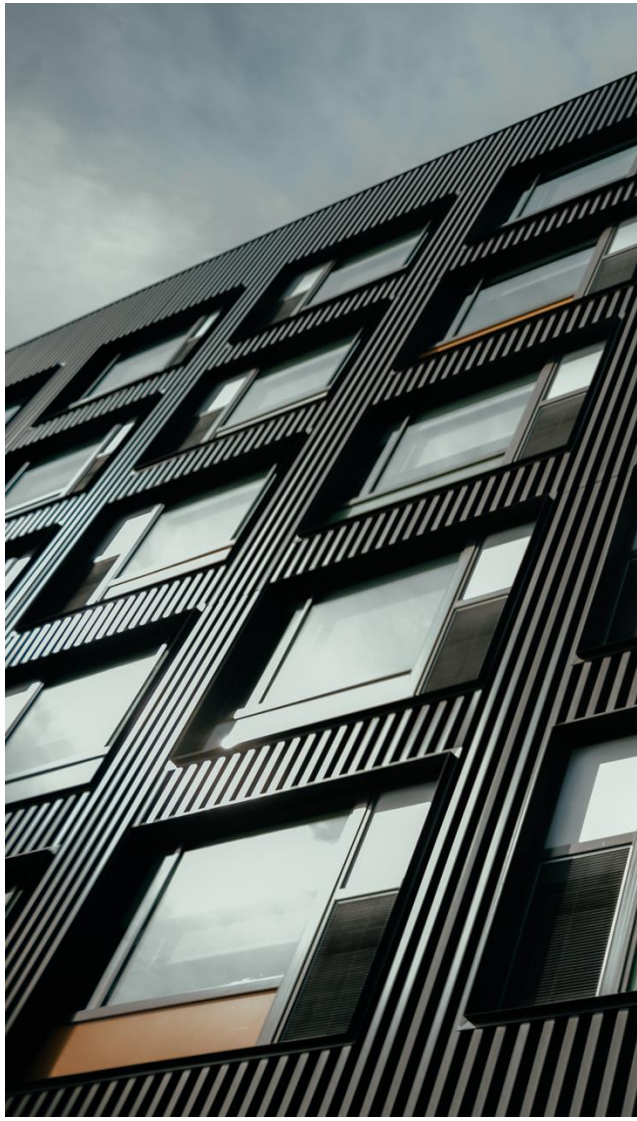
“What is the impact in these buildings?”



Energy savings case studies – Garden Houses

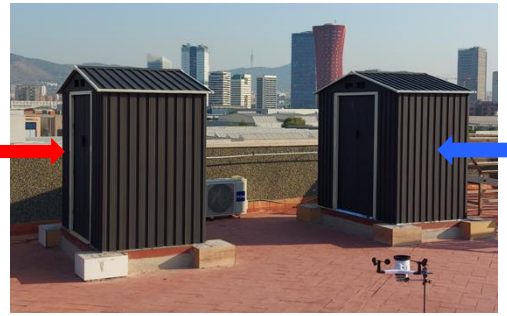
Garden Houses

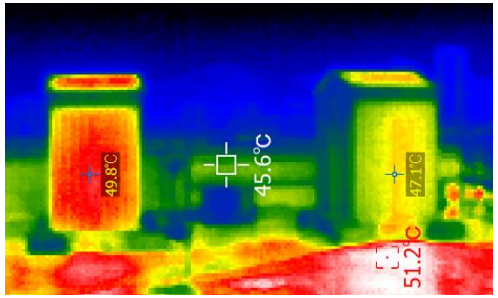
- “Cool” garden houses experiment in Vibrantz site (Barcelona, Spain)
- AC Energy savings approx 20%

2023 - Black coating

House A
Non Cool
(PBk 7)

House B
Cool
(PBr 29)





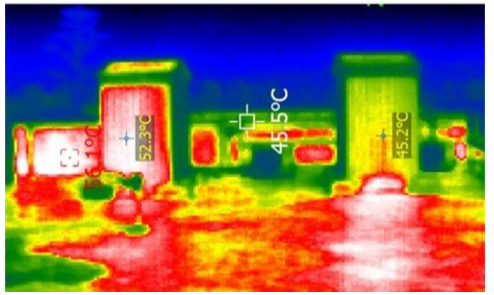
20% average AC saving
July-October 2023

	Set Point	Days	% Savings (kWh)
25/07/2023	27ºC	7	**10,92**
01/08/2023	27ºC	10	**13,83**
11/08/2023	27ºC	10	**14,49**
28/08/2023	27ºC	7	**20,41**
06/09/2023	27ºC	7	**20,73**
14/09/2023	27ºC	7	**20,30**
21/09/2023	27ºC	7	**24,20**
28/09/2023	27ºC	7	**22,38**
06/10/2023	27ºC	7	**23,59**
13/10/2023	27ºC	7	**26,04**

2024 - Grey coating

House A
Non Cool
(PBk 7)

House B
Cool
(PBr 29)



22% average AC saving
July-October 2024

	Set Point	Days	% Savings (kWh)
27/07/2024	27ºC	7	**12,16**
03/08/2024	27ºC	7	**11,37**
10/08/2024	27ºC	7	**15,64**
17/08/2024	27ºC	7	**19,46**
24/08/2024	27ºC	7	**19,08**
31/08/2024	27ºC	7	**21,74**
07/09/2024	27ºC	7	**24,89**
14/09/2024	27ºC	7	**24,73**
21/09/2024	27ºC	7	**24,45**
29/09/2024	27ºC	7	**28,31**
06/10/2024	27ºC	7	**27,41**
13/10/2024	27ºC	7	**29,50**

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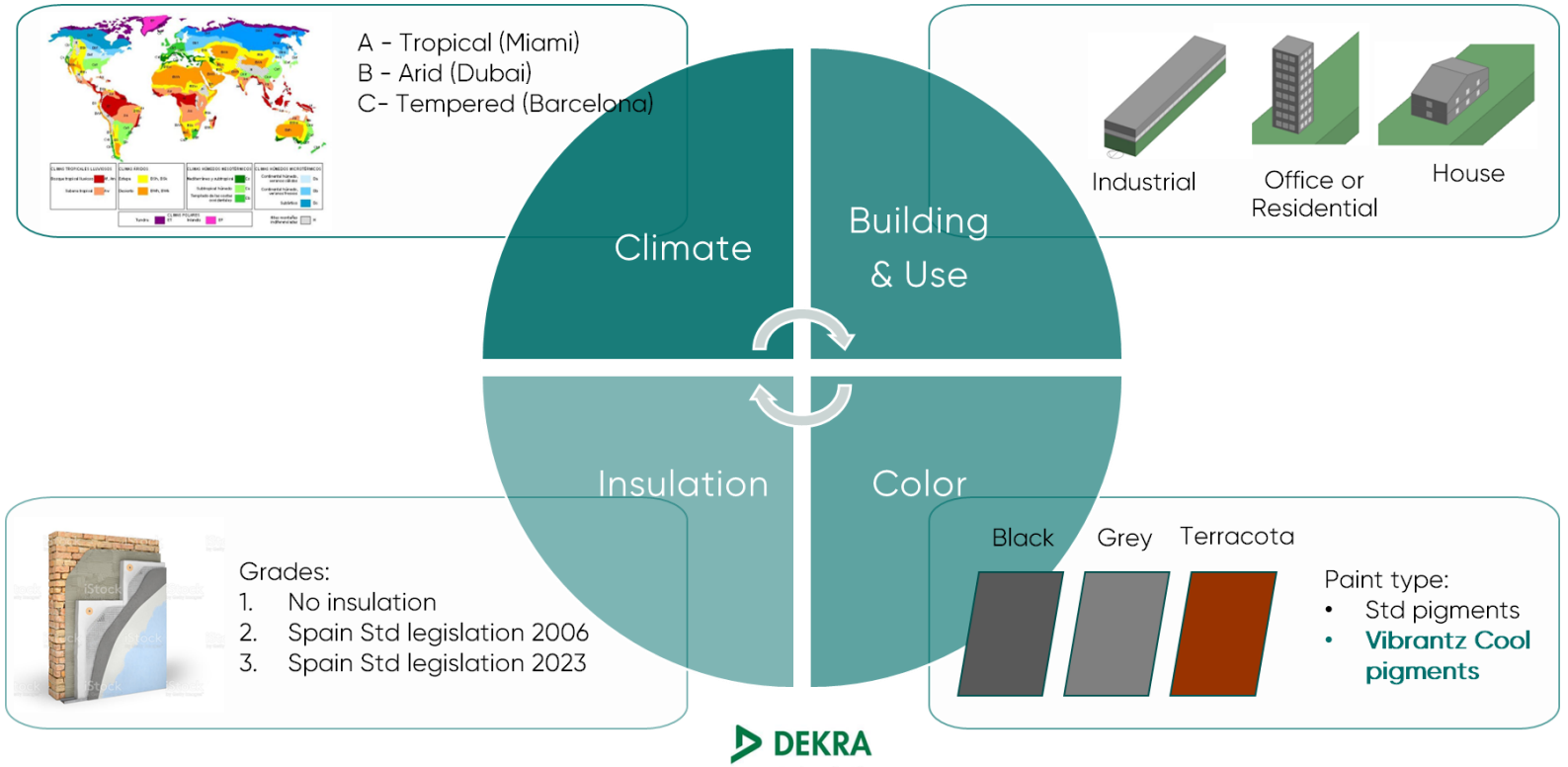
Energy savings case studies – Computer modeling simulation

Computer modeling simulation

- Computer modeling simulating AC energy savings of real buildings painted with “cool” colors in different conditions: climates, type of building, grades of insulations and colors.



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Energy savings case studies – Computer modeling simulation

Computer modeling simulation

- Link: Cool Colors - Vibrantz Technologies

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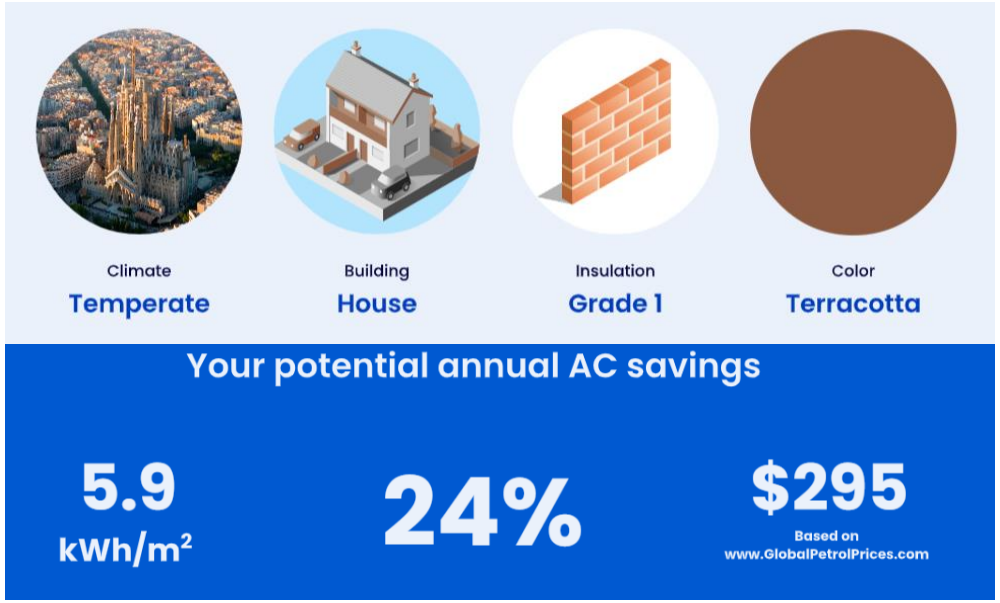
Energy savings case studies – Computer modeling simulation

Computer modeling simulation

Example simulation 1



Example simulation 2

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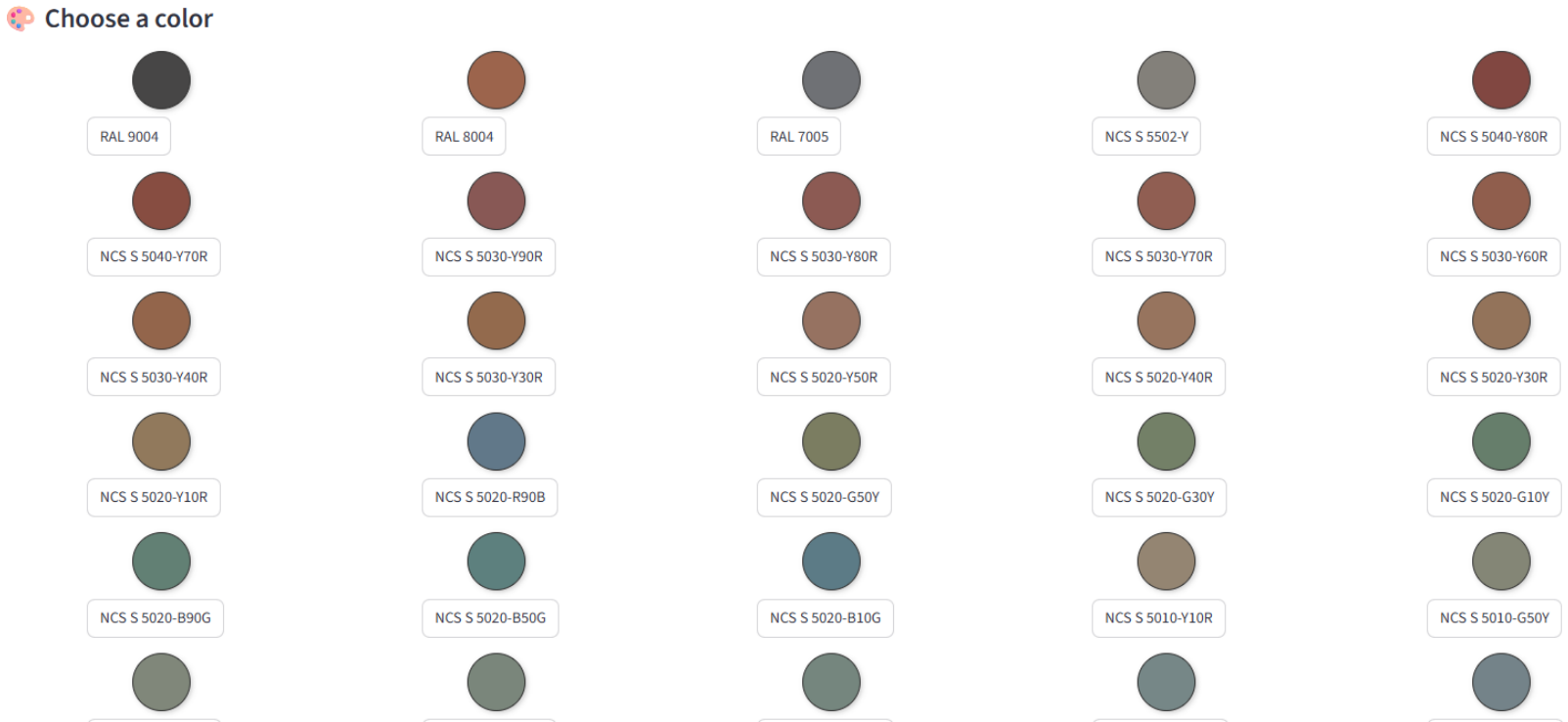
Energy savings case studies – Computer modeling simulation

Computer modeling simulation

Next steps

- Extended range of colors – linked to Tinting System Software
- Energy savings calculations for Roofs and/or Façades
- Other climate zones



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SUMMARY

- In response to the **Urban Heat Island effect**, both mitigation (reducing emissions) and adaptation (increasing overall resilience) actions are needed
- The use of **IR Reflecting materials reduce surface temperature**, and this technology can be used in asphalt, architectural roofs & façades and outdoor elements
- The **challenge in the Cool Black space** is to reach the highest IR reflectance with the highest bluish shade, and the alternative **Cr-free pigment "Eclipse Black 372"** can be the solution
- New **energy savings** studies carried out in a "garden houses" experiment and in a computer modelling simulations by using IRR "cool" paints, showed significant reduction of the AC energy demand up to **>20%**

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