

IR pigment technology is the key to successful cool building products

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**WE
BRIGHTEN
LIVES®**



3D Printed House Models

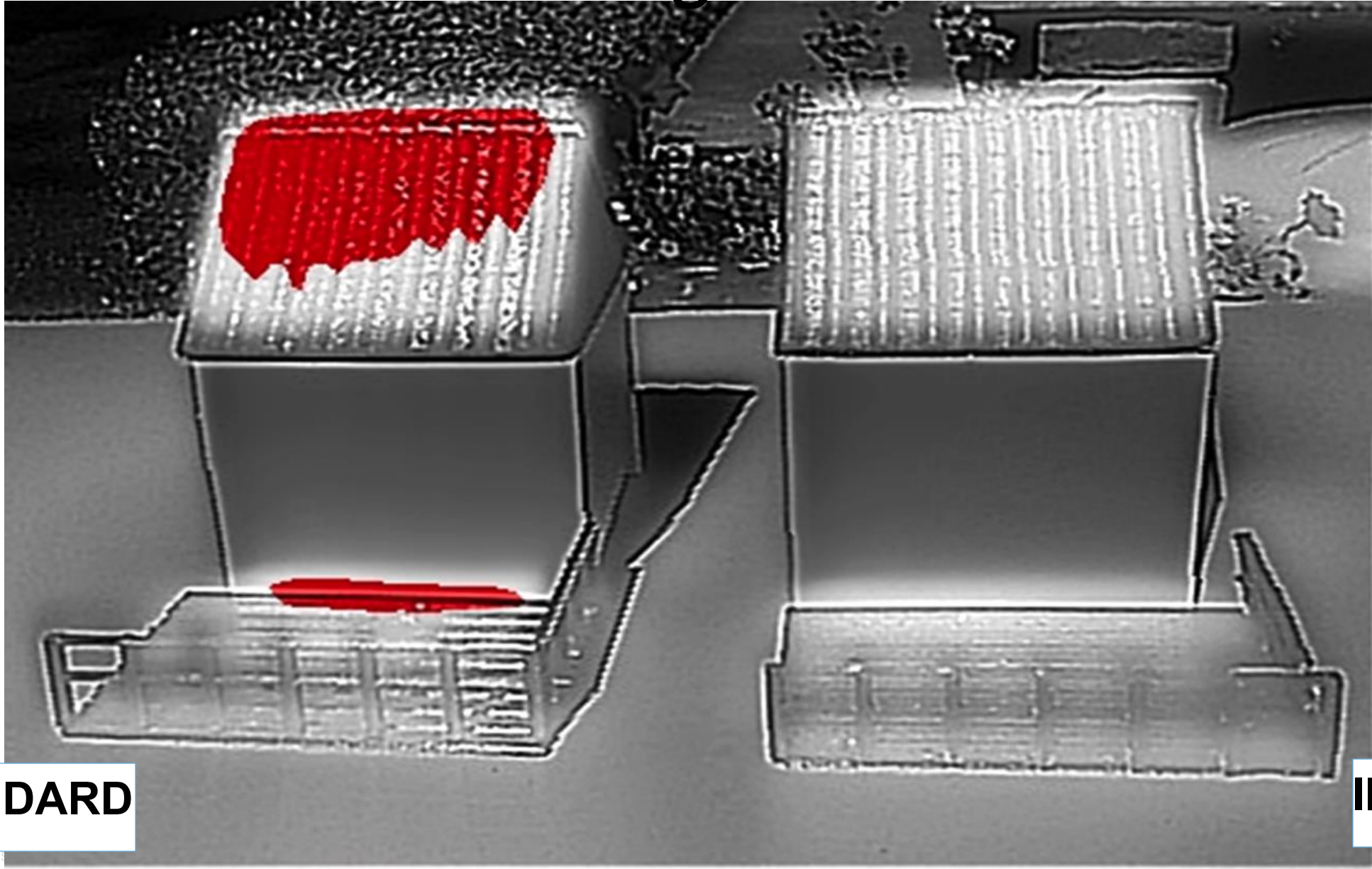


Ambient air temp:
90F/32C
Solar Irradiation:
900W/m²

STANDARD

IR Reflective

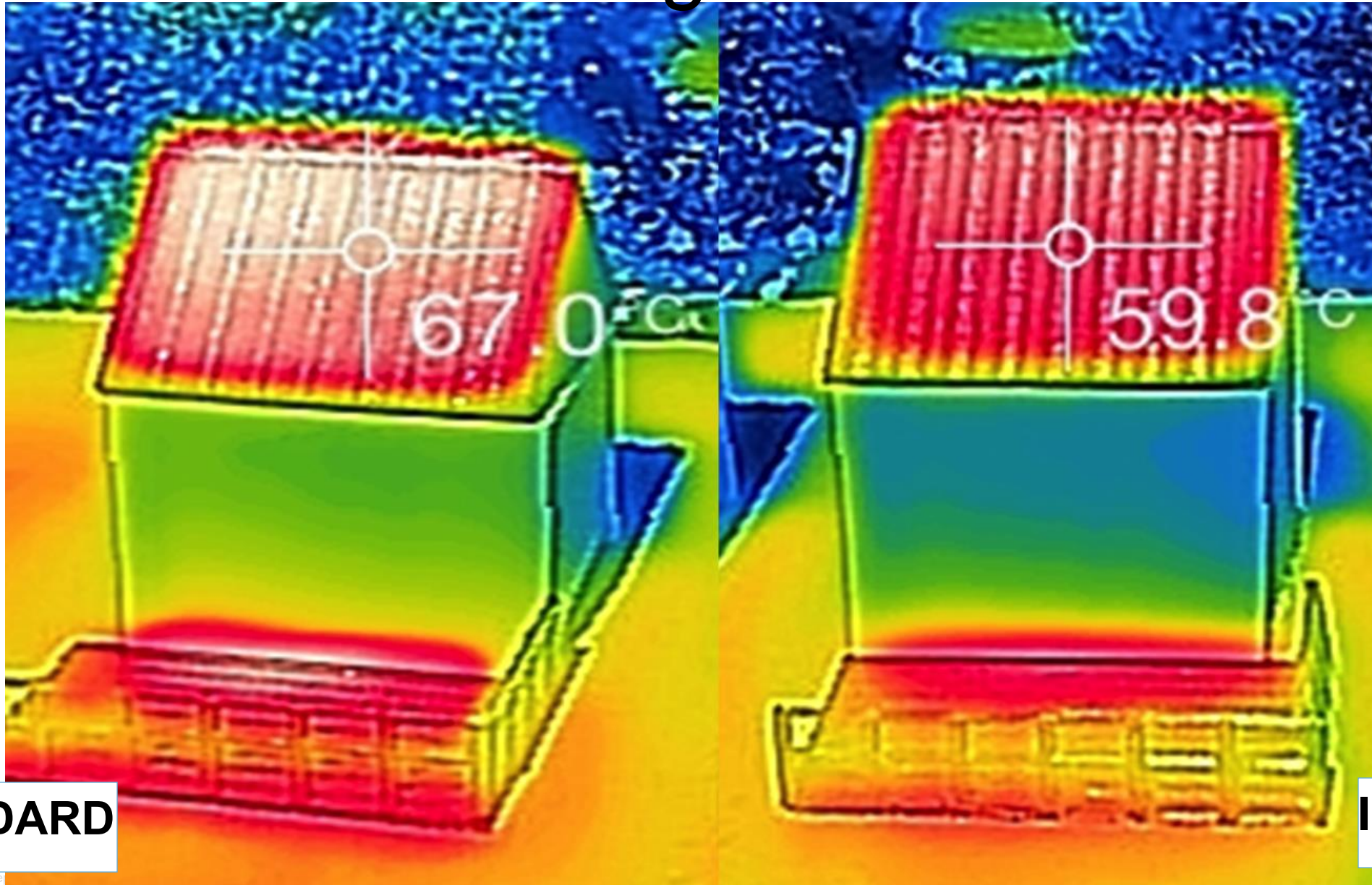
FLIR Thermal Image



STANDARD

IR Reflective

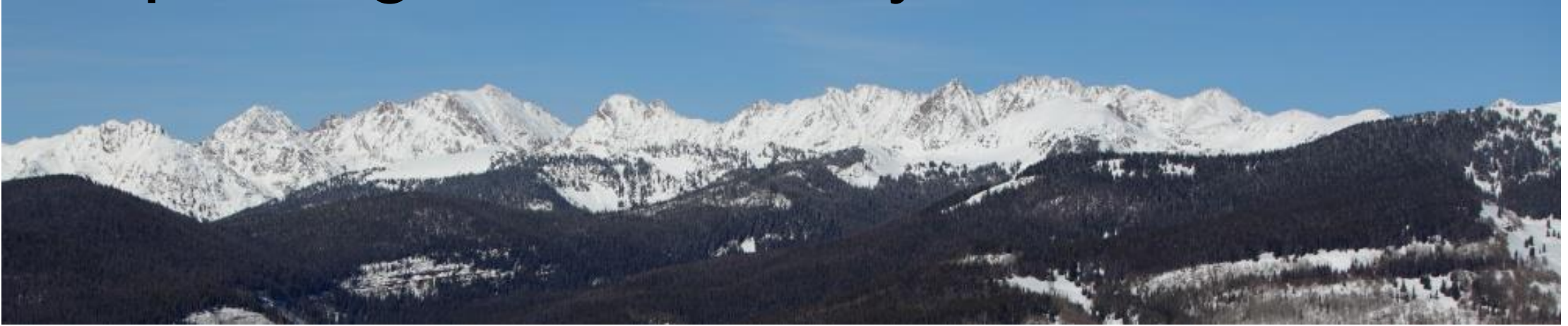
FLIR Thermal Image



STANDARD

IR Reflective

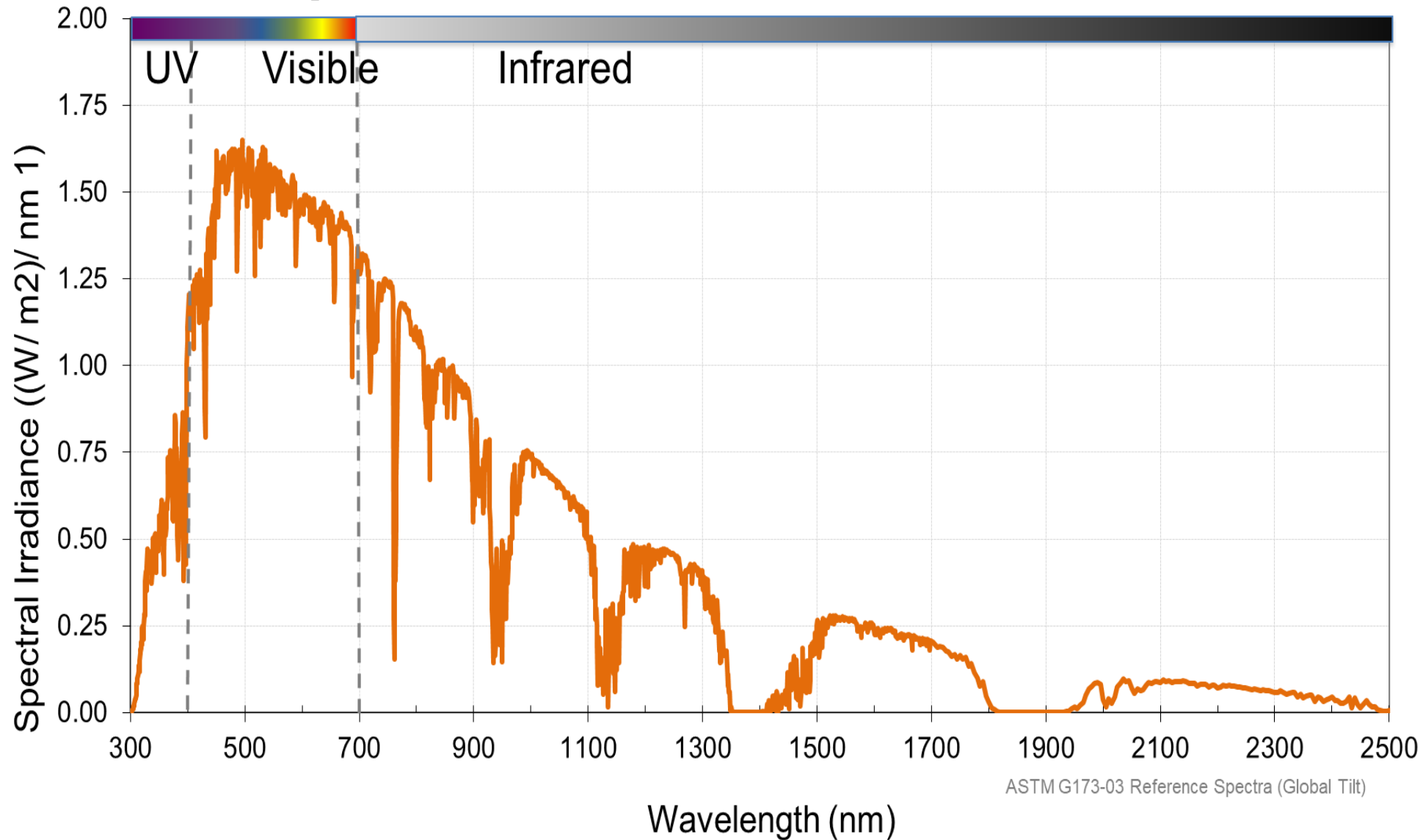
Improving Sustainability



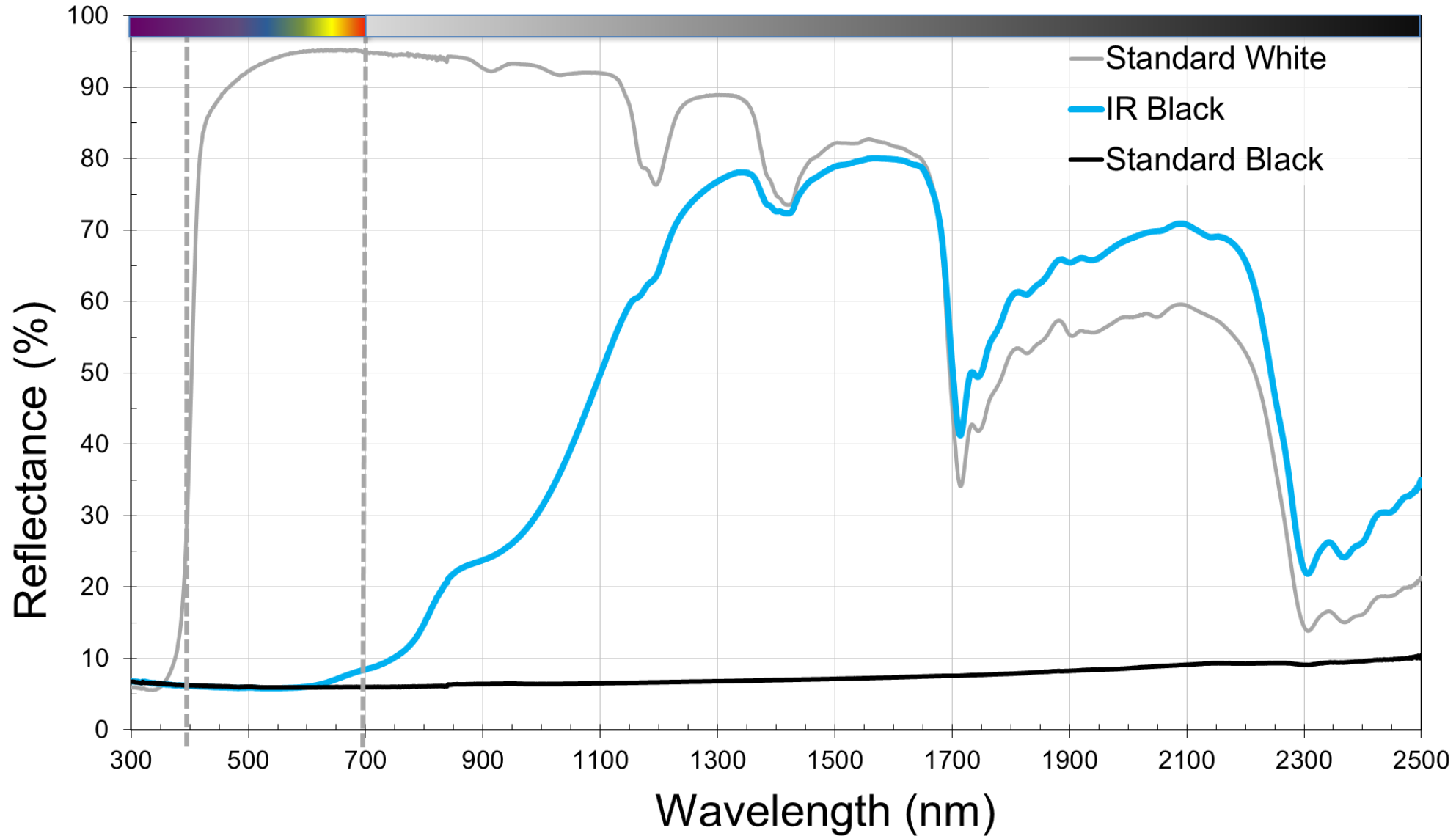
Presentation Topics

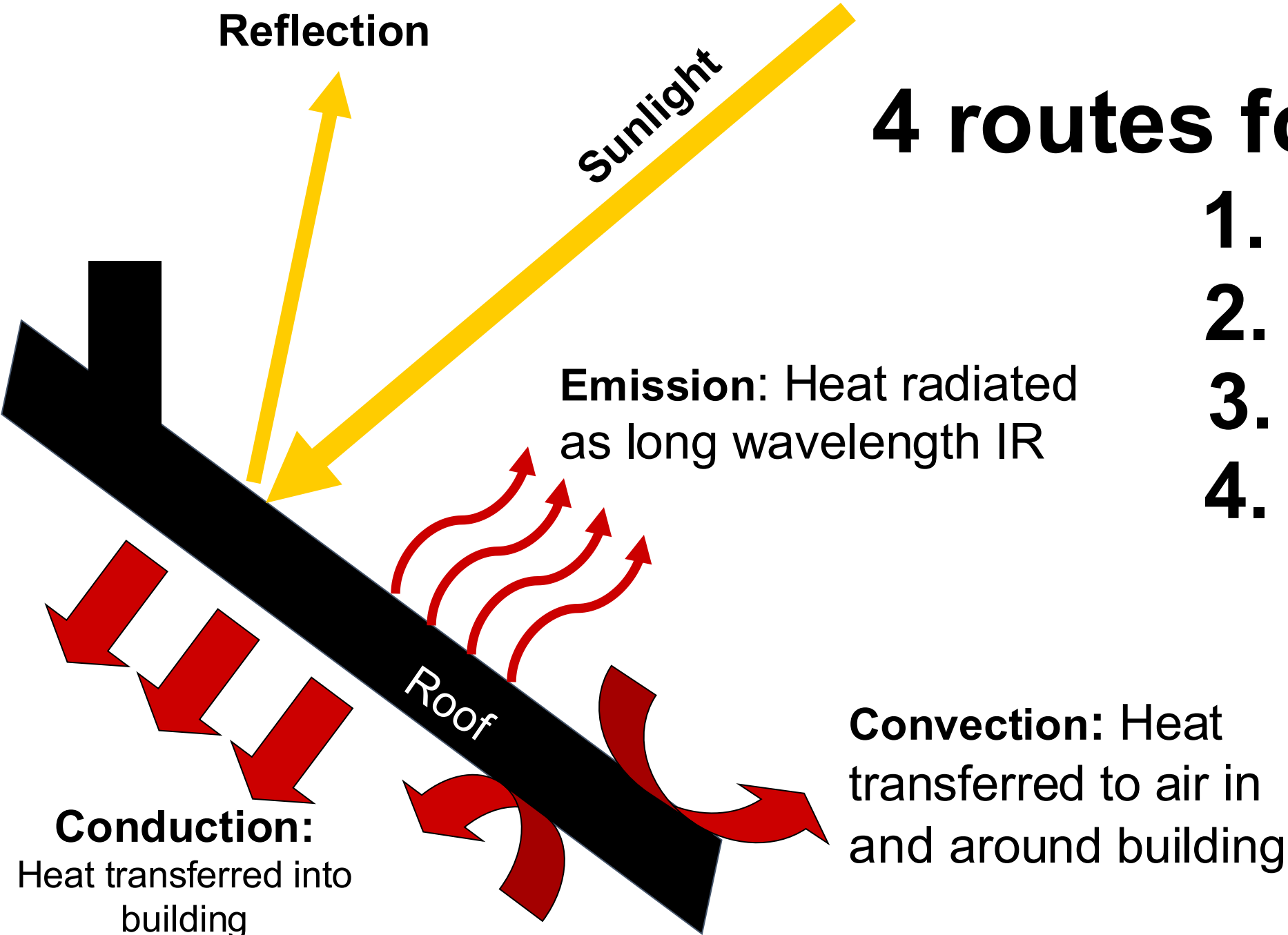
- Basic physics
- Measurement
- Pigment chemistries
 - PG17 and PBr29
 - PG17 optimized
 - PG17 modified
 - Other pigment chemistries
- Formulation basics

Solar spectrum



Pigment reflectance





4 routes for energy

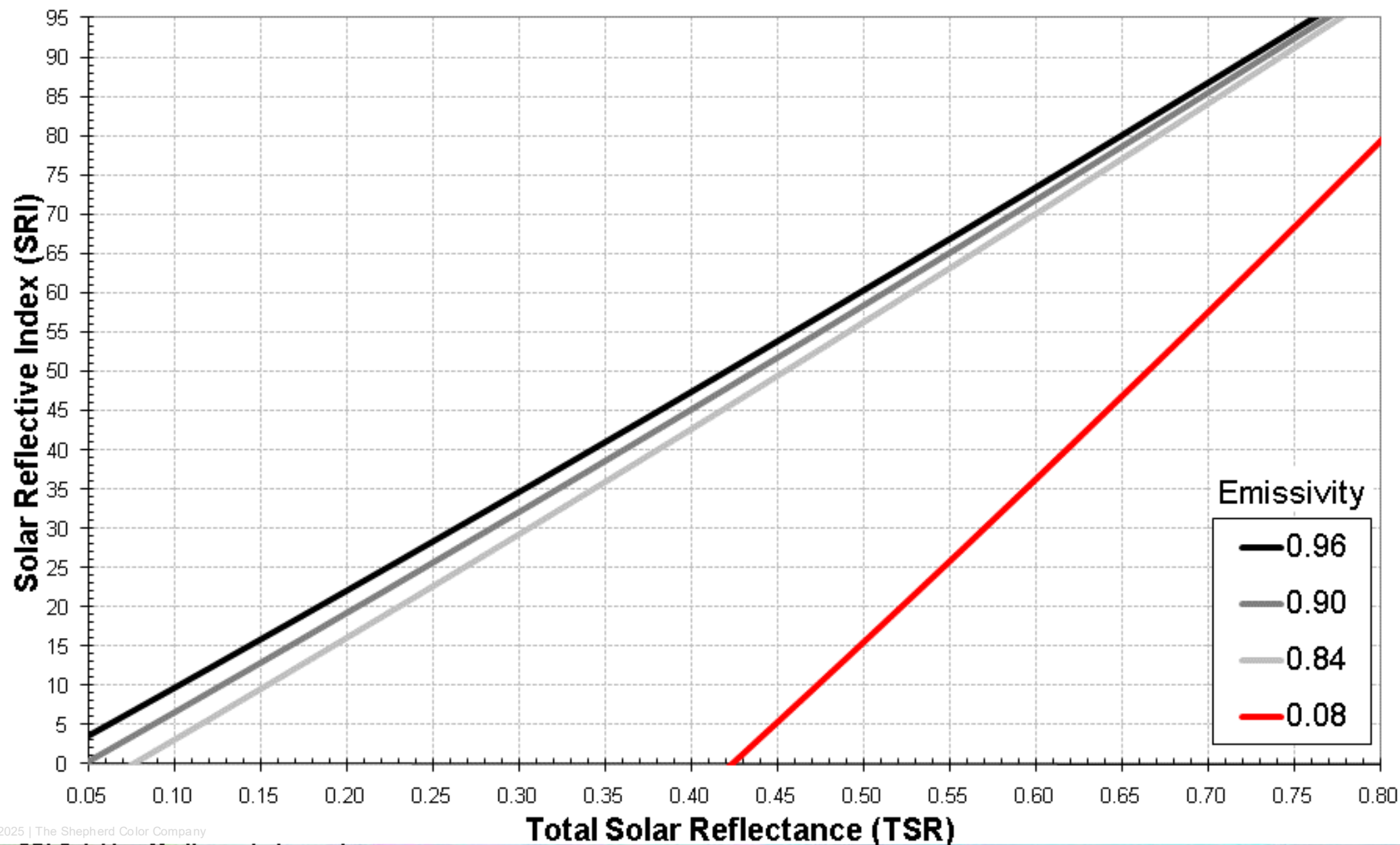
1. Reflection
2. Conduction
3. Emission
4. Convection

Measurement

- Total Solar Reflectance (TSR)
 - Equipment
 - Spectrophotometer- by wavelength/TSR calculated
 - Direct TSR measurement- TSR only
- Solar Reflective Index (SRI)
 - Incorporates thermal performance into a single value
 - TSR
 - Emissivity
 - Wind speed
- Heat build-up (HBU)
 - Based on physical lamps

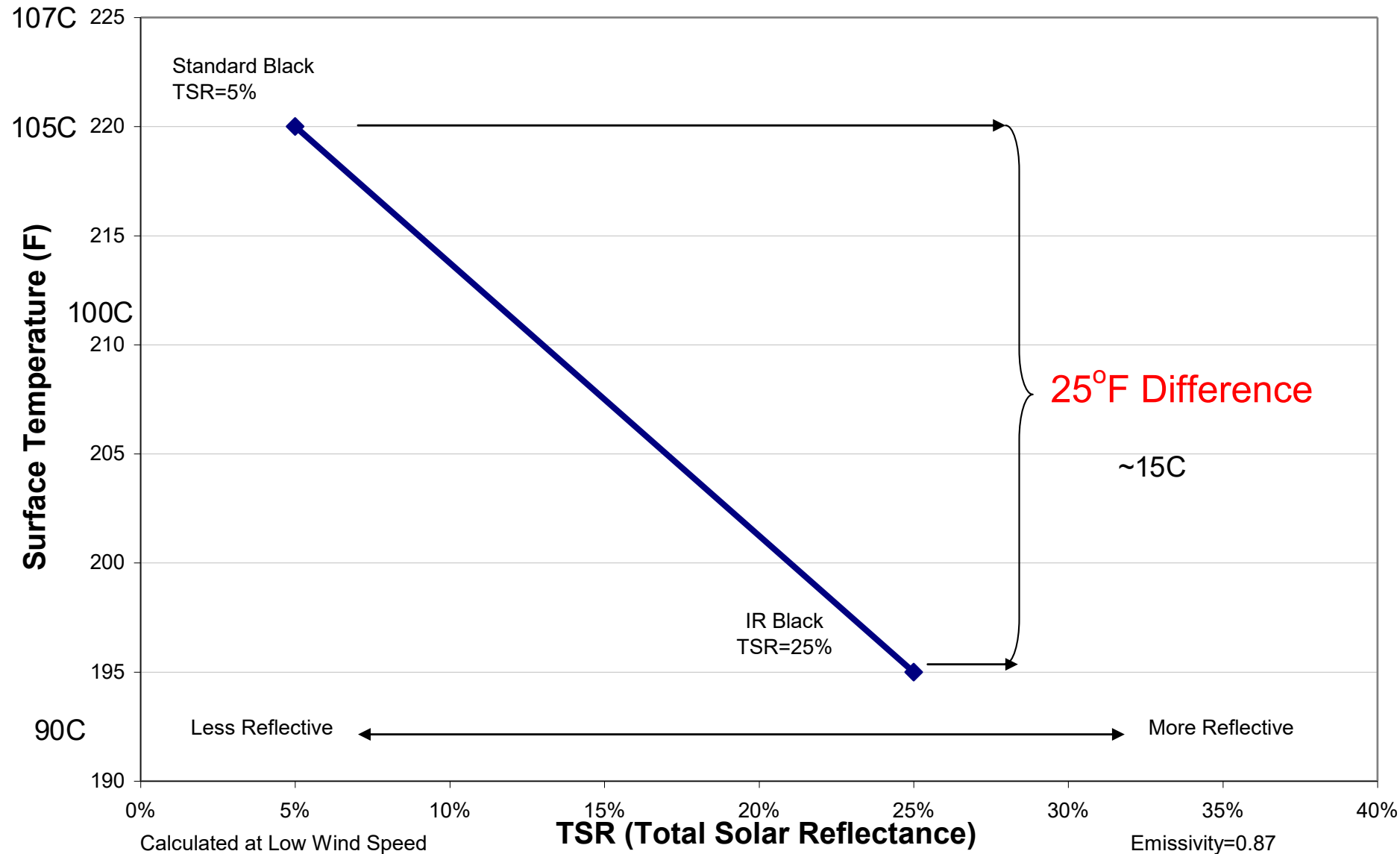
Solar Reflective Index

SRI at Various Emissivity and TSR Values



Standard and IR Black Surface Temperatures

At different Reflectance Values (ASTM E1980)



Calculated difference
in surface
temperature.
Actual difference
depends on location,
airflow, solar
intensity, emissivity
and atmospheric
conditions.

Pigment technologies for cool materials

- Titanium Dioxide white (PW6)
 - Standard pigment grades
 - IR optimized (large) version
- Organic pigments
 - Highly absorptive and colorful
 - IR transparent (TSR substrate and color formulation dependent)
 - Perylene Black (PBk32)
 - Phthalo Green (PG7)

Pigment technologies for cool materials

- Inorganic materials (focus on dark colors)
 - Standard oxides
 - Red iron oxide (PR101)
 - Chromium oxide green (PG17)
 - Standard grades
 - IR optimized (PSD and Color)
 - Complex Inorganic Color Pigments (CICPs)
 - FeCr Ir black pigments
 - Wide range of Fe to Cr(III) ratios]
 - Wide range of PSD
 - Smaller PSD- higher tint-strength, warmer color
 - Larger PSD- Jetter masstone, lower tint-strength
 - Influence of dopants for optimization
 - PG17 vs PBr29 (preferred nomenclature)
 - Chromium Oxide (PG17) with dopants/modifiers
 - Optimized for higher TSR color matches

Inorganic IR Pigments



IR Reflective FeCr Blacks (PBr29)

- Absorb in Visible for dark color
- Reflect in IR to reduce temperature

Masstone & tint optimized
Driven by Particle size

Chromium Oxide
IR optimized PG17
-Dark Color
-High TSR



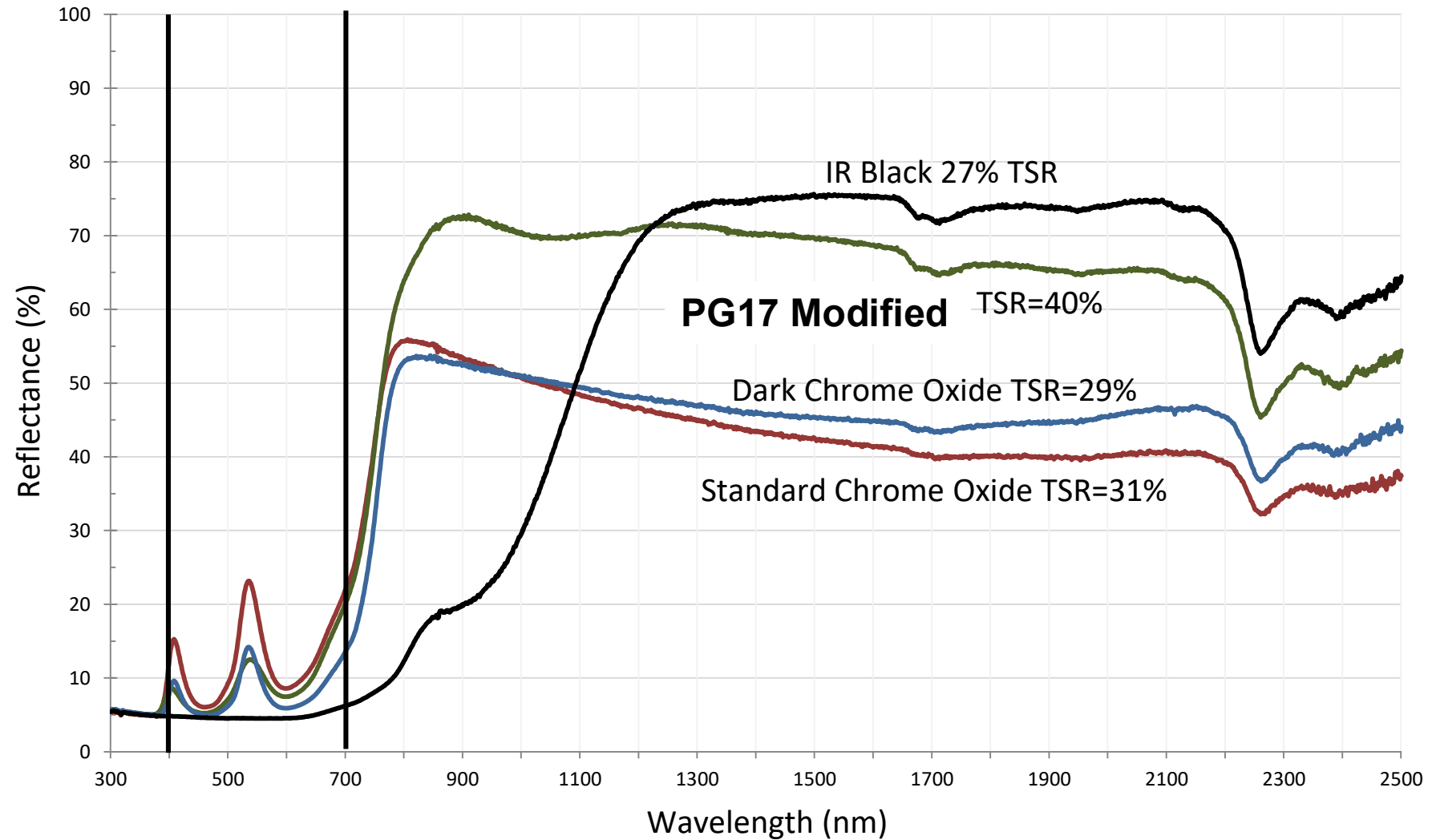
Chromium Oxide (Pg17 Mod')
-Dark Color
-High TSR
Excellent for High TSR color matches



Manganese Titanate (PY164)
Best-in-class
High tint strength – Low use rate

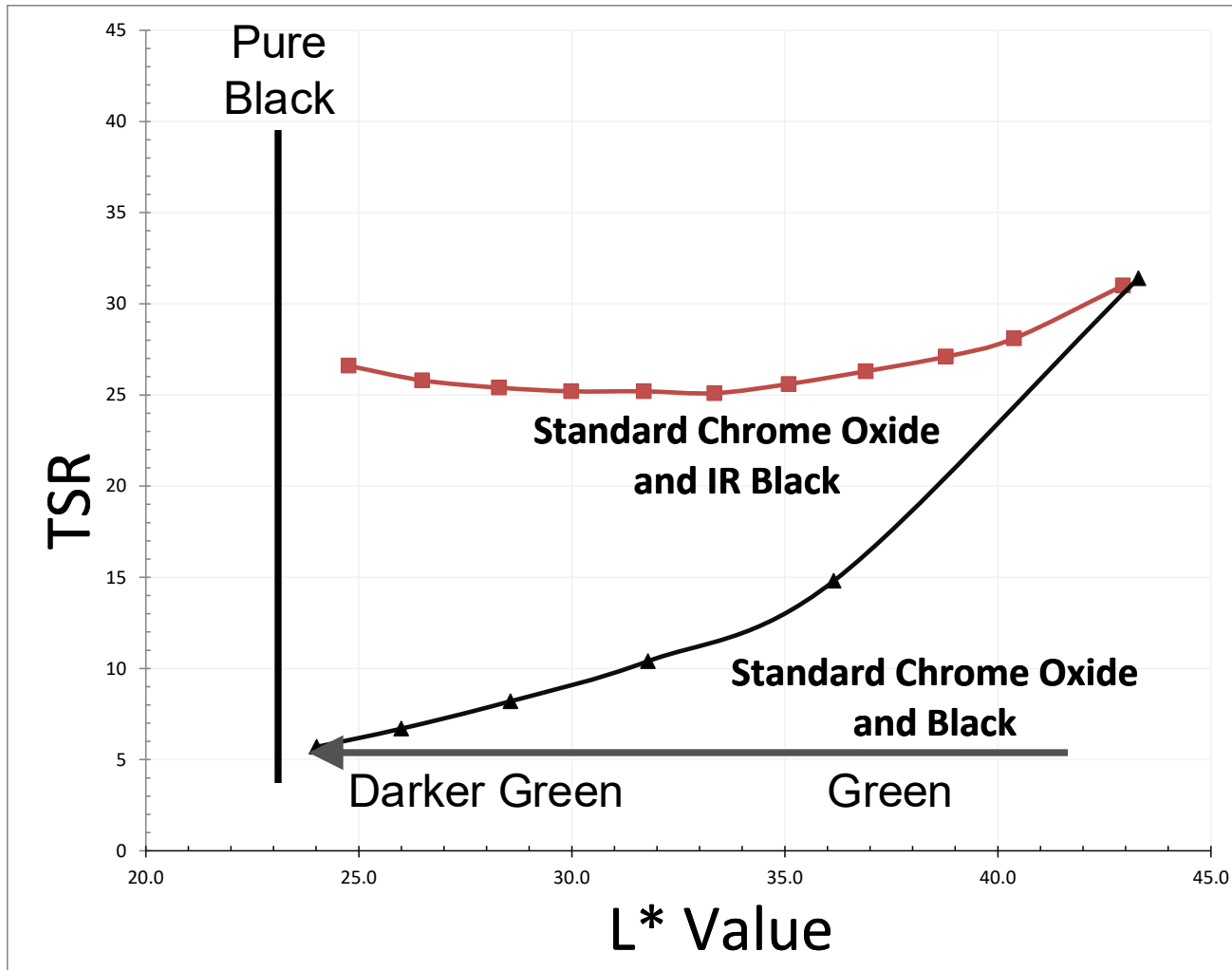
Reflectance Curves

PVDF/Acrylic over primed Al panels



Advantage of Using IR Pigments

Standard Black and Cr_2O_3 Green versus Standard Cr_2O_3 and IR Black

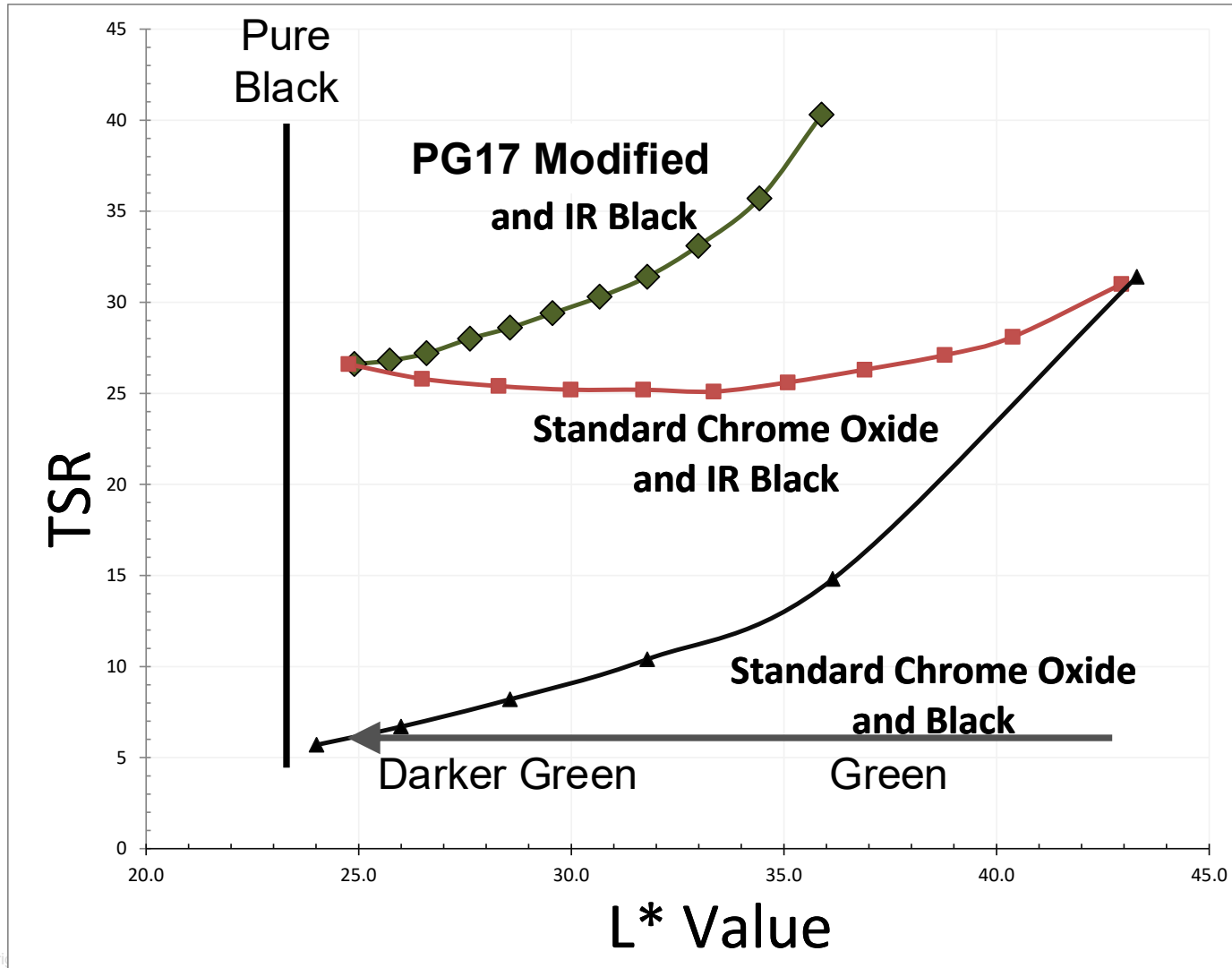


Dark green colors at higher TSRs

Advantage of Using PG17 Modified

Optimized dark green colors using IR Black and PG17 modified

Darker green colors at higher TSRs

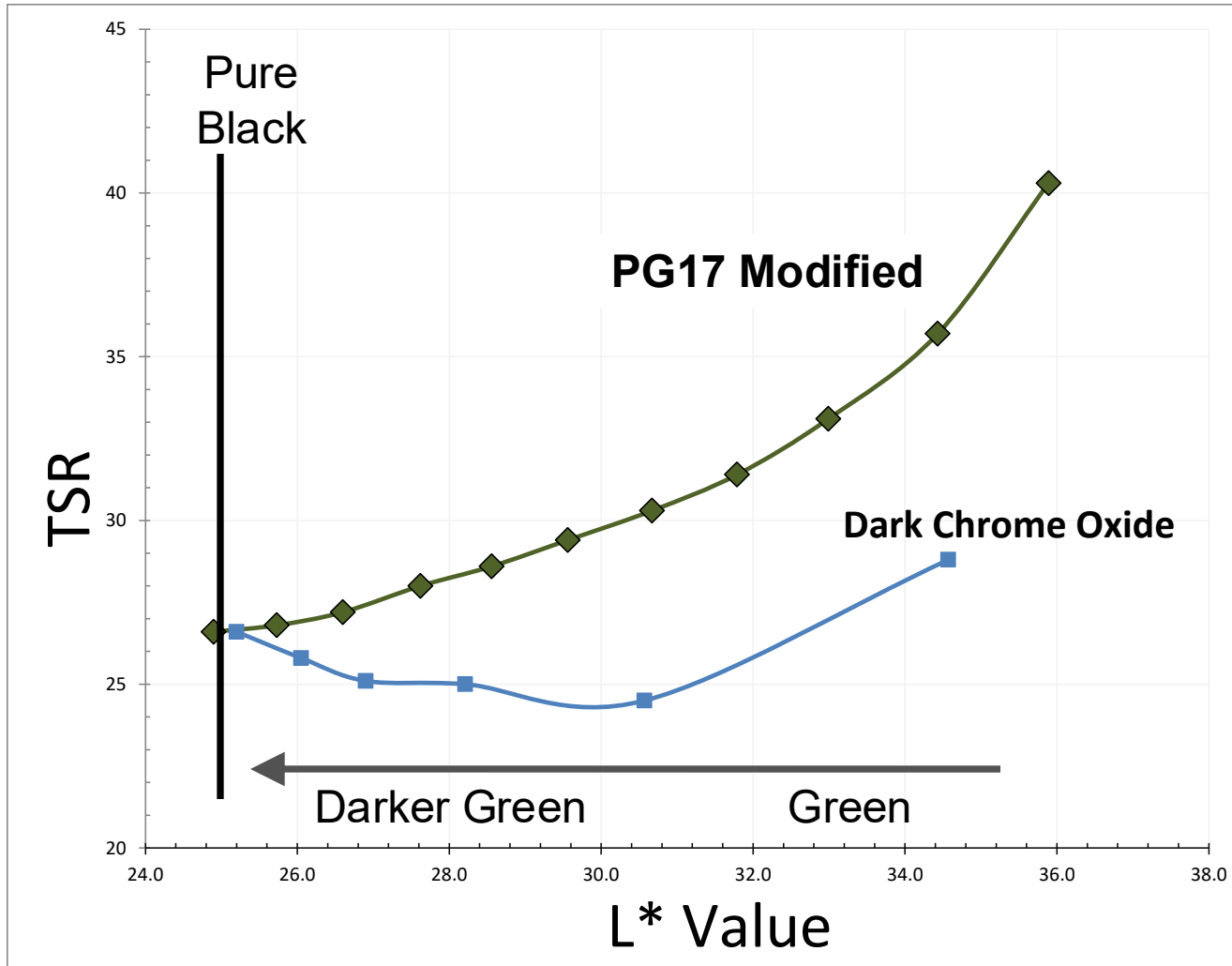


Dark green colors at higher TSRs

Even higher TSRs with
IR Black
PG17 modified

Advantage of Using PG17 Modified

Special Dark Grade of Cr_2O_3 Green versus PG17 Modified

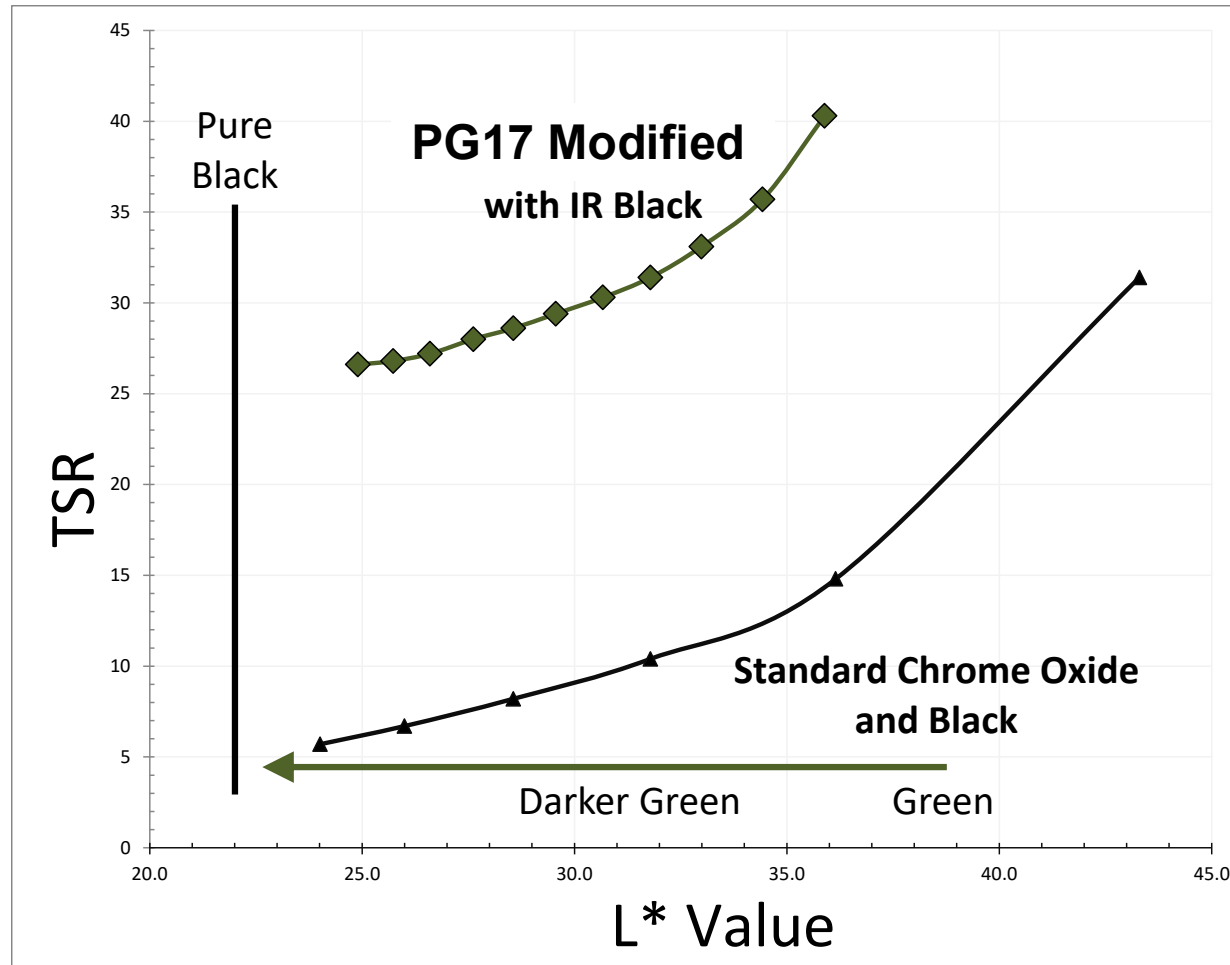


Darker green colors
at higher TSRs

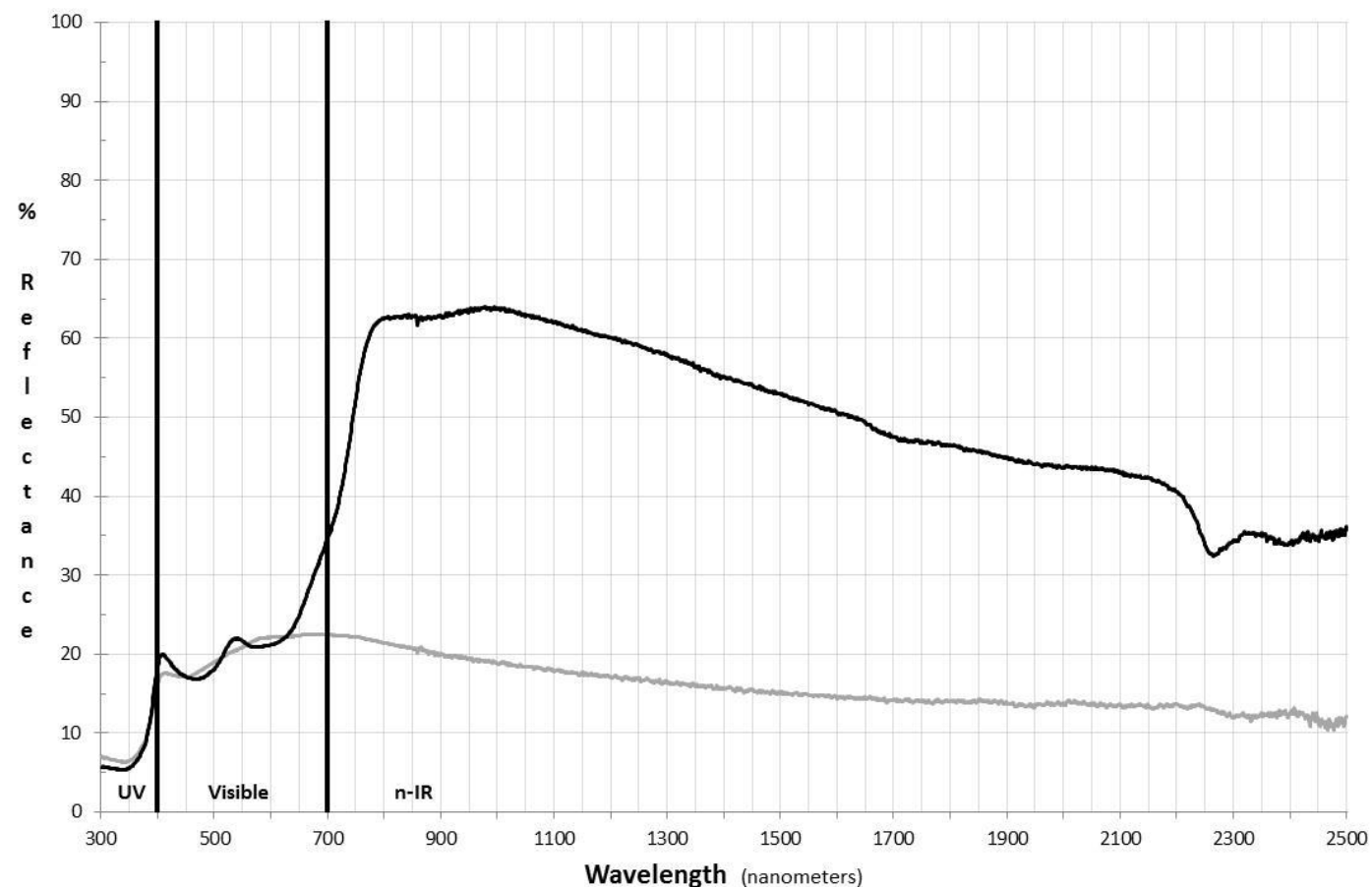
Advantage of Using IR Pigments

Standard Black and Cr_2O_3 Green (PG17) versus PG17 modified and IR Black

- For any given L^* value the IR pigments blend has an advantage in TSR
- Dark green colors at much higher TSRs



Mid-Gray TSR Improvement

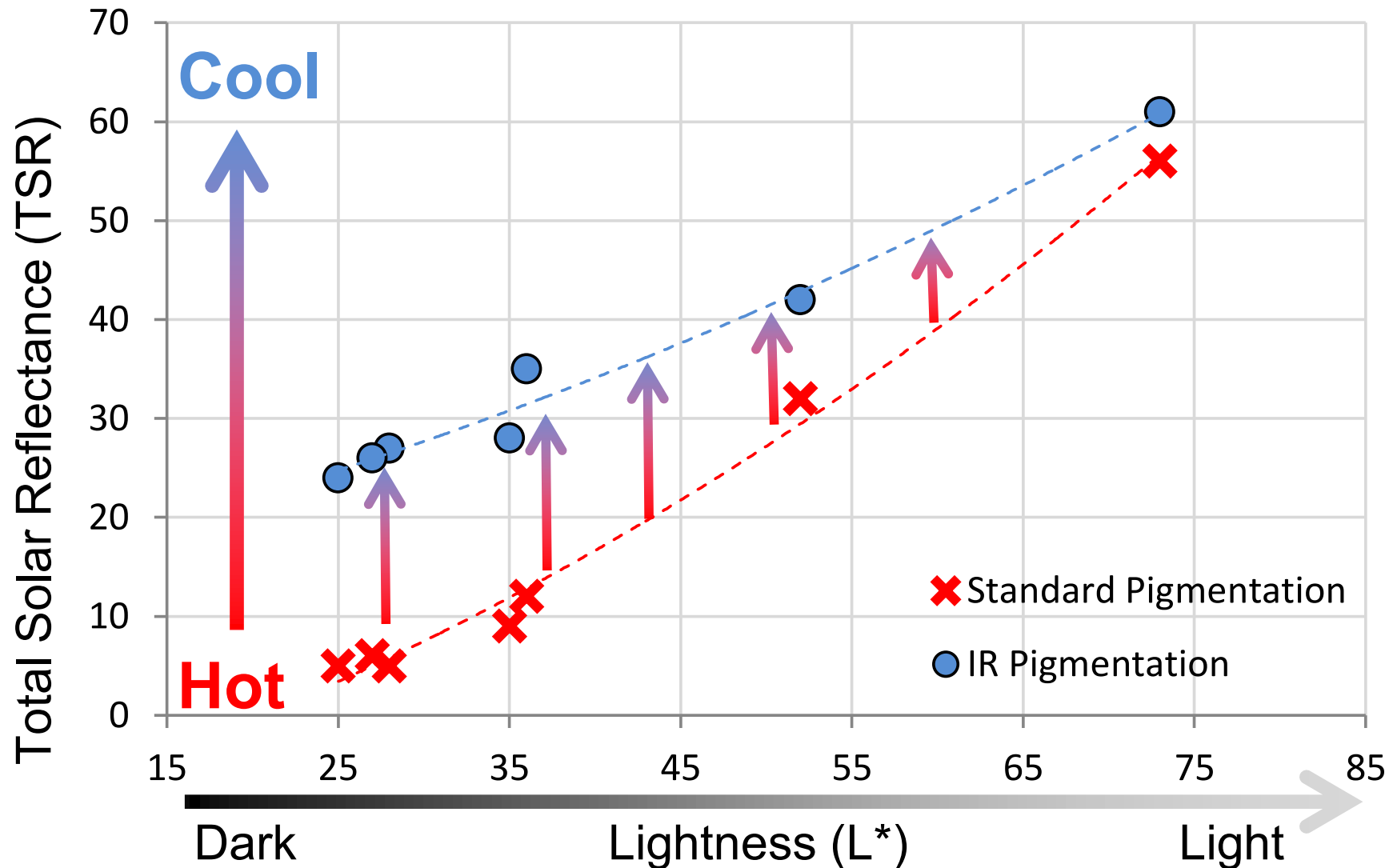


Total Solar
Reflectance
Standard 19 → IR Match 41

22 TSR
Improvement!!!

Pigment	Formula Percent
PG17 Modified	60.00
Titanium Dioxide, TiO ₂	32.00
Red Iron Oxide, Fe ₂ O ₃	4.00
PBr24	4.00
TOTAL	100.00

Color Palette Reformulation



Customer had to switch from standard to Cool coatings.

- Wide range of colors
- Dark to light shades
- Reformulate with IR Reflective pigments
- Consistent increase in TSR

Key to successful cool formulations

- Start with the right pigments (up to 20%)
 - Masstone
 - Tint
- Pigment IR compatibility (loss of 10%)
- Good dispersion properties (+/- 1% to -20%)
 - Don't contaminate with non-cool (carbon black!) pigments
- Remember visual vs IR opacity (substrate effect) (1-2%)
- Optimization (neutral to -1%)
 - Tweak dark masstones with organics
 - Use large PSD TiO₂s for ultimate
- Claims related to reflectance and “up to...”
 - Can't verify exact energy savings
- Verify measurement method and requirements/approvals

Opportunities for cool material

- PVC profiles and laminates
 - Windows
 - Doors
 - Decking
 - Fencing
- Coil and extrusion
- Architectural coatings
 - Stucco
 - Brick
 - Existing buildings that are difficult to insulate
- Road and parking structure coatings



The Shepherd Color Company®
We Brighten Lives

Thanks!

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