ARKEMA

CONFERENCE PRESENTATION

ACT ON CLIMATE CHANGE AND REDUCE ENERGY CONSUMPTION OF BUILDINGS

ARKEMA'S SOLUTIONS FOR LONG-LASTING REFLECTIVE PAINT SYSTEMS

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COOL ROOF

OCT

8TH

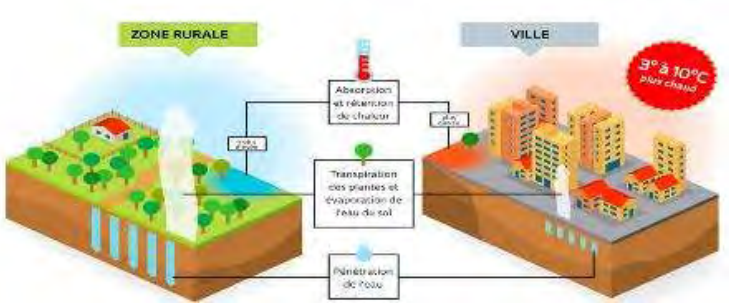
10:40

Building efficiency through reflective coatings

INTRODUCTION

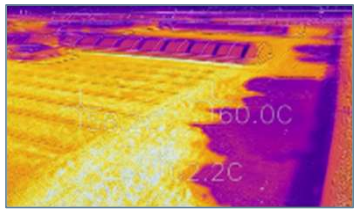
Structures such as buildings, roads, and other infrastructure absorb and **re-emit** the sun's heat more than natural landscapes such as forests and water bodies.

Urban areas usually experience the **urban heat island** (UHI) effect, that is, they are significantly warmer than surrounding rural areas.



ON BUILDINGS

- Insulation/sealing degradation
- Machine damage and breakage
- Loss of efficiency of PV systems



AROUND BUILDINGS

- Degradations of ecosystems
- Degradation of local economies
- Degradation of inhabitants' health

IN BUILDINGS

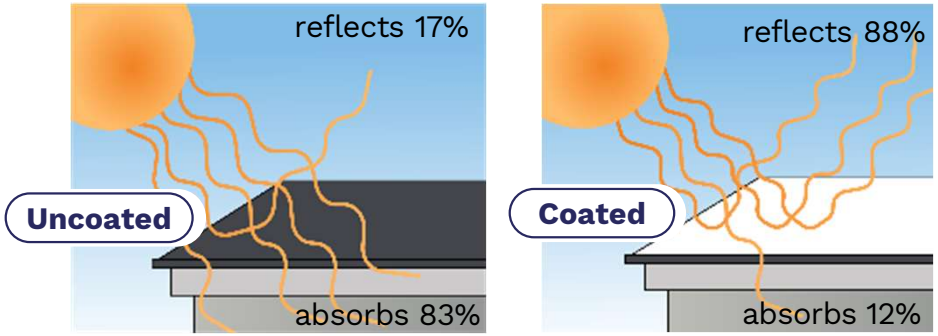
- Loss of goods
- Discomfort & Quality of Life
- Decrease in work productivity

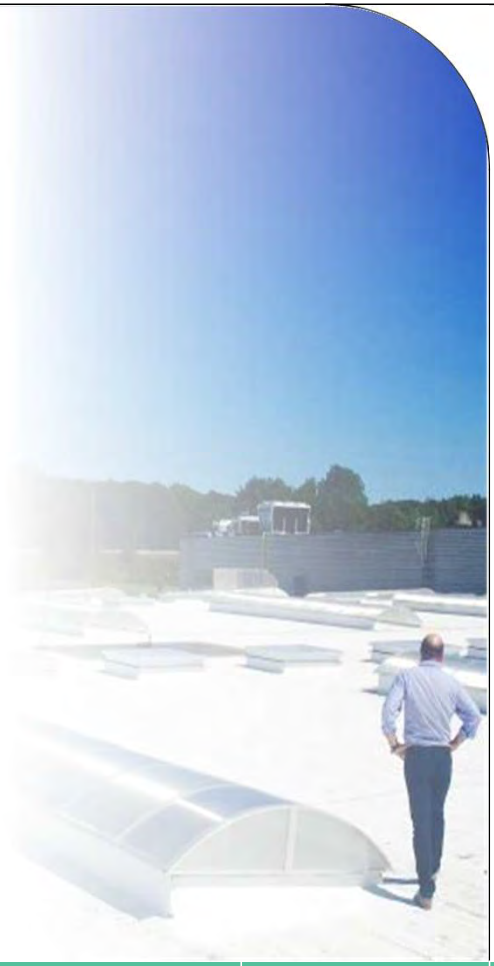
Building efficiency through reflective coatings

INTRODUCTION

Reflective coatings consist in applying a ***highly reflective white*** paint (containing resins, pigments and additives) in order to :

- Reflect the sun's energy
- Protect roof surfaces
- Enhance the durability of the roof





Solutions for cool coating applications are able to reflect light and **reduce surface temperature up to 35°C.**

→ The interior temperature is decrease by **6°C to 10°C.**

→ **Save 15-30% energy** in air conditioning.

Building efficiency through reflective coatings

INTRODUCTION

How cool surfaces improve Sustainability In Construction?

Reducing energy consumption by decreasing air conditioning needs

Decreasing roof temperature, which may **extend roof service life**

Reduce the **urban heat island effect**

Lower peak electricity demand

Reduce power plant emissions, including CO_2, SO_2, NOx, Hg

What are reflective coatings?

Contain white or special **reflective pigments**

Adhere to a **variety of substrates**

Flexible even at low temperatures

Protect from ultra-violet light and chemicals

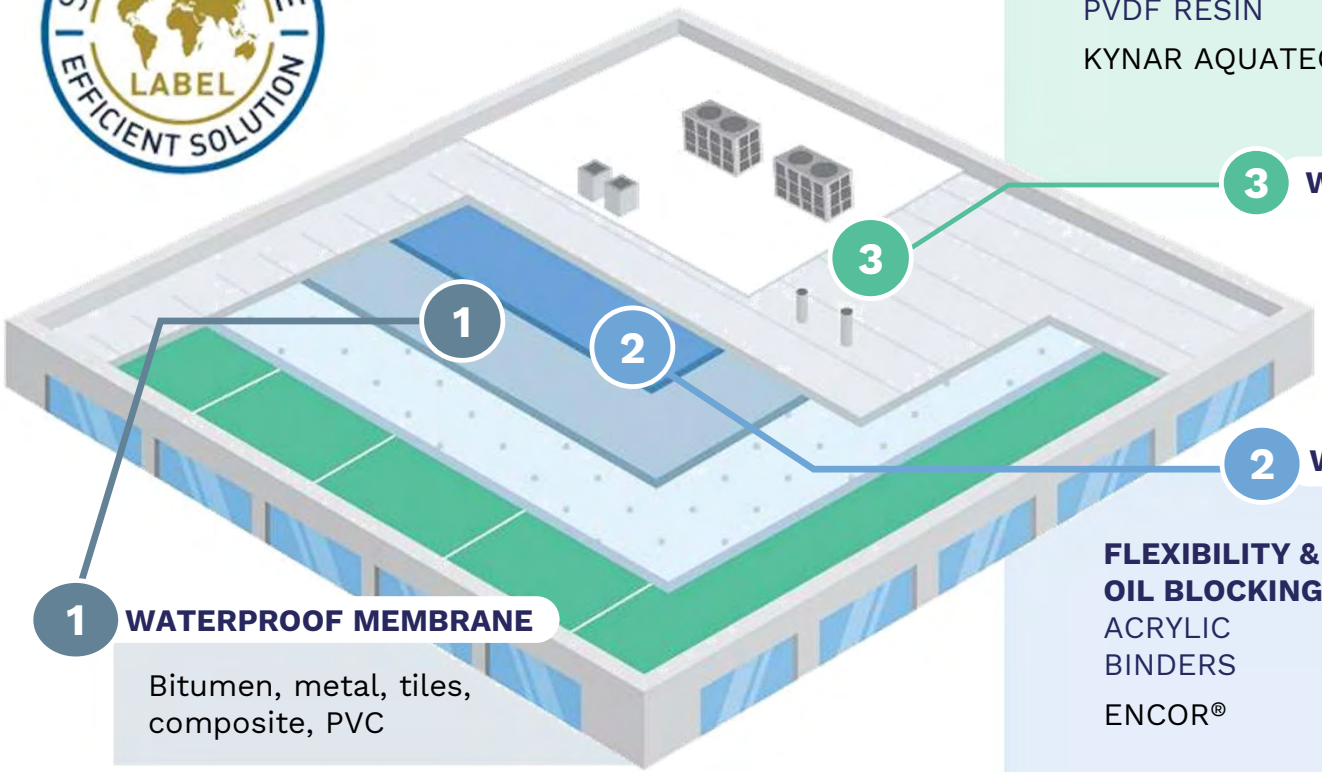
Field applied and ambient drying

Application by **spray or roll**

Arkema's solutions for high-performance, long-lasting reflective paints

Arkema's solutions for **high-performance, long-lasting** reflective paints

REDUCE ENERGY CONSUMPTION IN BUILDINGS



1 WATERPROOF MEMBRANE

Bitumen, metal, tiles, composite, PVC

3 WATERBORNE TOP COAT

HIGH DURABLE & CLEANABLE
PVDF RESIN
KYNAR AQUATEC®

+

LEVELLING & SPRABILITY
PU THICKENERS
COAPUR™

+

WATER RESISTANCE
ACRYLIC DISPERSANT
COADIS™

2 WATERBORNE BASE COAT

FLEXIBILITY & OIL BLOCKING
ACRYLIC BINDERS
ENCOR®

+

LEVELING, OPACITY & ANTISETTLING
PU & HASE THICKENERS
COAPUR™
RHEOTECH™

+

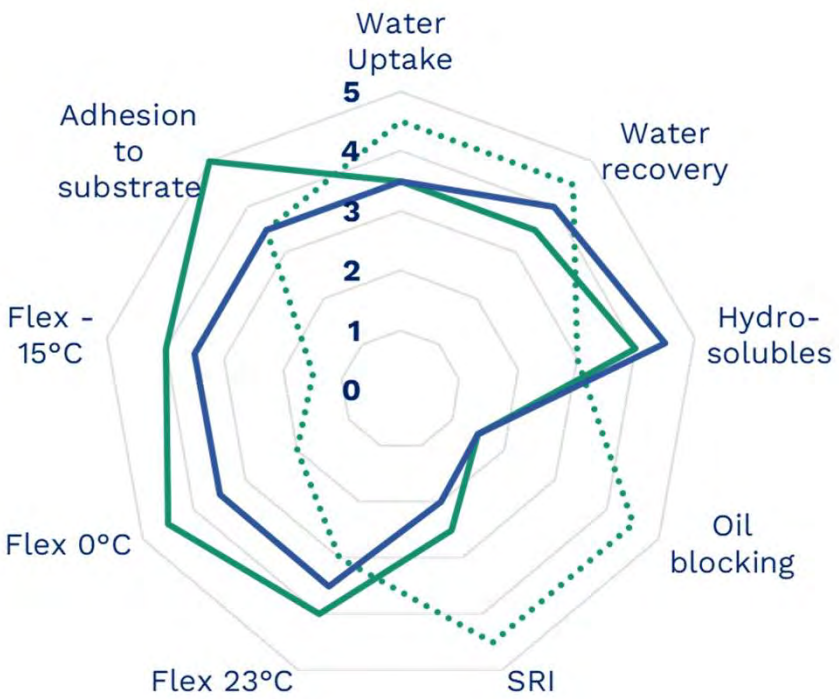
STABILISATION & WHITE COLOR STRENGTH
ACRYLIC DISPERSANTS
COADIS™
ECODIS™

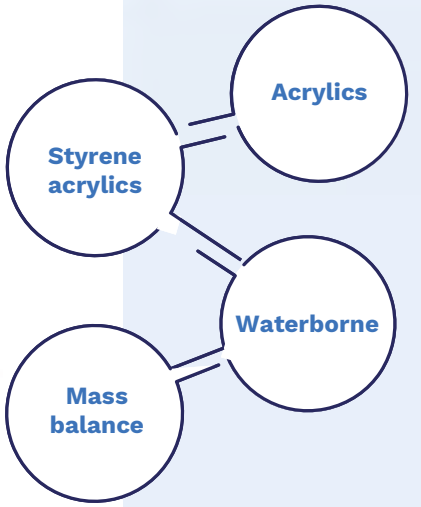
Arkema's solutions for high-performance, long-lasting reflective paints

BASECOAT RESIN FOR REFLECTIVE COATINGS – ENCOR® PERFORMANCES

BASECOAT:

- Adhesion
- Flexibility
- Water resistance
- Optical properties





ENCOR® acrylic performances according to your needs:

- Medium glass transition temperature for **great oil blocking resistance**
- Low glass transition temperature for **great flexibility at low temperatures**

Arkema's solutions for high-performance, long-lasting reflective paints

TOPCOAT RESIN TO BRING EXTREME DURABILITY – KYNAR AQUATEC® EMULSION

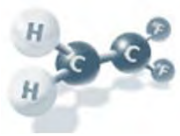
TOCOAT: Durable resistance to

UV

Mold & Mildew

Chemicals

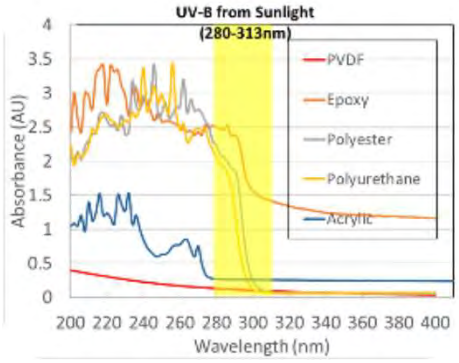
Improved cleanability



Polyvinylidene difluoride / PVDF

- C-F bonds have larger bond energy, and they **are not degraded by UVs**
- PVDF shows a lower UV-B absorbance

→ PVDF is intrinsically resistant to **UV, heat, and chemicals**



PVDF solvent based technology has been used for the last **60 years** for its ultra high performances such as

- Durability & Color retention
- Chemical & Biological resistance
- Easy cleanability

In the 2000's, a new generation of **waterborne binders** became commercial, combining **PVDF with acrylic**

- Water-based, Low VOC
- Great weathering performance
- Field or Factory applied
- Multiple substrates, for new or renovation purposes.

KYNAR AQUATEC®

Arkema's solutions for **high-performance, long-lasting** reflective paints

*TOPCOAT RESIN TO BRING EXTREME DURABILITY – **KYNAR AQUATEC®** EMULSION*

TOCOAT: Durable resistance to

UV

Mold & Mildew

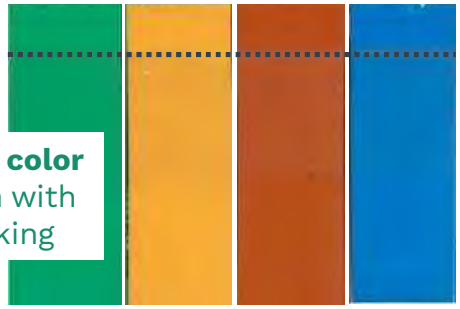
Chemicals

Improved cleanability

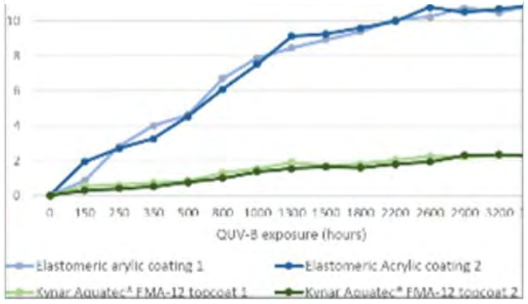
Excellent color retention with no chalking

Easy cleaning

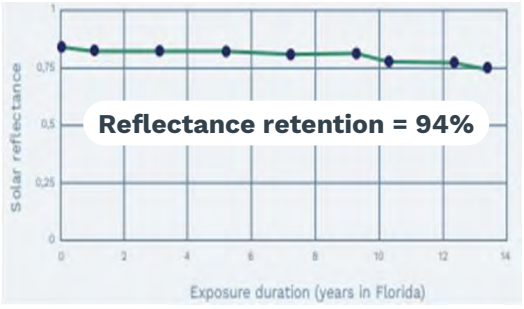
Kynar Aquatec® based coating
Weathering in Florida for **20 years**



Kynar Aquatec® vs Acrylic coating
Delta E evolution ; QUV-B exposure



Kynar Aquatec® coating
Solar reflectance evolution for **13 years** in Florida



Elastomeric Acrylic Resin Based Coating

Kynar Aquatec® Based Coating

Elastomeric Acrylic Resin Based Coating

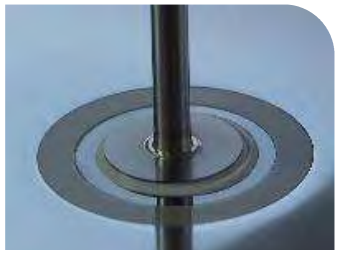
Kynar Aquatec® Based Coating

Arkema's solutions for high-performance, long-lasting reflective paints

ADDITIVES FOR BUILDING AND CONSTRUCTION TO OPTIMIZE THE PERFORMANCES

ADDITIVES:

To help formulators meet challenges of solvent-free, solvent-based and waterborne **coatings, inks, adhesives & sealants**



Rheology modifiers

To control flow behavior sedimentation and sag resistance

Dispersing agents

To optimize dispersion and wetting of pigments and fillers

Surface modifiers

To customize surface aspect or properties of coatings and inks

Flow & Leveling agents

To improve film aspect, leveling and gloss

Arkema's solutions for **high-performance, long-lasting** reflective paints

REDUCE ENERGY CONSUMPTION IN BUILDINGS

Waterborne, low VOCs

Solar reflectance

Washability

Hyperdurability

PU membrane

- Initial solar reflective index: **102**
- Decrease of SRI after 3 years to 82
- Low washability, regular cleaning needed

Silicone membrane

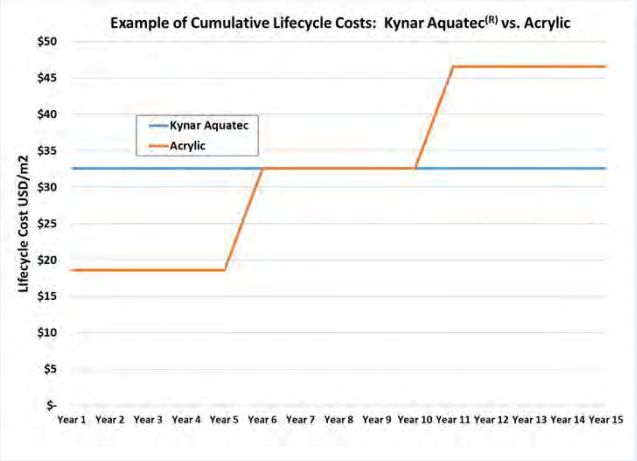
- High Initial solar reflective index: **109**
- Decrease of SRI after 3 years to **84**
- Low washability, regular cleaning needed

Commercial elastomeric acrylic

- High initial solar reflective index: up to **107**
- Reduction of solar reflectance after 3 years to **89**
- Low washability, regular cleaning needed

Encor® + Kynar® Aquatec® resins

- High Solar initial reflective index: up to **111**
- Long lasting solar reflectance, **SRI maintained at 100 after 3 years**
- Very good washability with **low dirt pick-up and high mildew resistance**
- **Lower maintenance** needed, longer service time.



Great **retention of properties** to increase the **durability** of the coating and of the roofing membrane.

Arkema's solutions provide a **high-performing** & **long-lasting** paint system.

ARKEMA

KYTEOS

BY

COOL ROOF

Enhanced Thermal Simulation (ETS): A tool designed for multiple and complex land assets

Dynamic Thermal Simulation (DTS) - Dynamic Energy Simulation (DES)

The Micro DTS, including the technical visit:
1 full day per site

Data to be provided:

- Department
- Type of coating / roofing material
- Slope
- Surface area
- Roof composition
- Building age
- Usage
- kWh price

Non-air-conditioned building

Temperature gains

Estimation du gain en température d'ambiance intérieure: -4.0 °C

Air-conditioned building

kWh savings

Estimation du gain électrique (par an): 21.3 kWh/m²

Estimation de l'impact écologique (sur 20 ans): 29 kg de CO2 par m²

Theoretical gains

Project

Analyses des performances

Mini STD (R =2,5 m2.K/W)

- Économies en énergie thermique, jusqu'à **30 kWh/m²/an.**
- Économies en énergie électrique, jusqu'à **10 kWh/m²/an.**
- Réduction de l'empreinte carbone de **16 kgCO2/m² sur 20 ans.**
- Economies financières réalisées, jusqu'à **114k euros par an.**
- Retour sur investissement à partir de **8 ans (HORS allongement de durée de vie de la toiture).**

Projection (R=2 m2.K/W)

- Économies en énergie thermique, jusqu'à **38 kWh/m²/an.**
- Économies en énergie électrique, jusqu'à **13,5 kWh/m²/an.**
- Réduction de l'empreinte carbone de **21 kgCO2/m² sur 20 ans.**
- Economies financières réalisées, jusqu'à **151k euros par an.**
- Retour sur investissement à partir de **6 ans (HORS allongement de durée de vie de la toiture).**

Go / No-Go decision

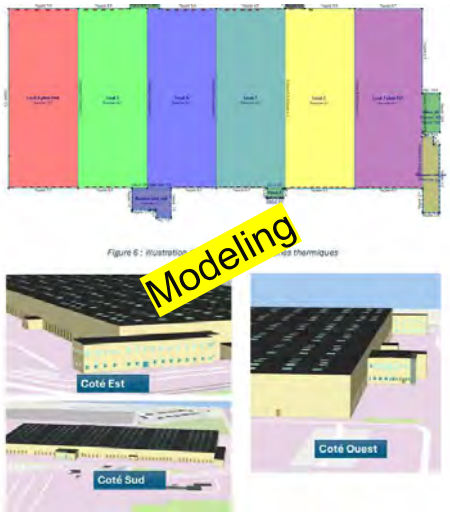
Dynamic Thermal Simulation (DTS) - Dynamic Energy Simulation (DES)

Complete DTS

1 full day per site / Workload: 3 man-days

Data to be provided:

- As-built documentation (DOE – Dossier des Ouvrages Exécutés)
- Building usage profiles
- Specific equipment (HVAC, AHU, etc.)
- Additional relevant technical data, if applicable



1 Synthèse

1.1 Gains en température dans les locaux de charges

	Local 1_plein Est	Local_2	Local_3	Local_4	Local_5	Local 6_plein Ouest
État existant	34,9 °C	34,8 °C	34,9 °C	35,0 °C	35,1°C	35,0 °C
CoolRoof	29,5 °C	29,2 °C	29,2 °C	29,2 °C	29,3 °C	29,5 °C
CoolRoof + CoolWall façades sud	29,4 °C	29,1 °C	29,1 °C	29,1 °C	29,2 °C	29,3 °C
Gains en T°	5,5 °C	5,7 °C	5,8 °C	5,9 °C	5,9 °C	5,7 °C

1.2 Réduction des besoins en refroidissement pour les bureaux

Gains

	Bureaux coté_Sud	Bureaux coté_Est
État existant	30 kWh/m2/an	20 kWh/m2/an
CoolRoof	13 kWh/m2/an	12 kWh/m2/an
CoolRoof + CoolWall façades sud	11 kWh/m2/an	11 kWh/m2/an
Gains%	-56 % - 63% (CoolRoof +CoolWall)	- 40 % (CoolRoof) -45 % (CoolRoof+CoolWall)

1.3 Réduction des heures d'inconfort

	Etat existant	CoolRoof	CoolRoof + CooWall façades sud
Zones	Heures d'inconfort (Base 26°C)		
Local 1_plein Est	993	307	283
Local_2	1030	297	273
Local_3	1044	299	275
Local_4	1038	300	272
Local_5	1040	307	282
Local 6_plein Ouest	1022	321	302
Bureaux coté_Sud	222	103	83
Bureaux coté_Est	135	80	72

Conclusion

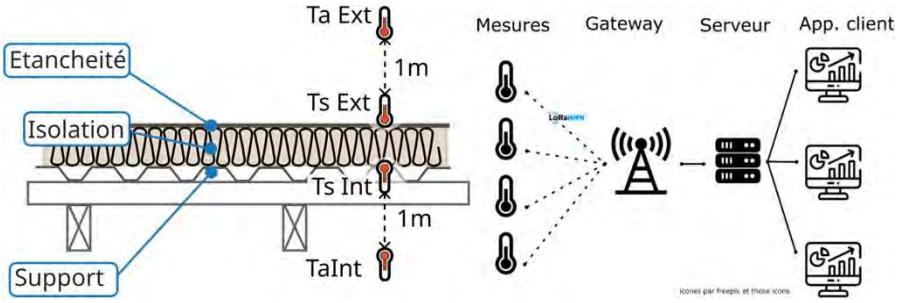
Synthesis

Les résultats de cette analyse démontrent l'efficacité des solutions CoolRoof et CoolWall, utilisées conjointement, pour améliorer les performances thermiques et énergétiques de la plateforme logistique étudiée. L'application [illegible] CoolRoof sur la toiture permet de réduire les températures internes de 5,4°C à [illegible] zones de stockage. Par ailleurs, l'ajout de CoolWall sur les façades [illegible] réductions thermiques déjà obtenues grâce au CoolRoof. Dans les [illegible] combinaison de CoolRoof et CoolWall entraîne une diminution significative de [illegible] refroidissement passif, avec une réduction de 63 % pour les bureaux orientés au sud [illegible] % pour ceux orientés à l'est. De plus, les heures d'inconfort thermique sont fortement réduites (base 26°C) : elles passent de 993-1044 heures à environ 297-321 heures dans les locaux techniques, et de 222 à seulement 83 heures pour les bureaux côté sud. Enfin, cette approche globale offre des bénéfices majeurs en termes de réduction des charges thermiques et des besoins énergétiques, tout en améliorant notablement le confort thermique des occupants, particulièrement dans un environnement logistique dépourvu de climatisation.

TRNSYS 18

PLEIADES

IoT-based Monitoring



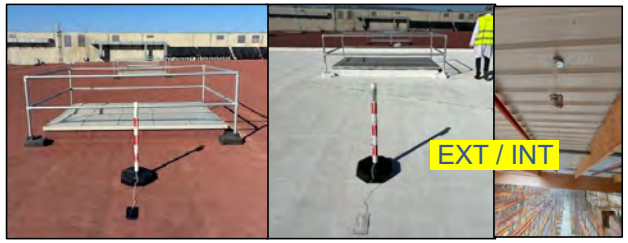
NILM (Non-Intrusive Load Monitoring)

1

PROTOCOL

ESTABLISHMENT OF AN APPROPRIATE INSTRUMENTATION PROTOCOL

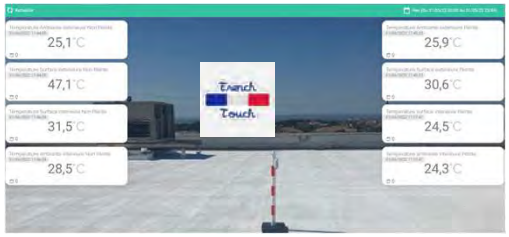
2



INSTALLATION

ON-SITE IOT SENSOR DEPLOYMENT + **DATA ACQUISITION AND TRANSMISSION** + **INTEGRATION AND MONITORING**

3



3

VISUALIZATION

Access and Visualization on the Data Platform

Enhanced Thermal Simulation

Satellite-Based thermal imaging for building envelope analysis

Our STA system **“KYTEOS”** indicates the following:

The **surface temperature** reaches an average of 43°C at 12:00 PM during summer.
This temperature is expected to increase by approximately 20% towards solar zenith around 2:00 PM, reaching about 60°C on average (maximum 80°C).
The **heat accumulation** on this roof forms a localized heat island (ICU), which is compounded by heat release from the test tracks.

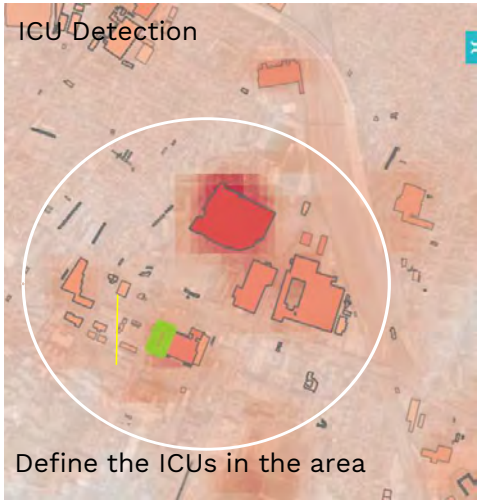
Immediate Consequences

- ❑ Photovoltaic production degradation
- ❑ Bitumen membrane aging
- ❑ Indoor overheating
- ❑ HVAC performance degradation (outdoor unit)
- ❑ ICU propagation and self-reinforcement

Aerial View

Individual Building Views

ICU Detection



Building Study and Results

HERMES SELLIER

153 RUE DE STALINGRAD, 93000, BOBIGNY

Commune : **BOBIGNY**

SIREN : **696520410**

Code APE/NAF : **15.12Z**

Surface (m²) : **3 749.6**

Température bâti

Été : **43.2°C** (moy) | **48.4°C** (max)

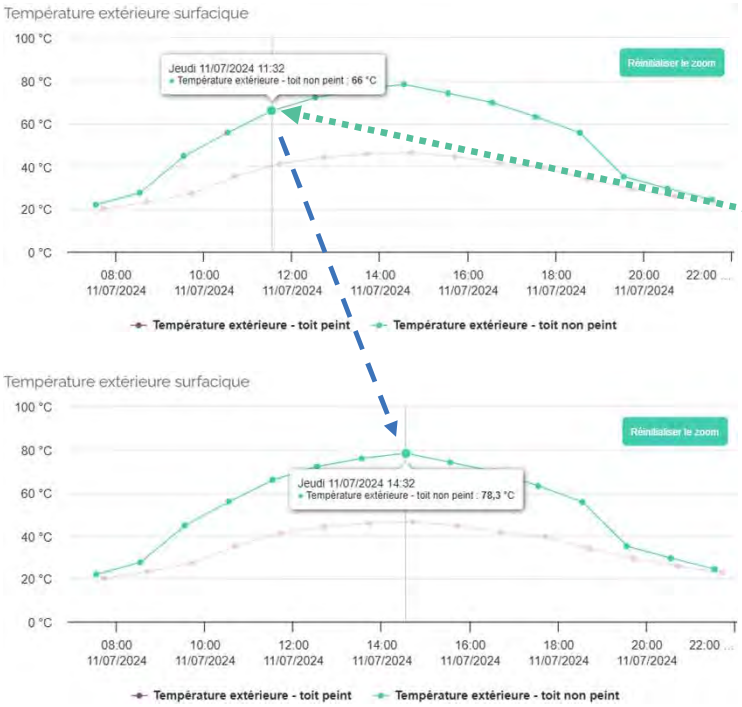
Automne : **20.5°C** (moy) | **30.9°C** (max)

Hiver : **13.7°C** (moy) | **15.9°C** (max)

Printemps : **29.8°C** (moy) | **46.2°C** (max)

Enhanced Thermal Simulation

Reliability and Temporal Resolution

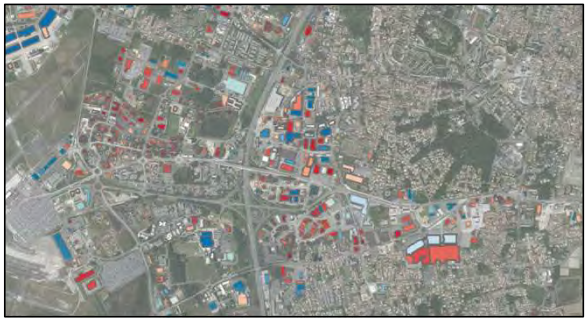


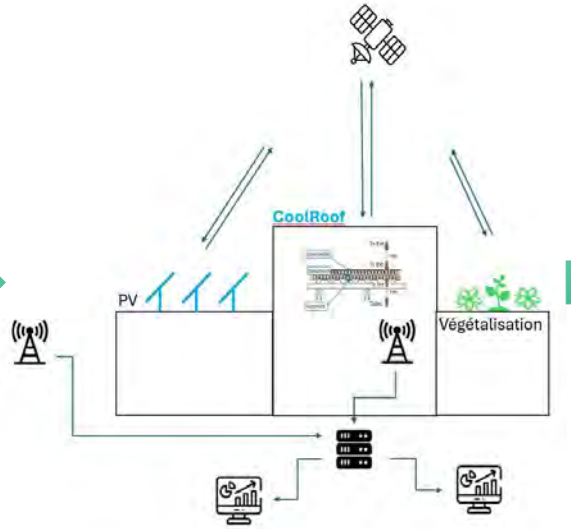
Enhanced Thermal Simulation

DTS/DES

Satellite-Based thermal imaging

Thermal reflectance index





Air-conditioned building

kWh savings

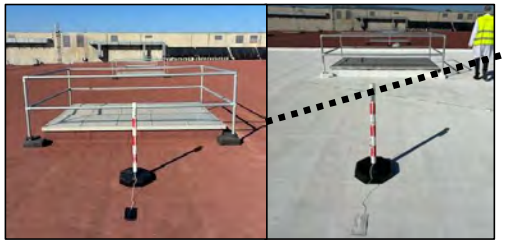
Non-air-conditioned building

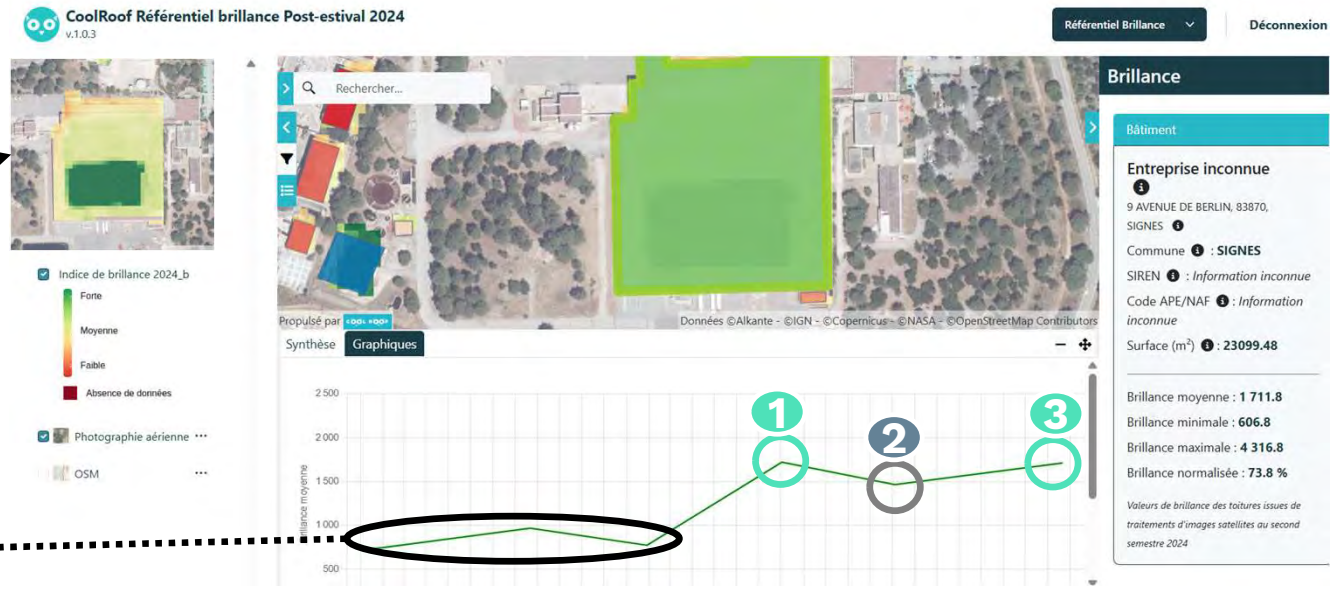
Temperature gains

Enhanced Thermal Simulation

Long-Term Performance Guarantee

Exemple : Half of the Roof Treated with Cool Roof Coating





Without Cool Roof – Bare Bitumen

1 COOLROOF

IMPLEMENTATION OF COOLROOF PROCESS

2 SOILING

ONSET OF SURFACE SOILING

3 MAINTENANCE

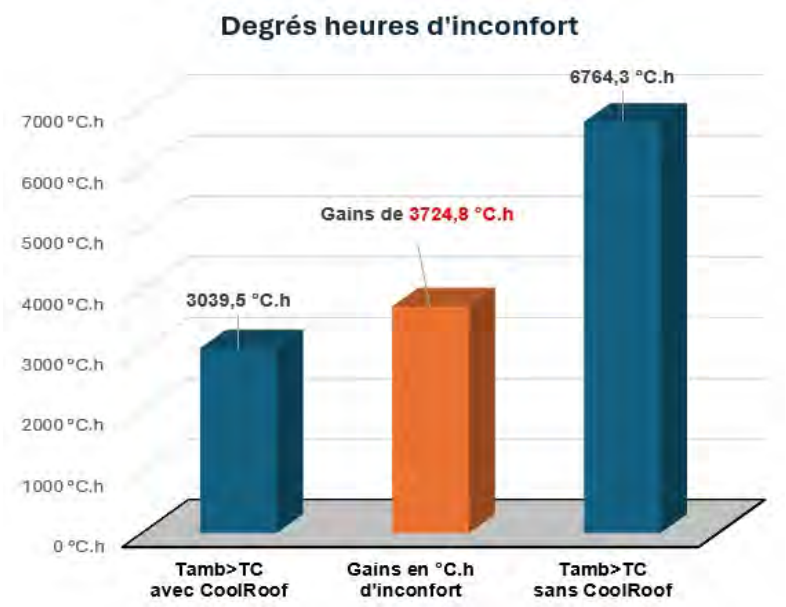
MAINTENANCE TO PRESERVE PERFORMANCE

Business case 1

CDC Habitat – H3

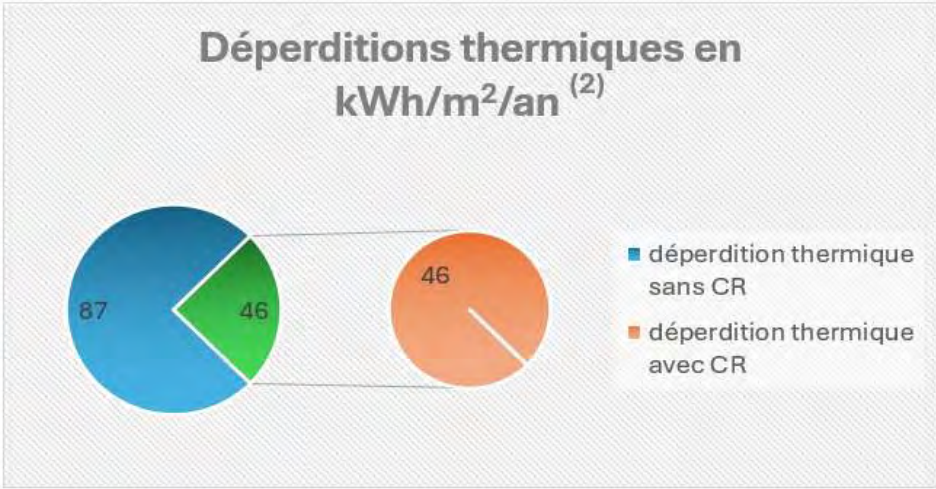
Analysis of Degree-Hours of Discomfort (DHI)

- Significant reduction of DHI in summer[2], down to **3724.8 °C·h/year[1]**.
- **Negligible** negative impact during winter.
- Achieved reduction: **55%**.



Performance Analysis

- Thermal energy savings: up to **41 kWh/m²/year[1].**
- Electrical energy savings: up to **13.7 kWh/m²/year[1].**
- Carbon footprint reduction: **17 kg CO_2/m² over 20 years[1].**



NB : [1] Le calcul est basé sur une résistance thermique du toit de 2.5 m²K/W.

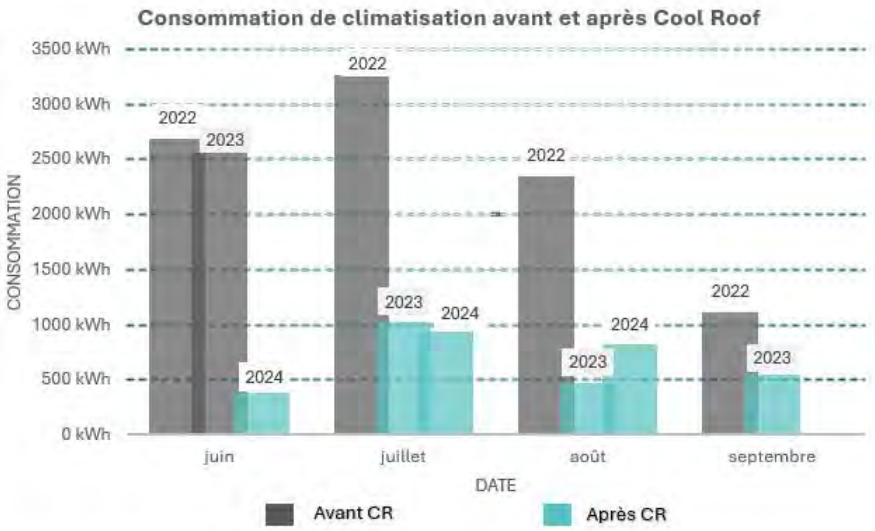
[2] Données du mois d'août 2024

Business case 2

Norauto / Gemo

Site de 1200 m² en H1

- Electrical energy savings: approximately **7.3 kWh/m²/year.**
- Carbon footprint reduction: **7.18 kg CO_2/m² over 20 years.**



NB : La résistance thermique du toit est de 2.7 m²K/W

Site de 1000 m² en H3

- Electrical energy savings: up to **10.2 kWh/m²/year.**
- Carbon footprint reduction: **11.66 kg CO_2/m² over 20 years.**

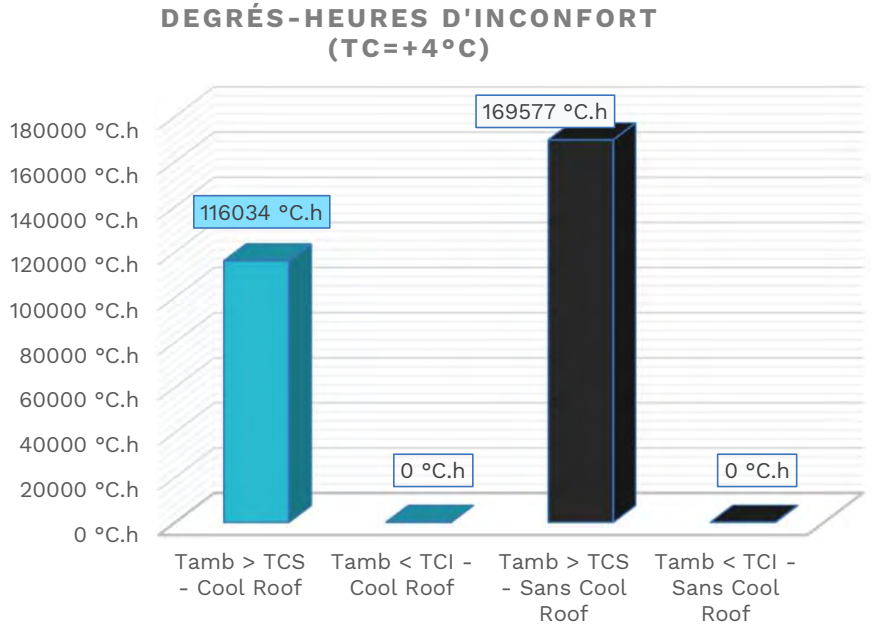
NB : La résistance thermique du toit est de 3.5 m²K/W

Business case 3

Coca Cola – H3

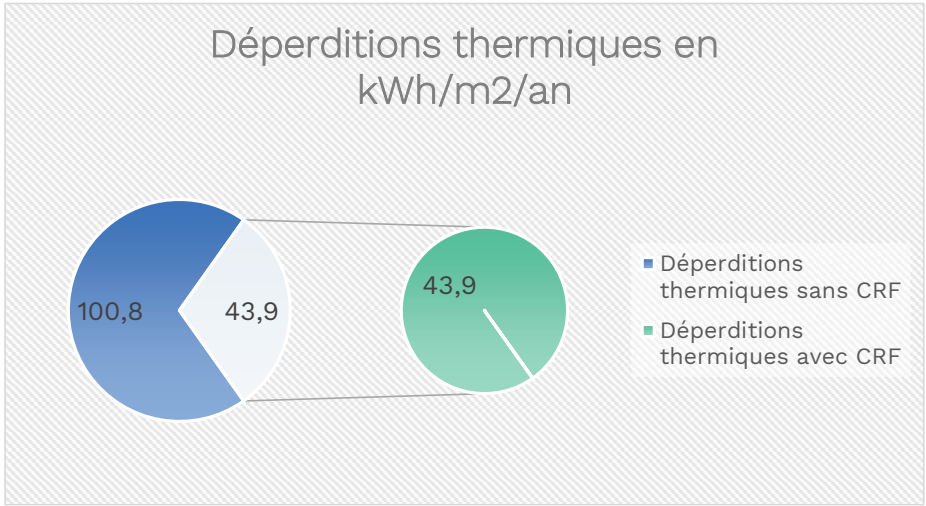
Analysis of Degree-Hours of Discomfort (DHI)

- Significant reduction of DHI up to **53,543 °C·h/year[1].**
- **Zero** negative impact during winter (positive cold rooms at +4 °C).
- Achieved reduction: **21%.**



Performance Analysis

- Thermal energy savings: up to **56.90 kWh/m²/year[1].**
- Electrical energy savings: up to **20.32 kWh/m²/year[1].**
- Carbon footprint reduction: **27.31 kg CO_2/m² over 20 years[1].**



NB : La résistance thermique du toit est de 3 m²K/W

CONCLUSION

- ✓ The unique actor measuring and ensuring real impact.
- ✓ Renowned expertise & bespoke guidance.

SCAN ME

Thank you!

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