steel CONNECT

BlueScope

HOW TO SCORE GREEN BUILDING POINTS FOR METAL ROOF SYSTEMS

WHAT ARE GREEN BUILDINGS?

Source: https://www.trendhunter.com/trends/sustainable-building-design

MUST IT BE GREEN?

Source: https://www.trendhunter.com/trends/sustainable-building-design

WHAT IS A SUSTAINABLE BUILDING DESIGN?

Source: BlueScope

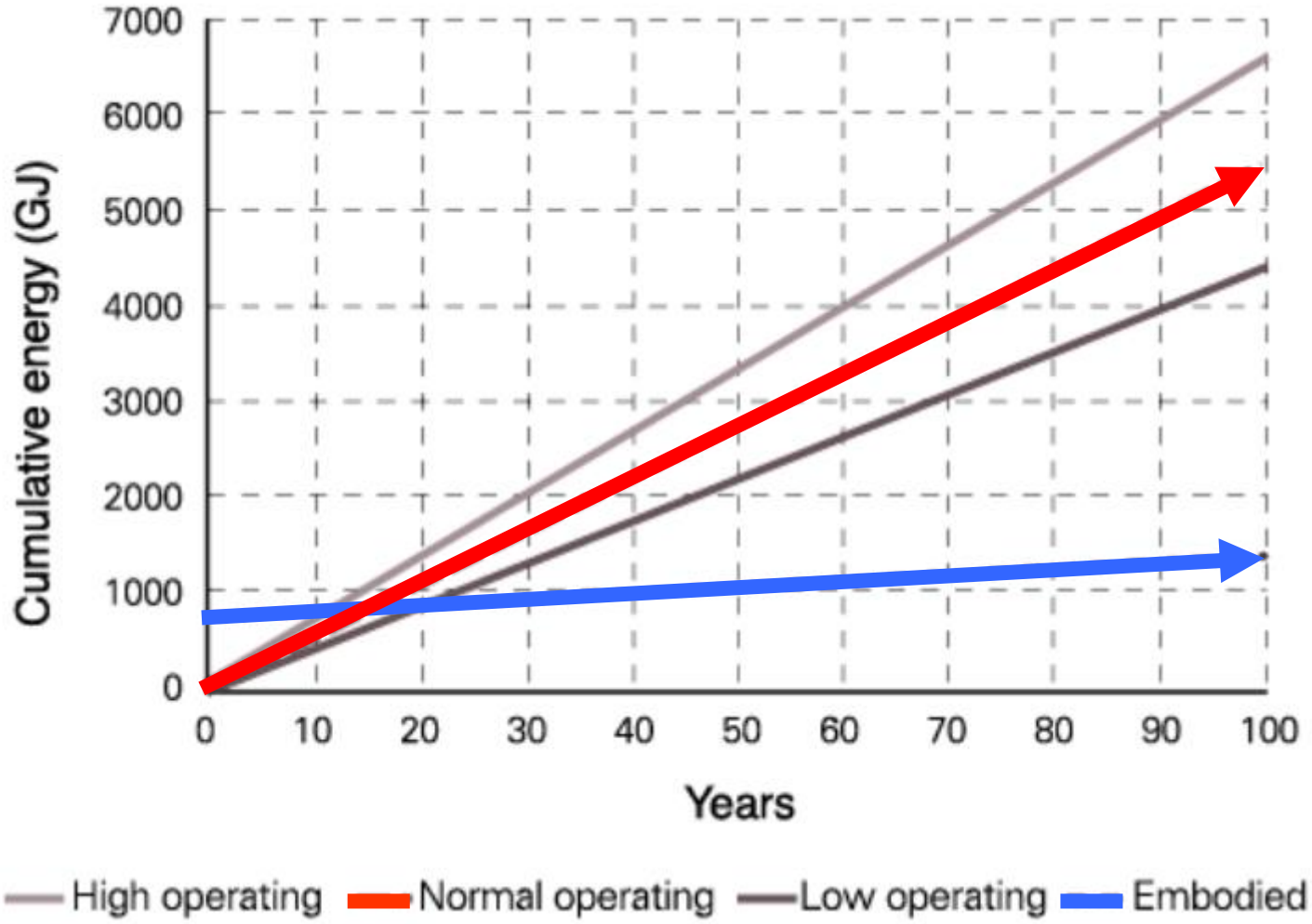
GREEN BUILDING RATING TOOLS

GREEN BUILDING PRODUCTS & DESIGNS

Source: https://www.greenbiz.com/article/7-steps-get-your-piece-green-building-market

GREEN BUILDING PRODUCTS CERTIFICATIONS

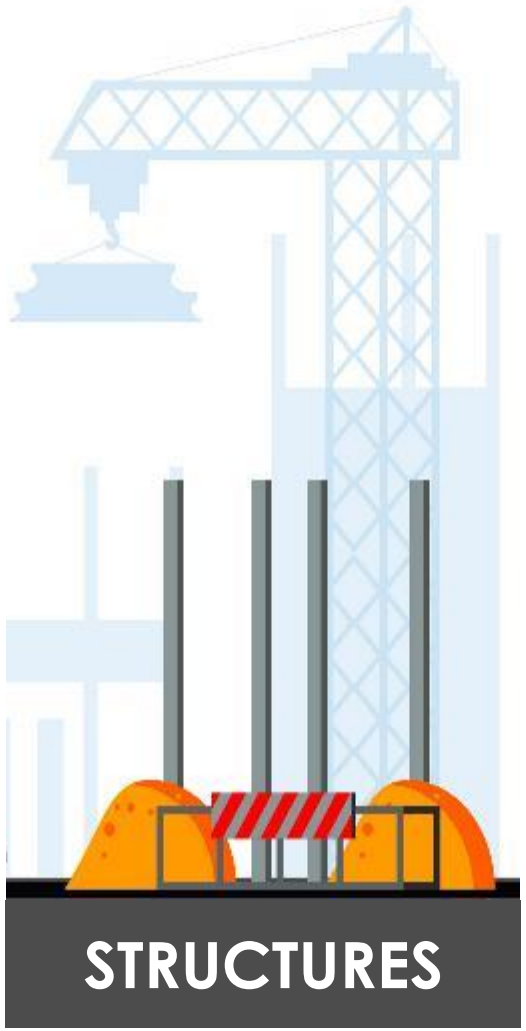
Source:



EMBODIED ENERGY VS OPERATIONAL ENERGY

Source: Adams, Connor and Ochsendorf 2006

ENERGY USED TO EXCAVATE THE SITE



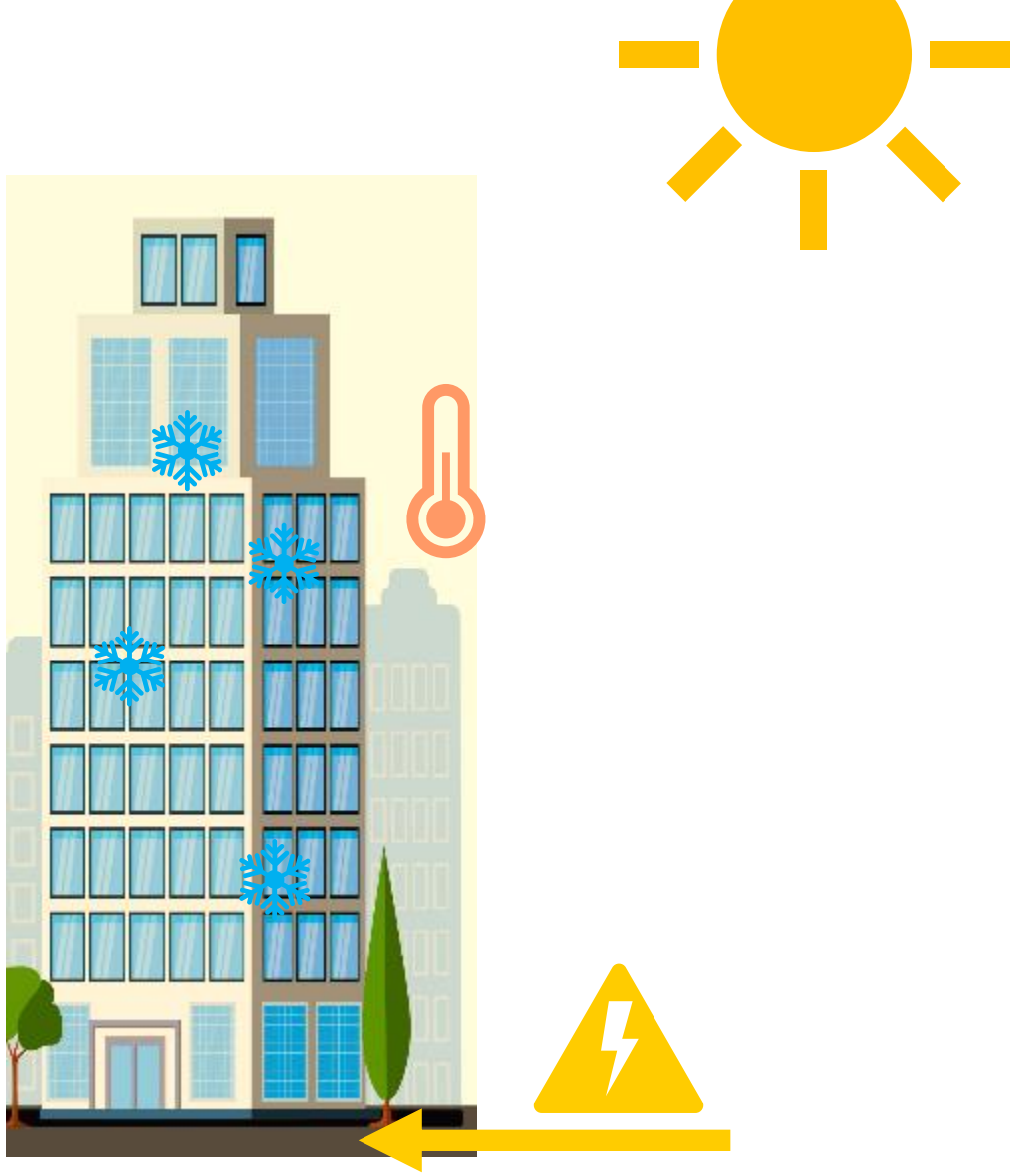
ENERGY USED TO BUILD THE STRUCTURES

BUILDING COMPONENTS

ENERGY USED TO MANUFACTURE & TRANSPORT ALL THE BUILDING COMPONENTS

COMPLETION

UNTIL THE CONSTRUCTION IS COMPLETED

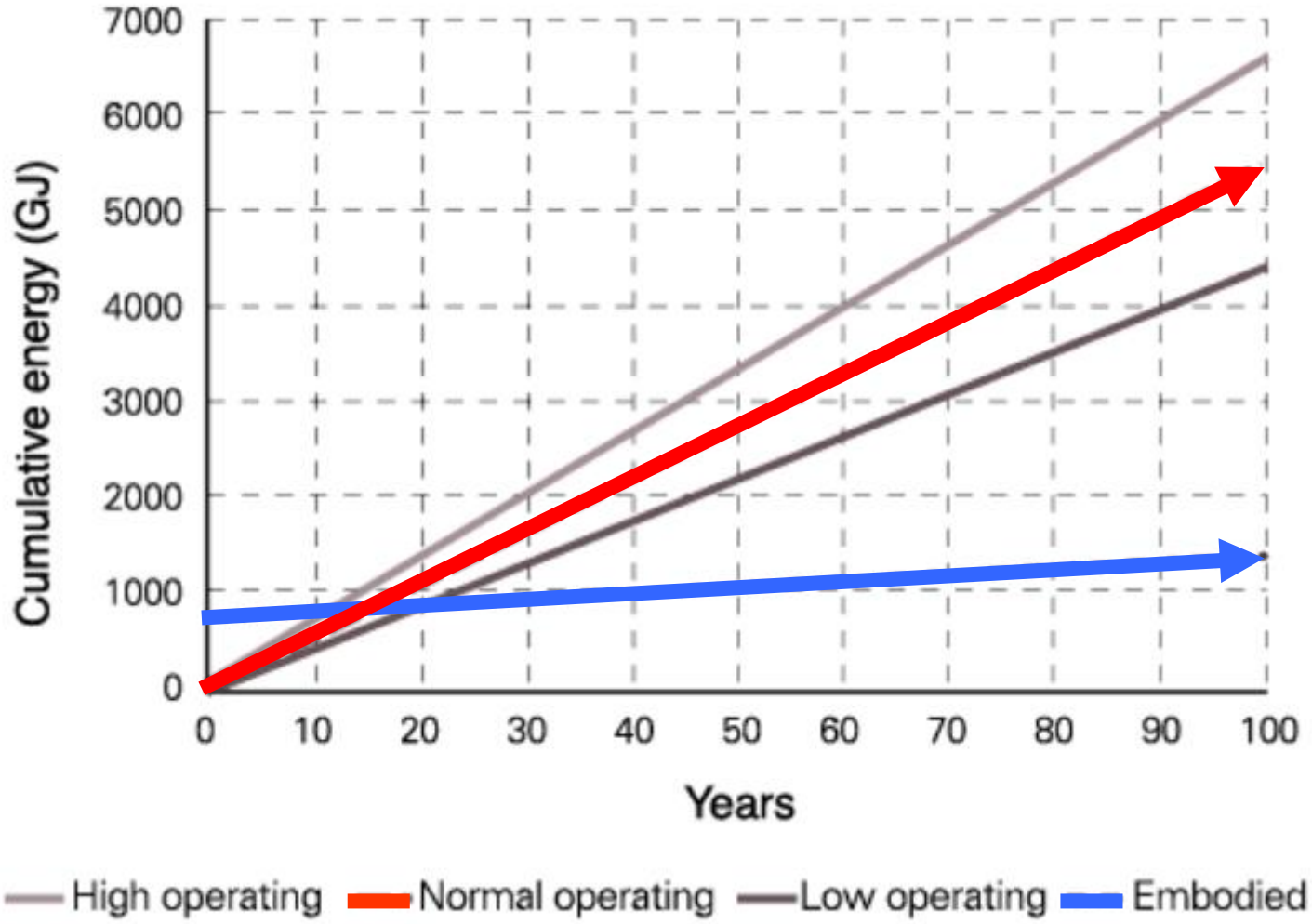


ENERGY USED TO OPERATE THE BUILDING

EMBODIED ENERGY:
- Energy used to manufacture each building material;
- Energy used to complete the construction.

OPERATIONAL ENERGY:
- Energy used during the whole lifespan of the building.

THESE ENERGIES CAN BE MEASURED AND CLASSIFIED INTO 2 TYPES



EMBODIED ENERGY & OPERATIONAL ENERGY

Source: https://www.yourhome.gov.au/materials/embodied-energy

1 RECYCLED CONTENT

Source: https://www.euractiv.com/section/sustainable-dev/news/study-recycling-scrap-steel-offers-environmental-and-competitive-benefits/

ACHIEVABLE POINTS FOR RECYCLED CONTENT

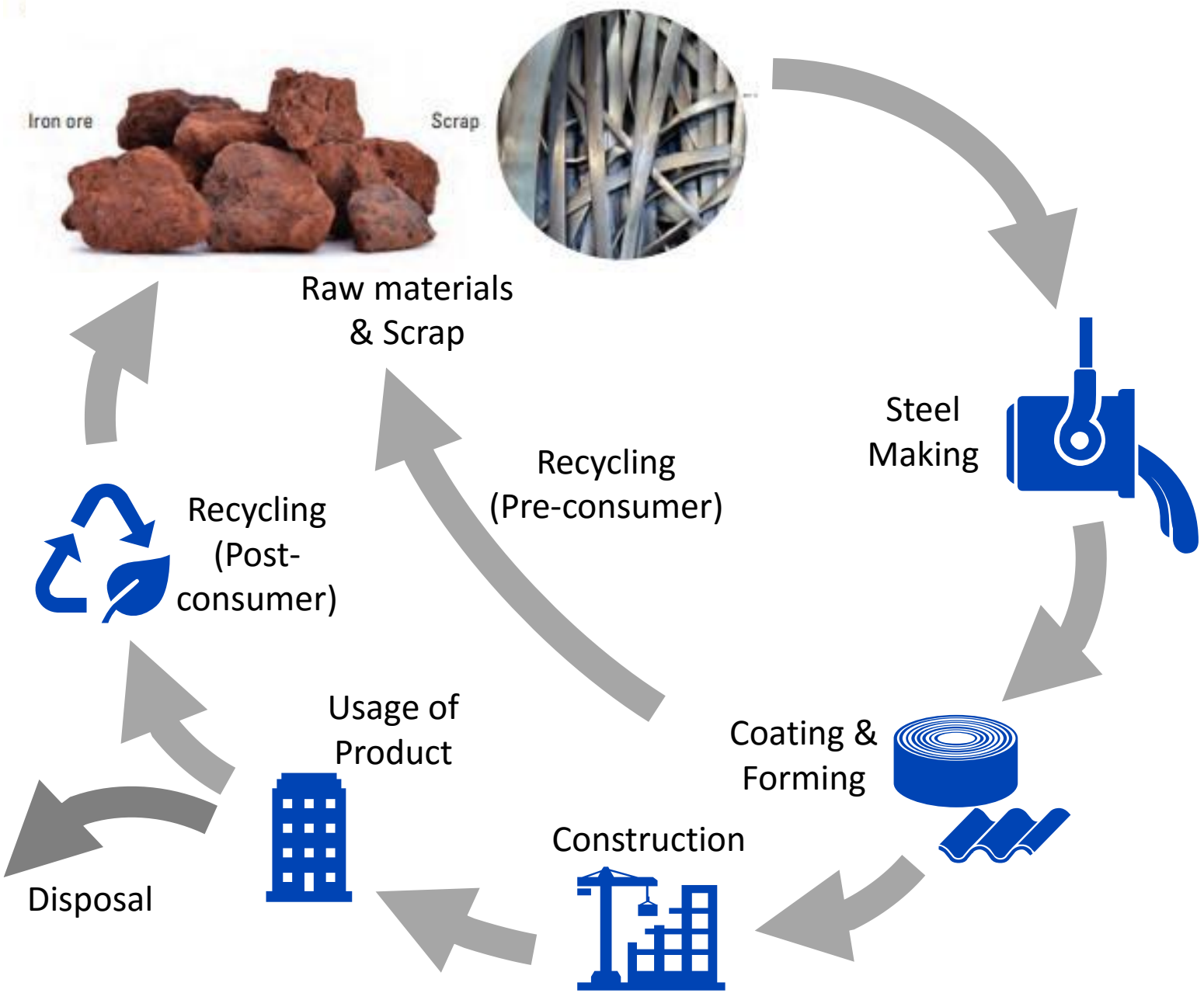
	POSSIBLE POINTS FOR METAL ROOF SYSTEMS
GBI (MY)	2
GreenRE (MY)	2
LEED (US)	1
Green Mark (SG)	2
Green Star (SA)	3

1 RECYCLED CONTENT

STEEL IS RECYCLABLE WITHOUT DEGRADATION

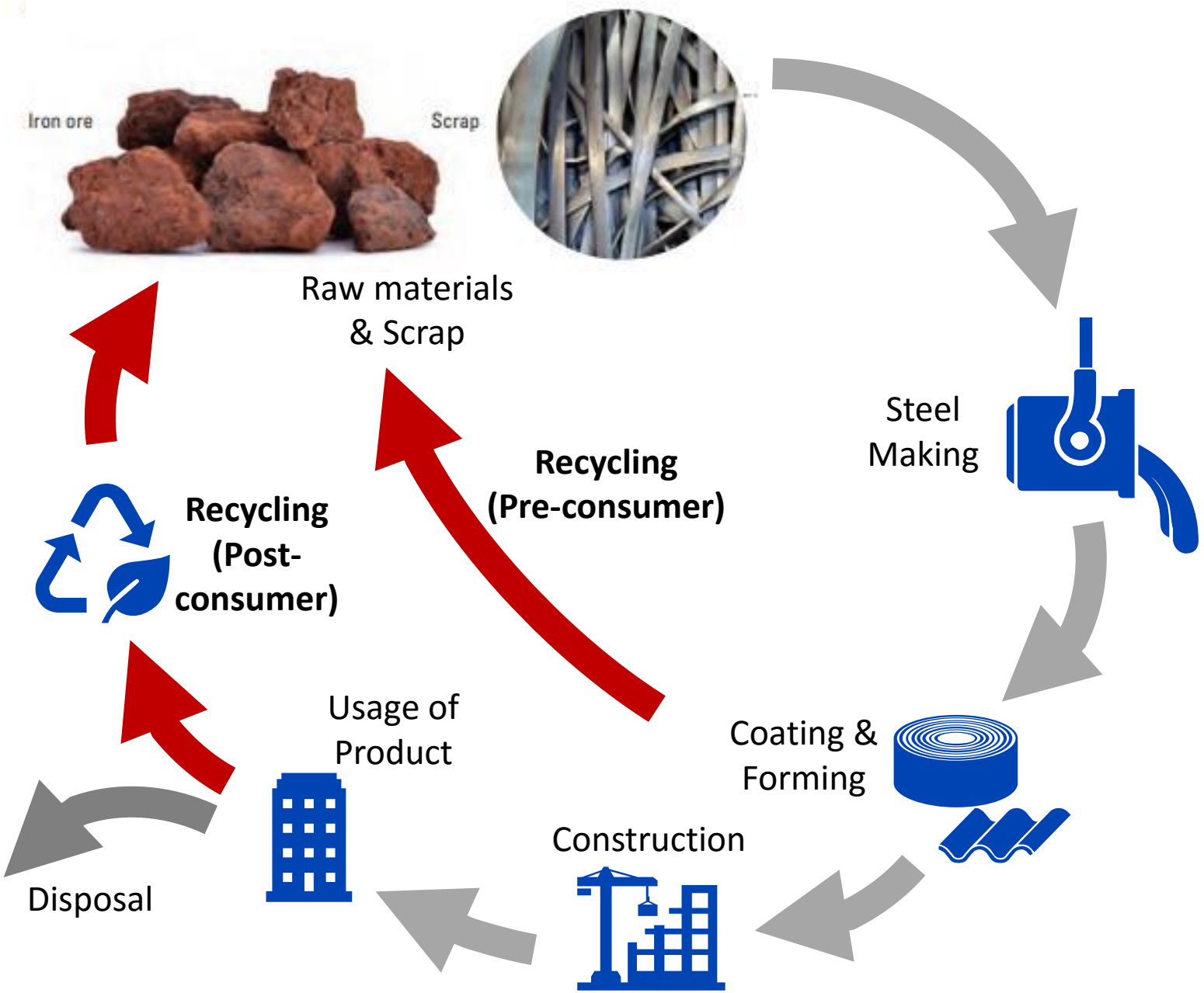
Source: https://cdn.dcs.bluescope.com.au/download/environmental-product-declaration-colorbond-steel

COMPLETE LIFE CYCLE OF STEEL



Source: https://cdn.dcs.bluescope.com.au/download/environmental-product-declaration-colorbond-steel

COMPLETE LIFE CYCLE OF STEEL



Source: https://cdn.dcs.bluescope.com.au/download/environmental-product-declaration-colorbond-steel

CALCULATING RECYCLED CONTENT

% POST-CONSUMER CONTENT

+

½ OF % PRE-CONSUMER CONTENT

=

% RECYCLED CONTENT

POST-CONSUMER CONTENT (5%)

PRE-CONSUMER CONTENT (10%)

RECYCLED CONTENT

RAW STEEL (FROM IRON ORE)

PRE-CONSUMER VS POST-CONSUMER CONTENT

CALCULATING RECYCLED CONTENT

5% POST-CONSUMER CONTENT

+

½ OF 10% PRE-CONSUMER CONTENT

=

??

CALCULATING RECYCLED CONTENT

5% POST-CONSUMER CONTENT

+

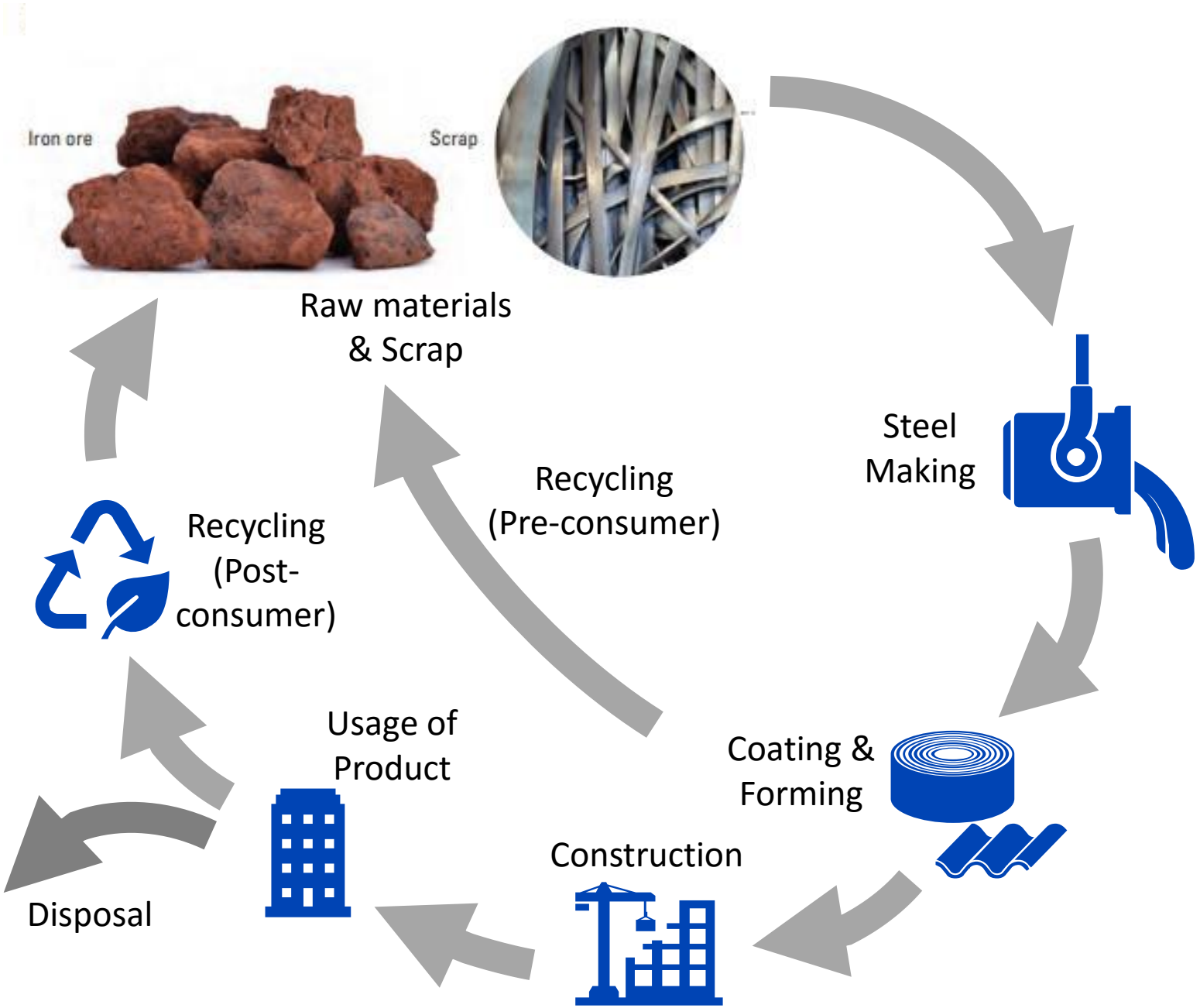
5% PRE-CONSUMER CONTENT

=

10% RECYCLED CONTENT

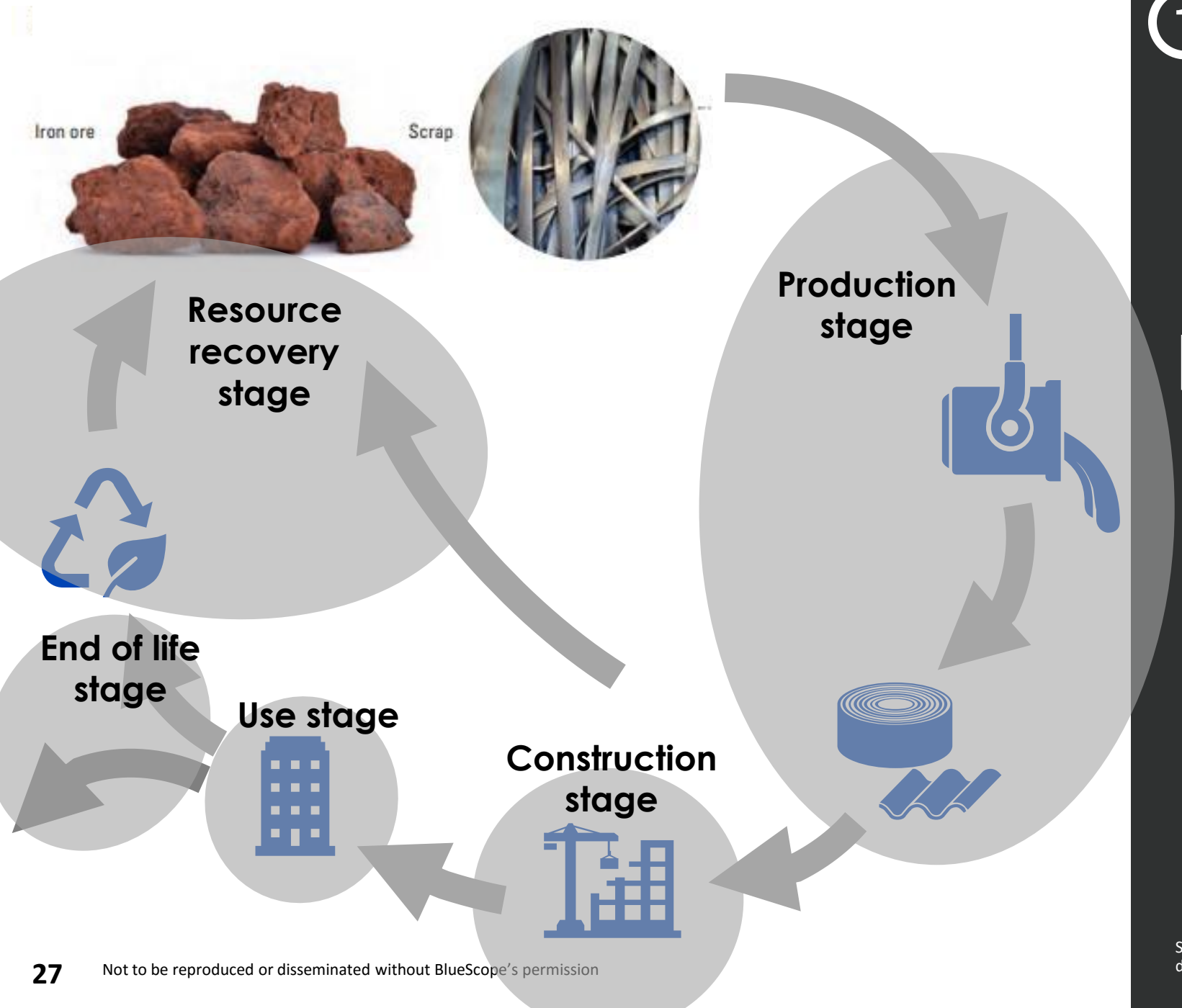
	REQUIREMENTS ON RECYCLED CONTENT
GBI (MY)	>10%
GreenRE (MY)	Green Product Cert.
LEED (US)	>25%
Green Mark (SG)	Green Product Cert.
Green Star (SA)	>54%

ACHIEVABLE POINTS FOR RECYCLED CONTENT



ENVIRONMENTAL PRODUCT DECLARATION (EPD)

Source: https://cdn.dcs.bluescope.com.au/download/environmental-product-declaration-colorbond-steel



1 RECYCLED CONTENT

ENVIRONMENTAL PRODUCT DECLARATION (EPD)

Source: https://cdn.dcs.bluescope.com.au/download/environmental-product-declaration-colorbond-steel

Table 1. Scope of Declaration in EPD

Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
Raw materials	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse – recovery – recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	X	X

X = Module declared; MND = Module Not Declared (such a declaration shall not be regarded as an indicator of a zero result).

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1 RECYCLED CONTENT

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Raw materials	Transport	Manufacturing		Maintenance							De-construction demolition	Transport	Waste processing	Disposal	Reuse – recovery – recycling potential
A1	A2	A3		B2							C1	C2	C3	C4	D
X	X	X		MND							MND	MND	X	X	X

X = Module declared; MND = Module Not Declared (such a declaration shall not be regarded as an indicator of a zero result).

1 RECYCLED CONTENT

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A1	A2	A3		B2							C1	C2	C3	C4	D
X	X	X		MND							MND	MND	X	X	X

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1 RECYCLED CONTENT

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X	X	X		MND							MND	MND	X	X	X

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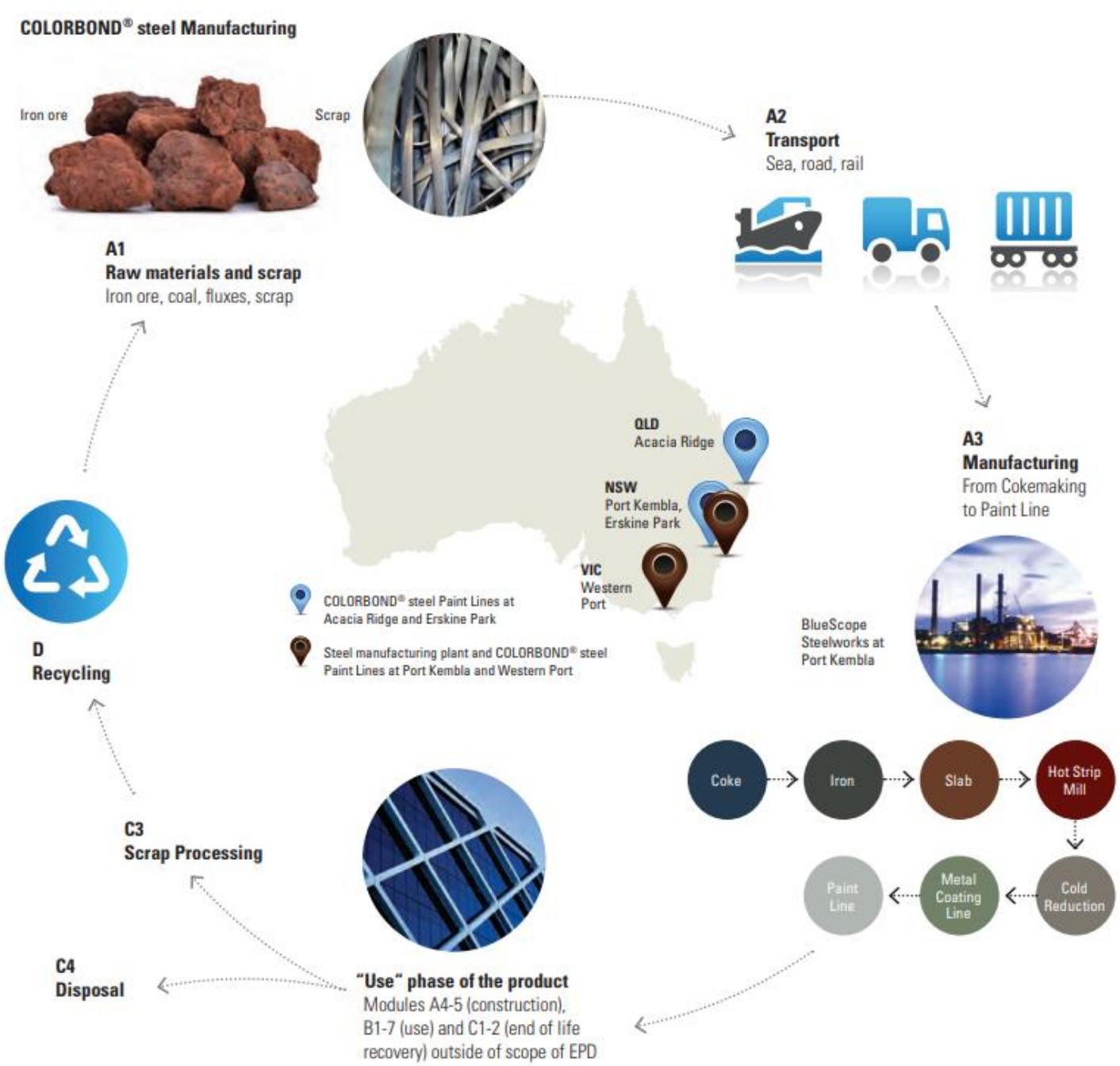
1 RECYCLED CONTENT

ENVIRONMENTAL PRODUCT DECLARATION (EPD)

Source: https://cdn.dcs.bluescope.com.au/download/environmental-product-declaration-colorbond-steel



1 RECYCLED CONTENT

GAIN MORE HOLISTIC VIEW OF PRODUCT LIFECYCLE

Source: https://cdn.dcs.bluescope.com.au/download/environmental-product-declaration-colorbond-steel

Base Metal (Steel) Thickness (BMT)		0.42mm			
Declared Unit		1m²			
EN 15804 INDICATORS	**units**	**A1-A3**	**C3**	**C4**	**D**
Global warming potential	kg CO_2-eq.	11.4	0.131	0.0182	-3.72
Depletion potential of the stratospheric ozone layer	kg CFC11-eq.	1.18E-11	6.92E-16	4.83E-15	2.27E-08
Acidification potential of land and water	kg SO_2-eq.	0.0350	5.60E-04	5.07E-05	-0.00355
Eutrophication potential	kg PO_4^3-eq.	0.00365	4.79E-05	6.38E-06	-0.000125
Photochemical ozone creation potential	kg C_2H_4-eq.	0.00580	2.98E-05	4.56E-06	-0.00167
Abiotic depletion potential for non fossil resources	kg Sb-eq.	2.99E-05	1.44E-08	1.97E-09	-3.52E-06
Abiotic depletion potential for fossil resources	MJ	131	1.51	0.264	-37.3

LIFE CYCLE IMPACT ASSESSMENT INDICATORS

Source: https://cdn.dcs.bluescope.com.au/download/environmental-product-declaration-colorbond-steel

Base Metal (Steel) Thickness (BMT)		0.42mm			
Declared Unit		1m²			
EN 15804 INDICATORS	units	A1-A3	C3	C4	D
Renewable primary energy as energy carrier	MJ	5.40	0.219	0.0203	2.67
Renewable primary energy resources as material utilisation	MJ	0	0	0	0
Total use of renewable primary energy resources	MJ	5.40	0.219	0.0203	2.67
Non-renewable primary energy as energy carrier	MJ	132	1.51	0.274	-35.8
Non-renewable primary energy as material utilisation	MJ	0.00226	0	0	0
Total use of non-renewable primary energy resources	MJ	132	1.51	0.274	-35.8
Use of secondary material	kg	0.402	0	0	0
Use of renewable secondary fuels	MJ	0	0	0	0
Use of non-renewable secondary fuels	MJ	0.00109	0	1.82E-23	5.55E-23
Use of net fresh water	m^3	0.0222	0.000808	2.90E-05	0.00597

RESOURCE INDICATORS

Source: https://cdn.dcs.bluescope.com.au/download/environmental-product-declaration-colorbond-steel

Base Metal (Steel) Thickness (BMT)		0.42mm			
Declared Unit		1m²			
EN 15804 INDICATORS	units	A1-A3	C3	C4	D
Hazardous waste disposed	kg	2.73E-07	2.77E-10	1.46E-09	-2.65E-06
Non hazardous waste disposed	kg	0.218	0.000428	0.382	0.519
Radioactive waste disposed	kg	6.55E-04	2.55E-07	3.82E-06	5.83E-06
Components for re-use	kg	0	0	0	0
Materials for recycling	kg	0	2.68	0	0
Materials for energy recovery	kg	0	0	0	0
Exported electrical energy	MJ	0	0	0	0
Exported thermal energy	MJ	0	0	0	0

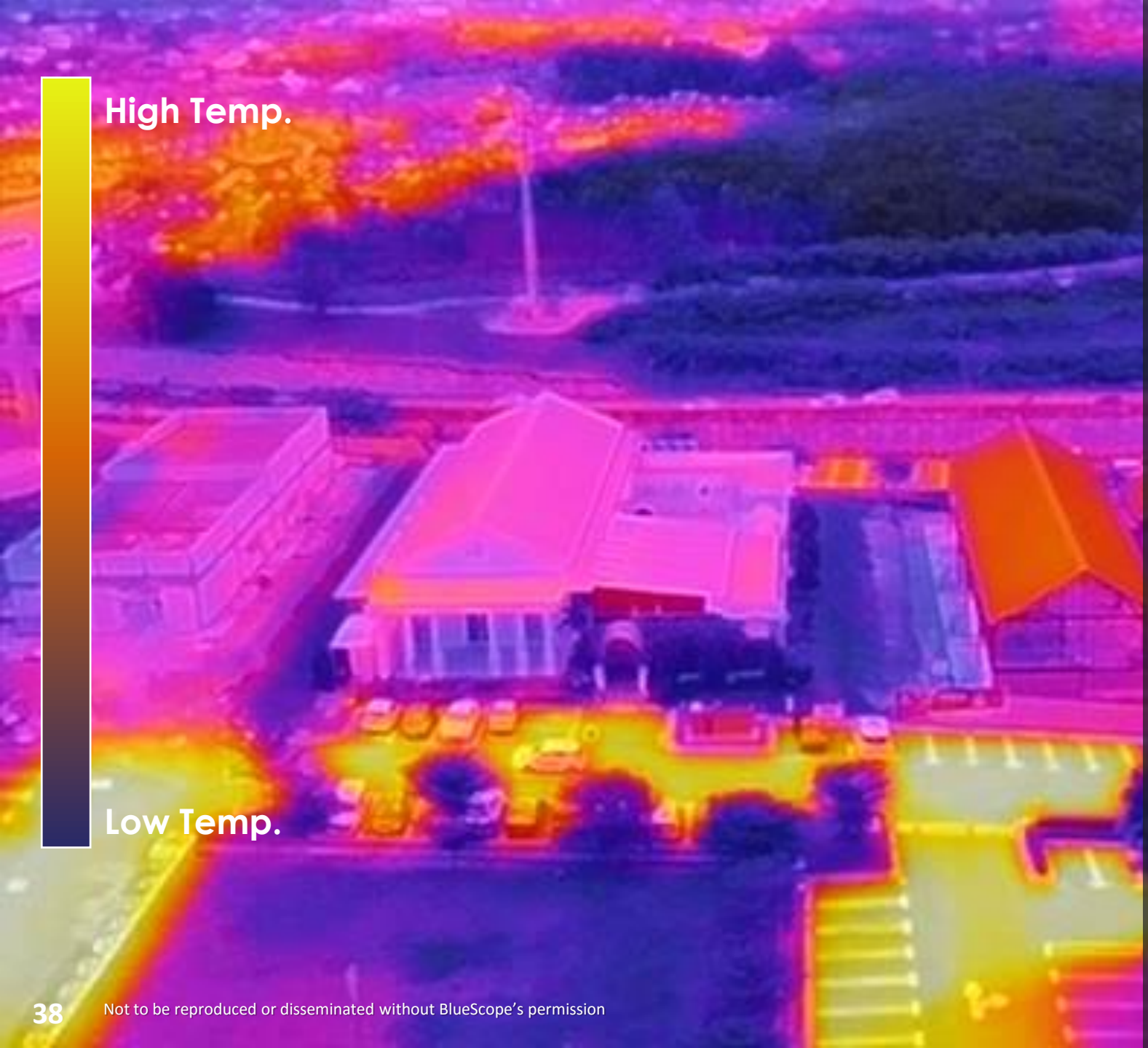
WASTE & OTHER OUTPUTS

Source: https://cdn.dcs.bluescope.com.au/download/environmental-product-declaration-colorbond-steel

② SOLAR REFLECTANCE INDEX (SRI)

	POSSIBLE POINTS FOR METAL ROOF SYSTEMS
GBI (MY)	2
GreenRE (MY)	3
LEED (US)	2
Green Mark (SG)	2
Green Star (SA)	2

ACHIEVABLE POINTS FOR SRI VALUE



URBAN HEAT ISLAND EFFECT (UHI)

Source: BlueScope

CONDUCTION, CONVECTION & RADIATION

Source: Photo by Lukas from Pexels

② SOLAR REFLECTANCE INDEX (SRI)

RADIATION

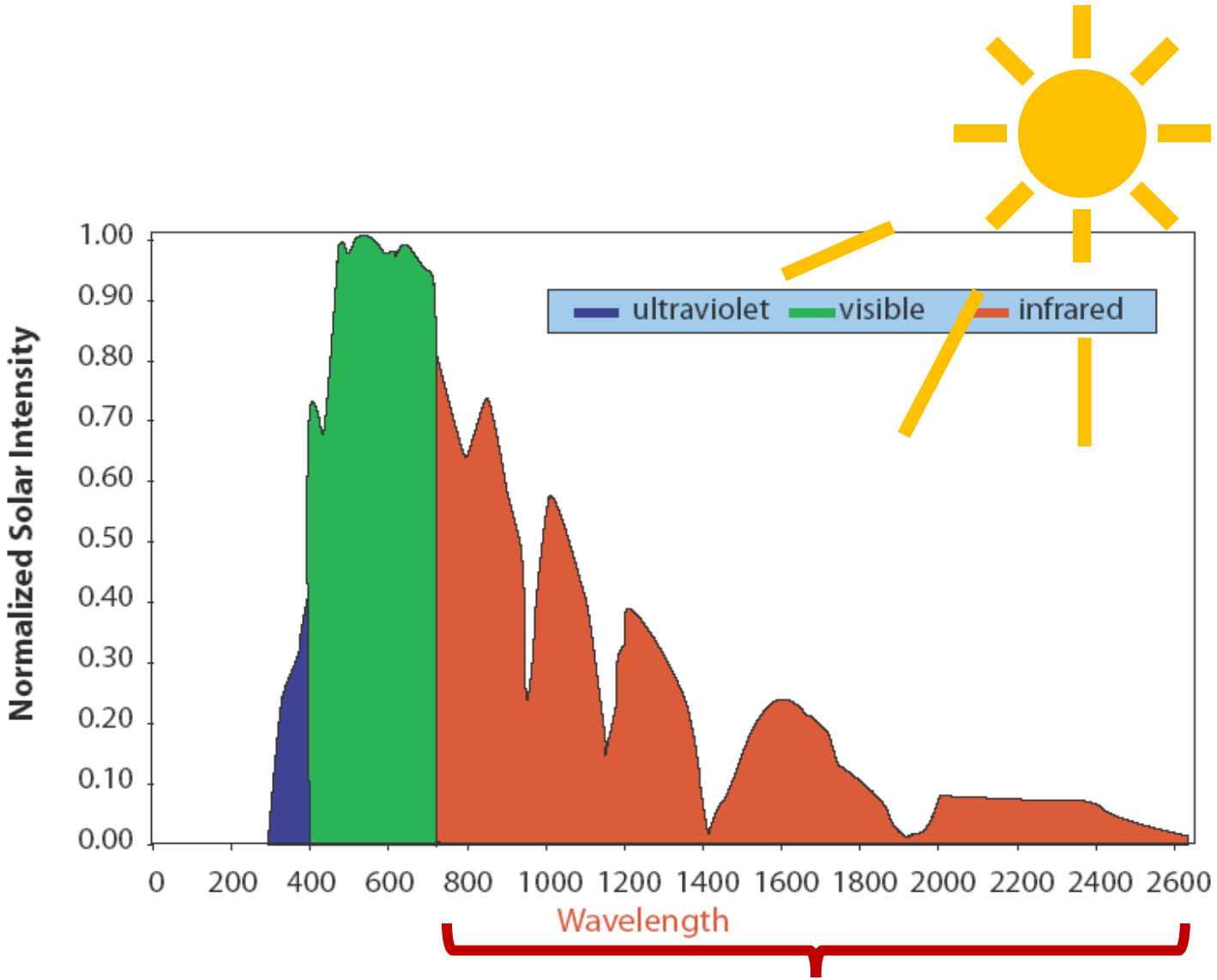
Source: Photo by Lukas from Pexels

CONDUCTION

Source: Photo by Lukas from Pexels

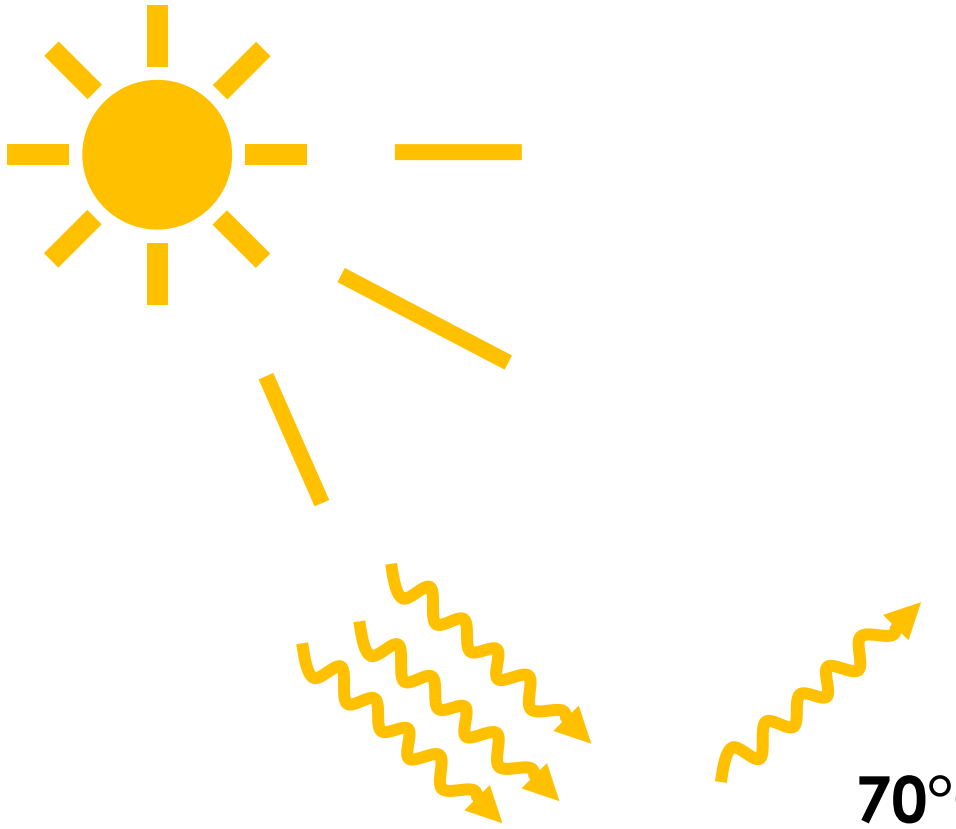
CONVECTION

Source: Photo by Lukas from Pexels



NEAR INFRARED (NOT VISIBLE)

SOLAR ENERGY



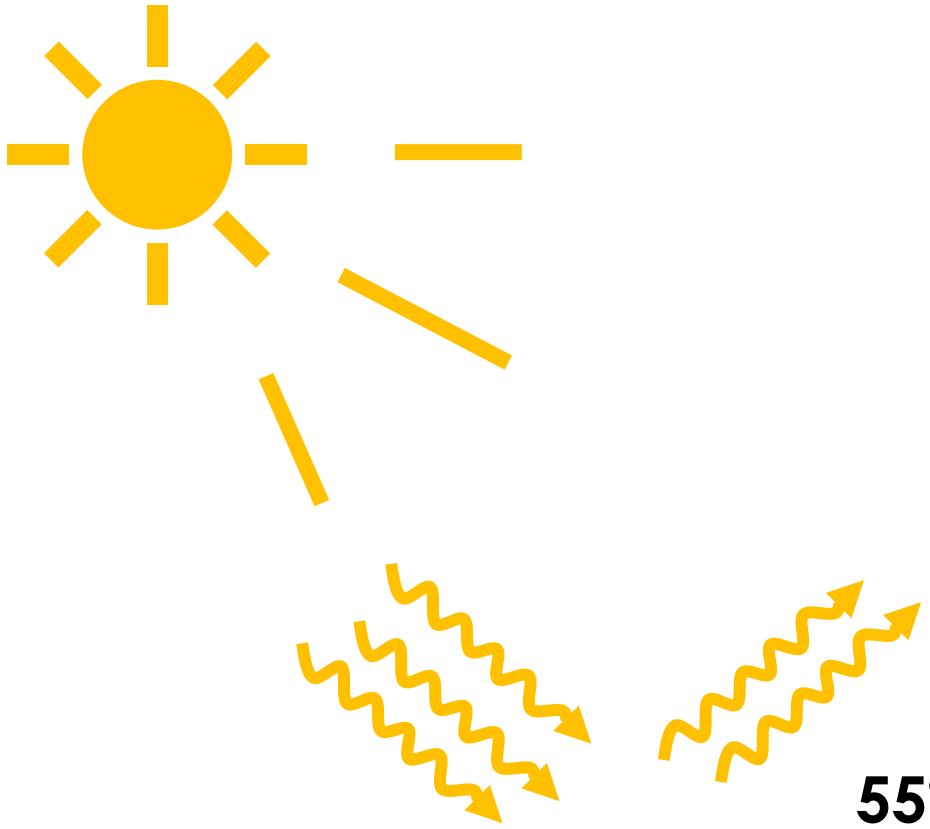
ROOFING SHEET (BLACK)

② SOLAR REFLECTANCE INDEX (SRI)

SOLAR REFLECTANCE

-

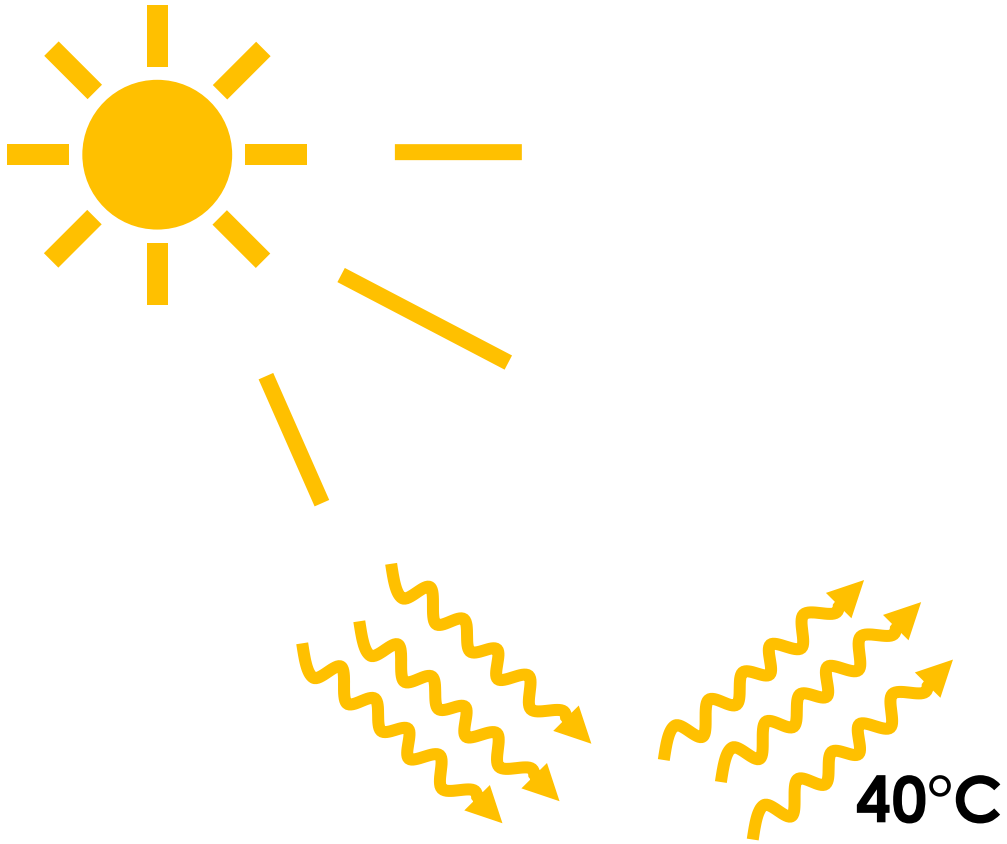
DEPENDS ON COLOUR AND PIGMENT



ROOFING SHEET (GREY)

② SOLAR REFLECTANCE INDEX (SRI)

SOLAR REFLECTANCE - DEPENDS ON COLOUR AND PIGMENT

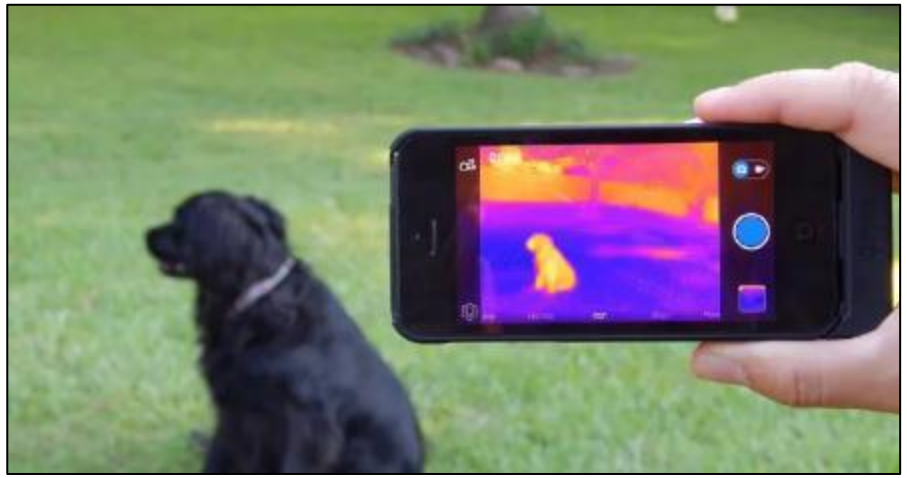


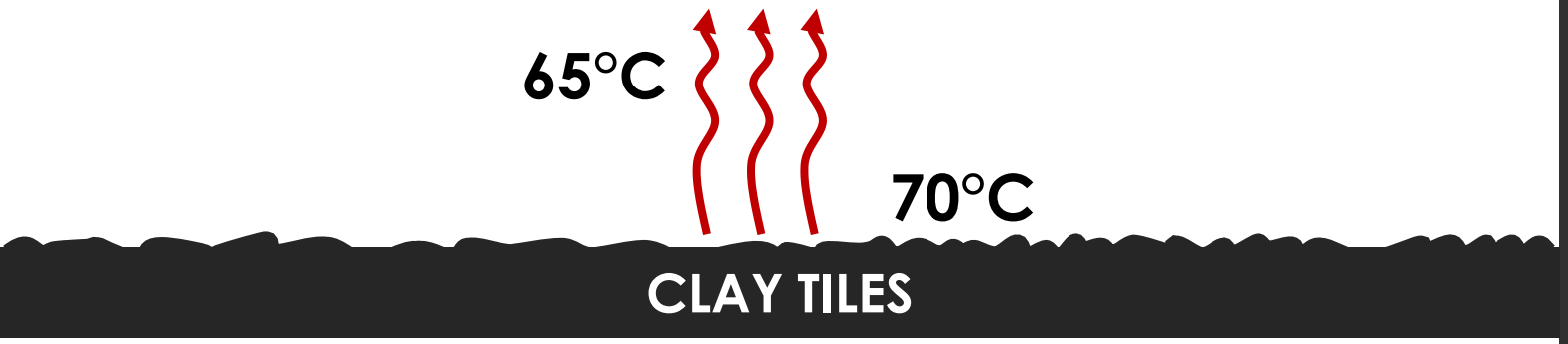
ROOFING SHEET (WHITE)

SOLAR REFLECTANCE

-

DEPENDS ON COLOUR AND PIGMENT



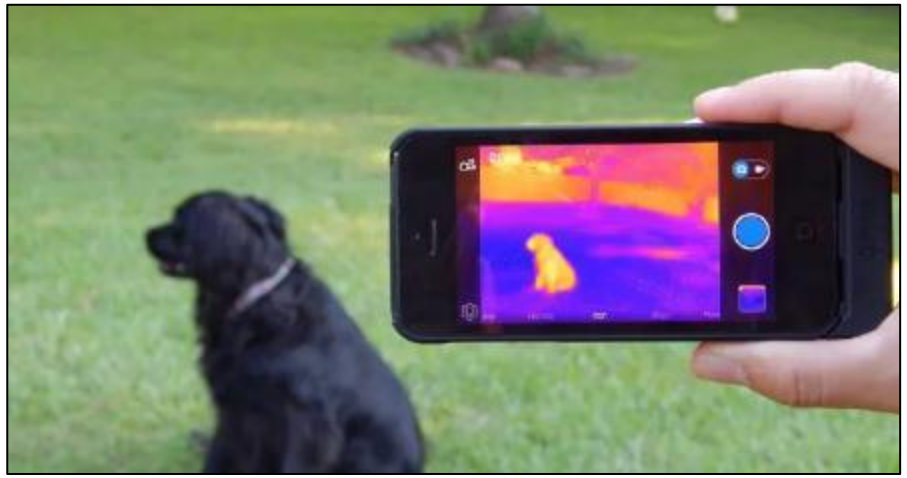


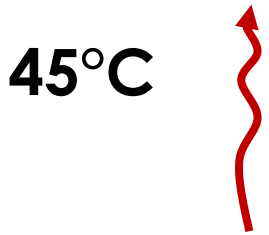
THERMAL EMITTANCE

-

DEPENDS ON MATERIAL AND SURFACE

Source: https://www.wired.com/2014/08/a-review-of-the-iphone-infrared-camera-the-flir-one/



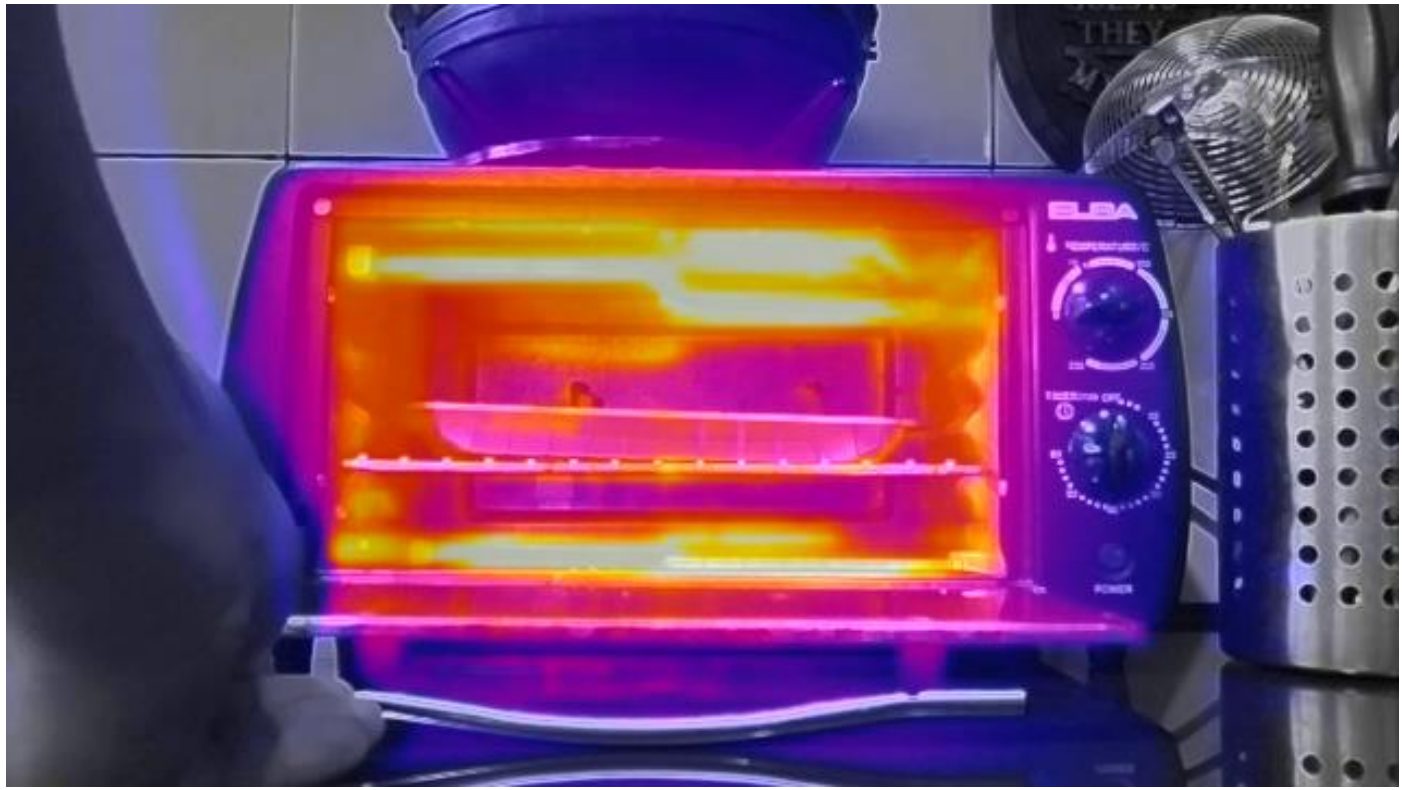


PREPAINTED STEEL

THERMAL EMITTANCE

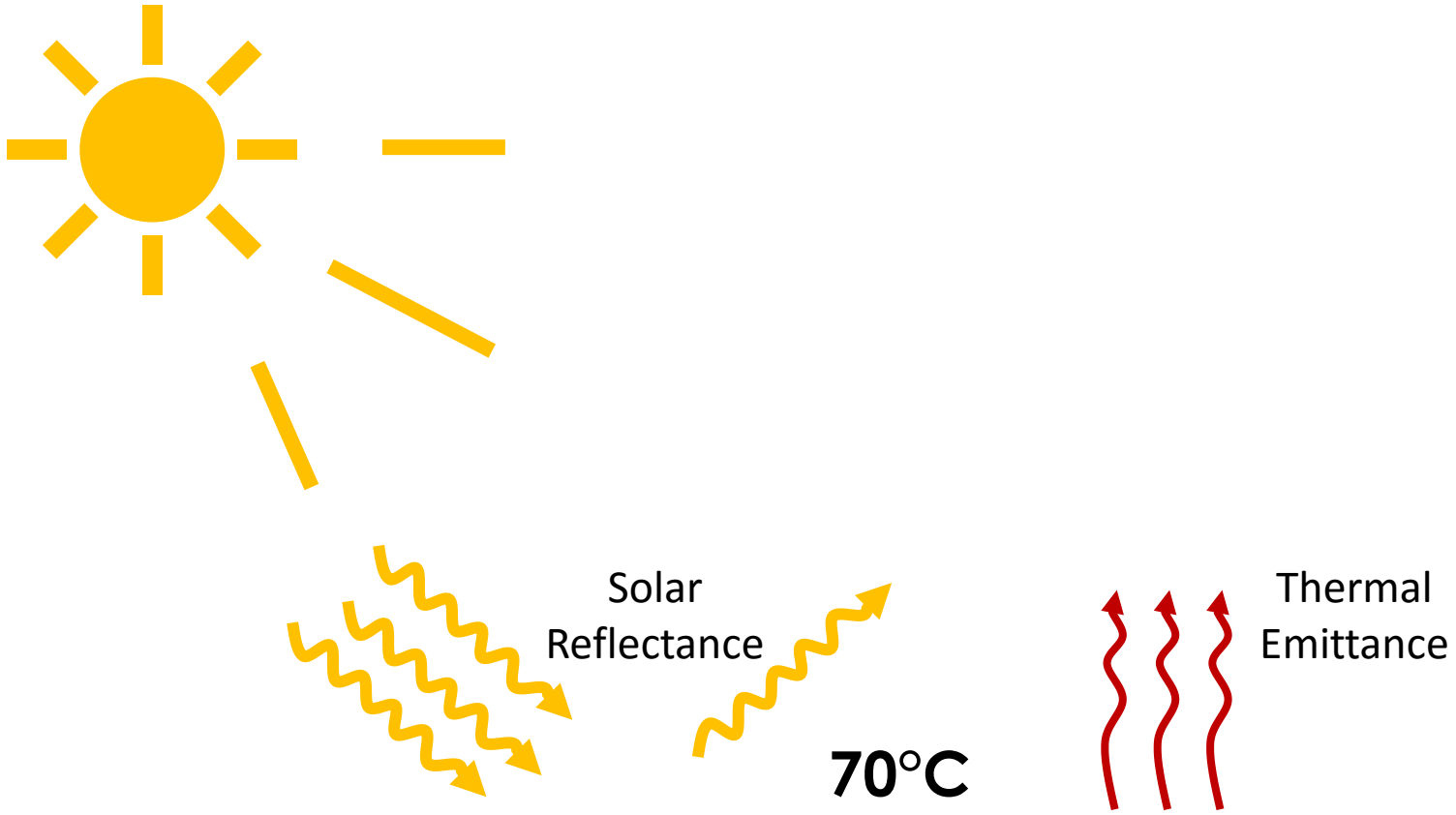
-

DEPENDS ON MATERIAL AND SURFACE



EXAMPLE OF THERMAL EMITTANCE

② SOLAR REFLECTANCE INDEX (SRI)



SRI CAN BE DETERMINED BY THESE 2 FACTORS

SOLAR REFLECTANCE INDEX (SRI)

HOW IS SRI VALUE CALCULATED?

Online solar reflectance index (SRI) calculator

Condition	Low-wind (0-2 m/s)	Medium-wind (2-6 m/s)	High-wind (6-10 m/s)
Black surface temperature	103.7 °C	82.5 °C	61.1 °C
White surface temperature	49.3 °C	44.6 °C	40.8 °C
Sample surface temperature	62.5 °C	53.1 °C	45.1 °C
Solar reflectance index (SRI)	**75.6**	**77.7**	**78.9**

Solar reflectance: 0.650

Emittance: 0.85

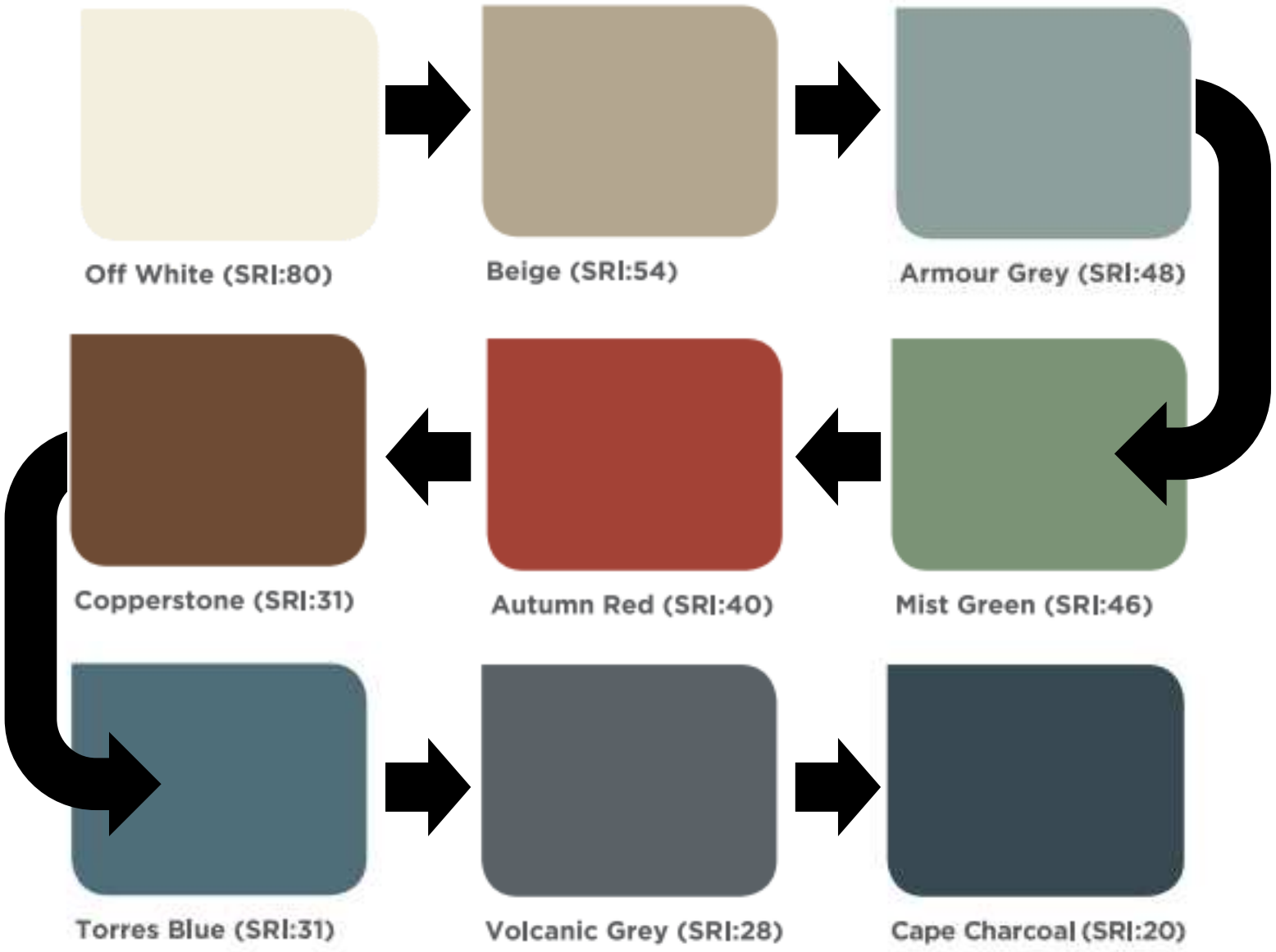
Solar absorptance: 0.350

Temperature unit: Celsius [°C]

Calculate SRI

Source: https://www.otm.sg/sri-calculator

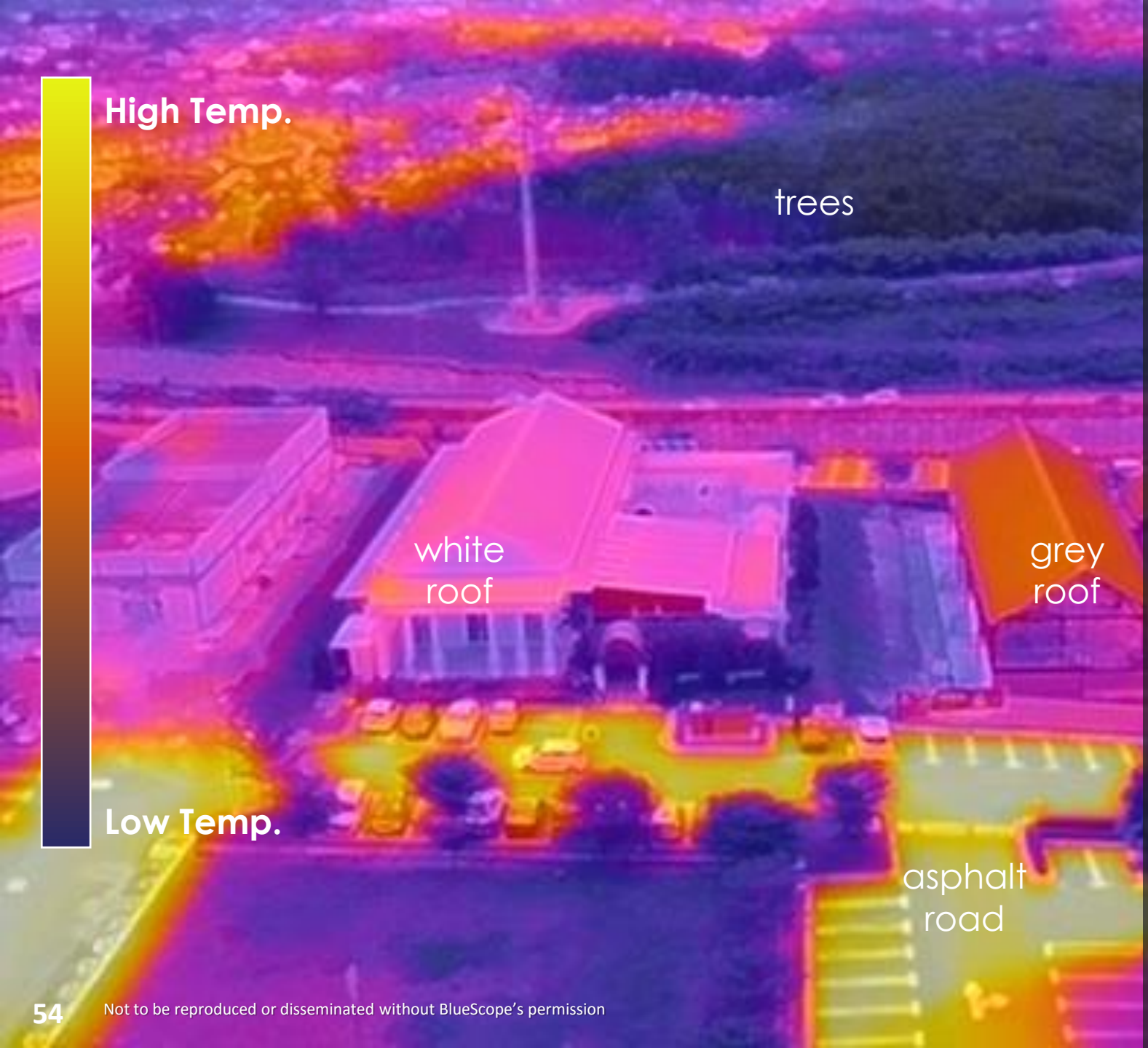
2 SOLAR REFLECTANCE INDEX (SRI)



LIGHTER COLOUR TYPICALLY MEANS HIGHER SRI VALUE

Source:

URBAN HEAT ISLAND EFFECT (UHI)



Source: BlueScope photo

2 SOLAR REFLECTANCE INDEX (SRI)

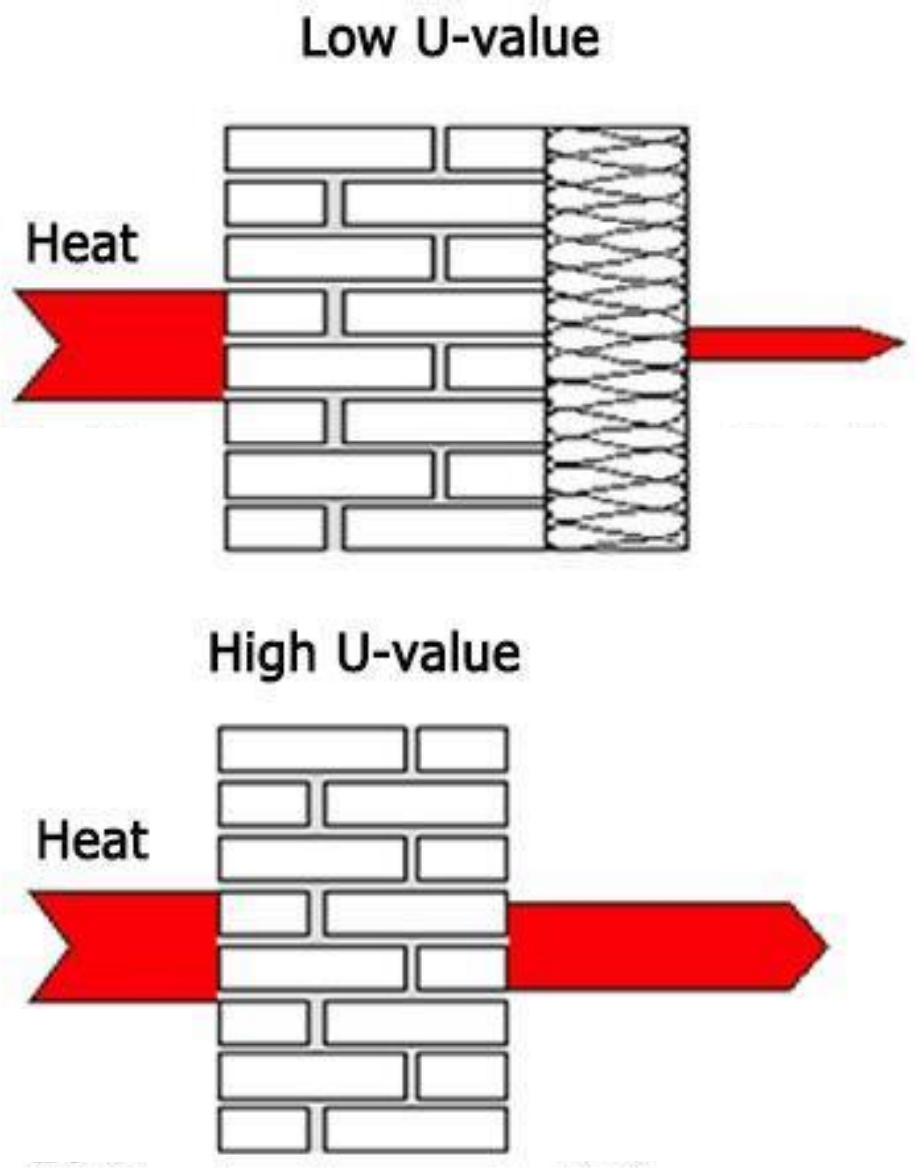
NON-CLEAN VS CLEAN

2 SOLAR REFLECTANCE INDEX (SRI)

INCREASED CLEANLINESS = HIGHER SRI

ACHIEVABLE POINTS FOR URBAN HEAT ISLAND REDUCTION

	REQUIREMENT ON UHI REDUCTION
GBI (MY)	SRI >78 for roof pitch ≤ 9.5° SRI >29 for roof pitch > 9.5°
GreenRE (MY)	SRI >29
LEED (US)	<u>Initial SRI</u> SRI >82 for roof pitch ≤ 9.5° SRI >39 for roof pitch > 9.5° <u>3-year aged SRI</u> SRI >64 for roof pitch ≤ 9.5° SRI >32 for roof pitch > 9.5°
Green Mark (SG)	“Cool paints”
Green Star (SA)	SRI >78 for roof pitch ≤ 10° SRI >29 for roof pitch > 10°



3 THERMAL TRANSMITTANCE (U-VALUE)

Source: https://id.pinterest.com/pin/189925309270976714/

	POSSIBLE POINTS FOR METAL ROOF SYSTEMS
GBI (MY)	10
GreenRE (MY)	4
LEED (US)	1
Green Mark (SG)	Prerequisite
Green Star (SA)	Prerequisite

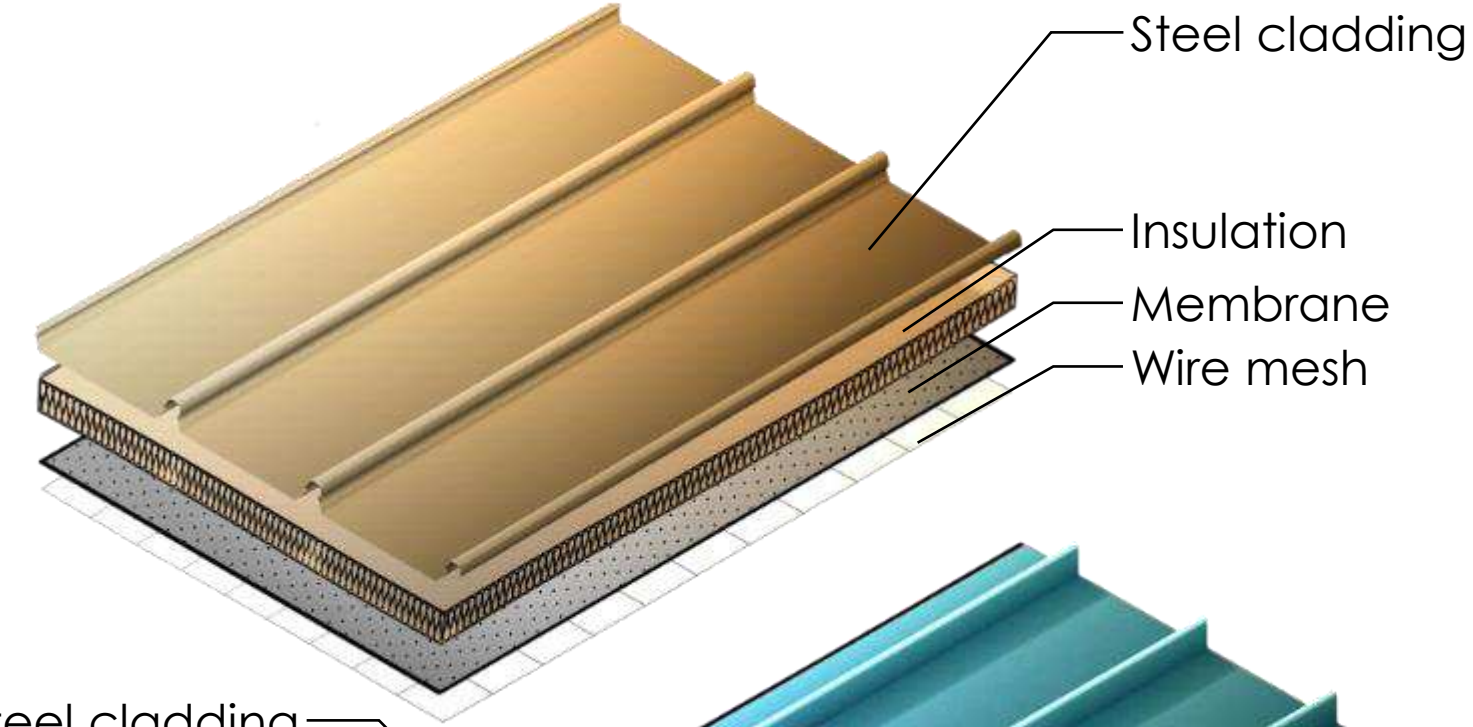
ACHIEVABLE POINTS FOR U-VALUE

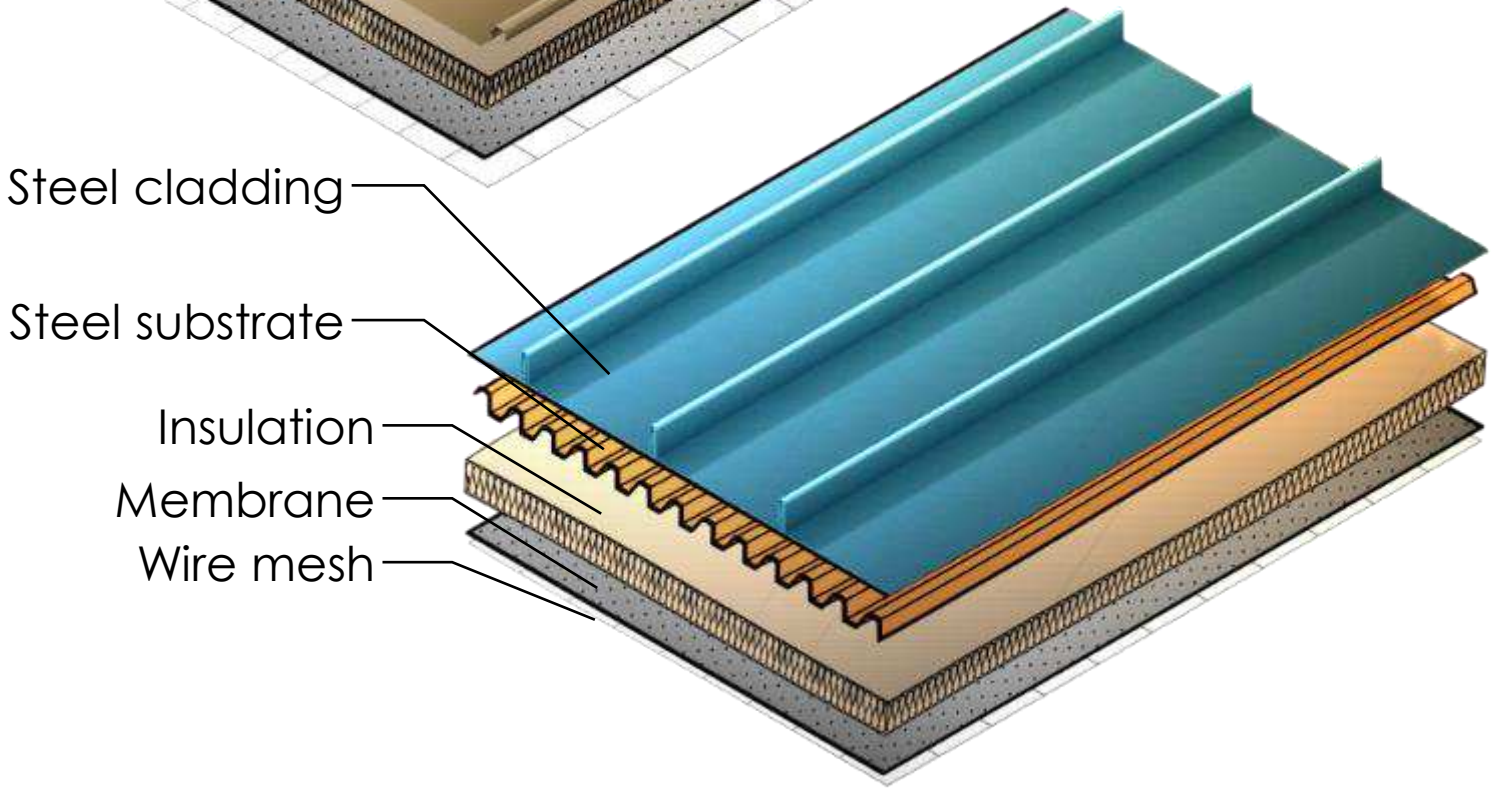
CONDUCTION

Source: Photo by Lukas from Pexels

APPLIES TO THE WHOLE BUILDING ENVELOPE

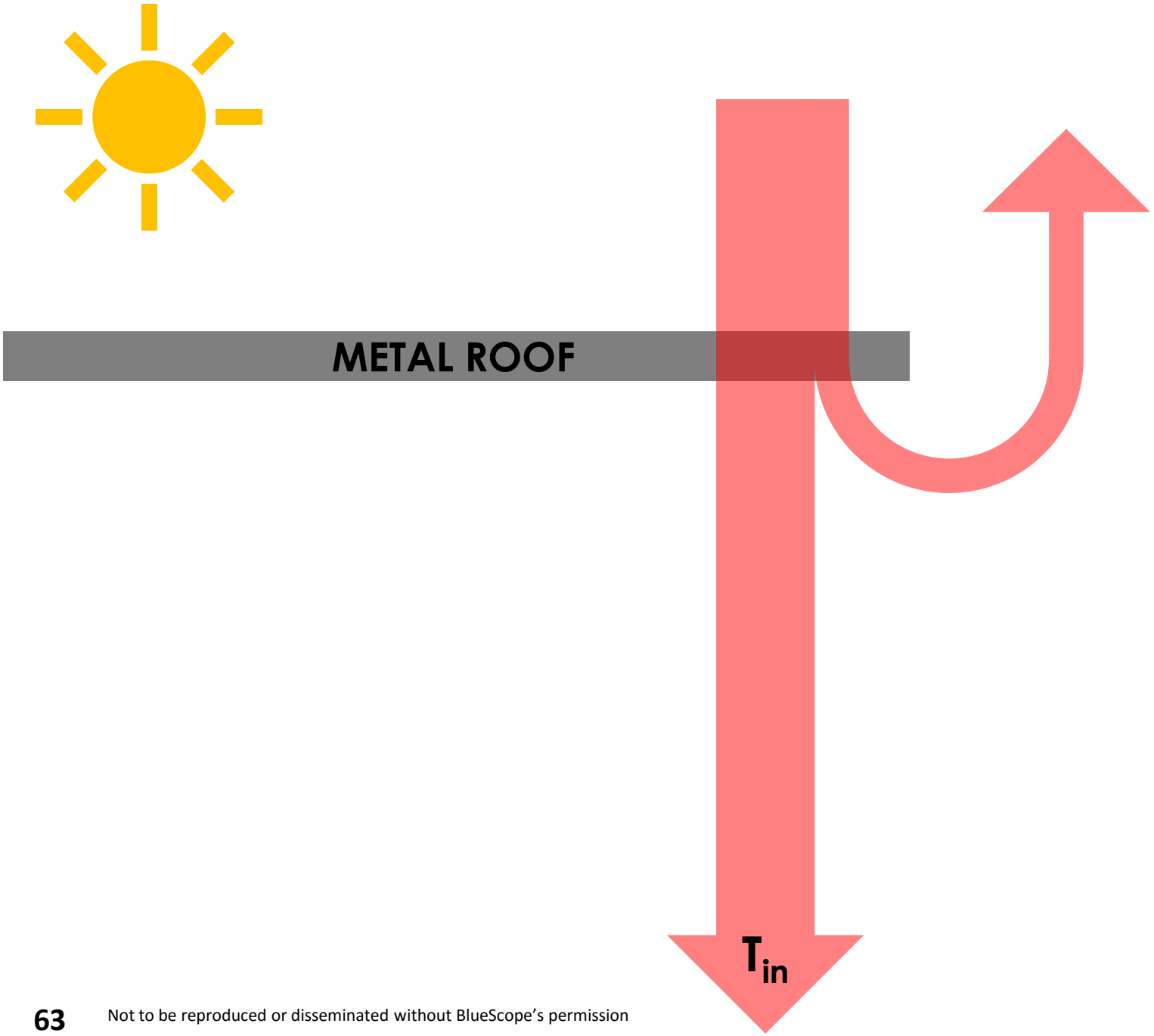
Source: BlueScope photo





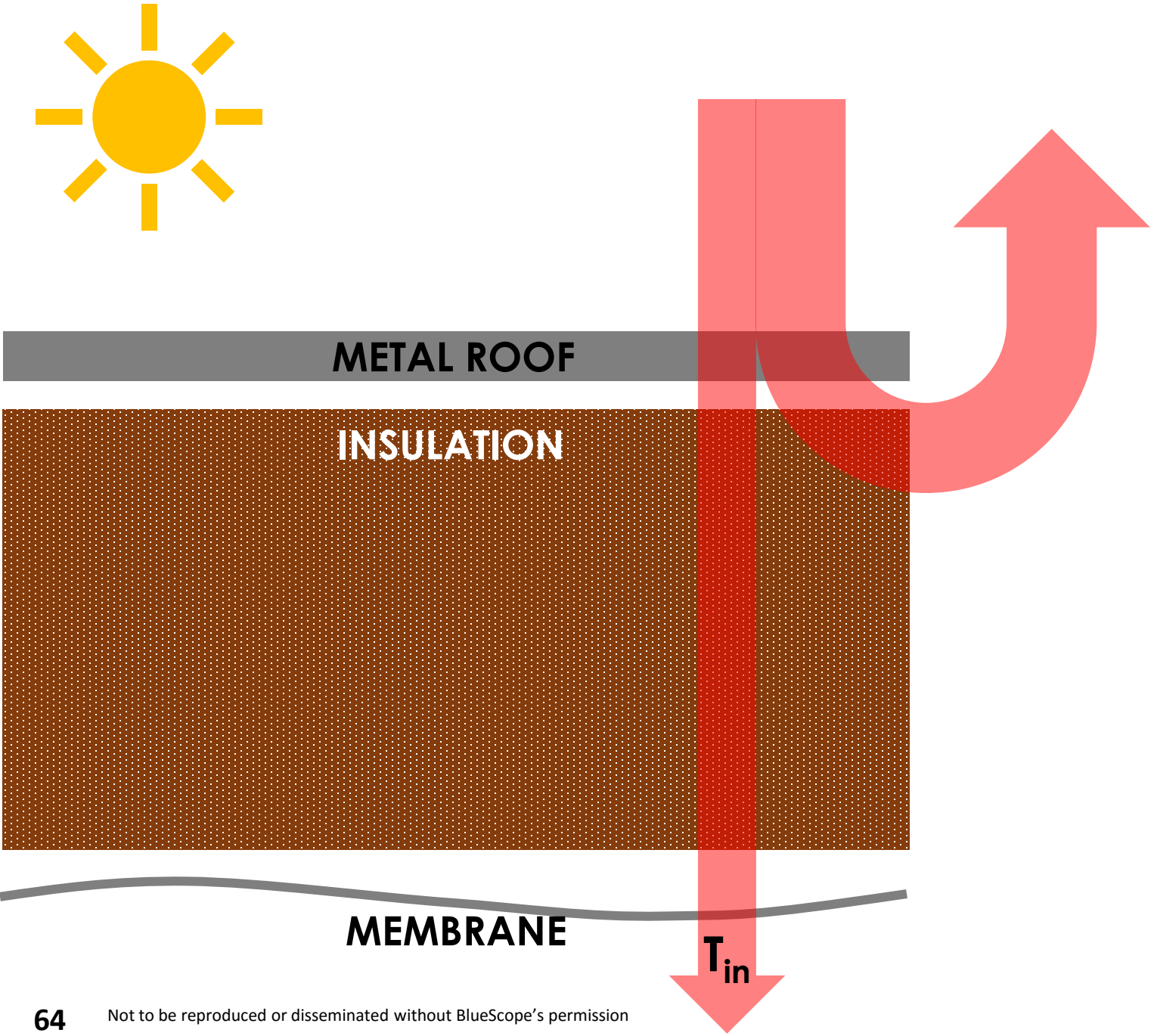
REQUIRES A "BUILD-UP SYSTEM"

Source: BlueScope



THERMAL CONDUCTIVITY OF EACH MATERIAL

Source:



THERMAL CONDUCTIVITY OF EACH MATERIAL

Source:

CALCULATION TO COMPUTE THERMAL TRANSMITTANCE (U-VALUE)

Thermal Transmittance Calculation

The general formula for calculating the U-Value is:

U = 1/Rt

Where:

- U = Thermal Transmittance ($W/m^2 \cdot K$)*
- Rt = Total Thermal Resistance of the element composed of layers ($m^2 \cdot K/W$), obtained according to:

Rt = Rsi + R1 + R2 + R3 + ... + Rn + Rse

Where:

- Rsi = Interior Surface Thermal Resistance (according to the norm by climatic zone)
- Rse = Exterior Surface Thermal Resistance (according to the norm by climatic zone)
- R1, R2, R3, Rn = Thermal Resistance of each layer, which is obtained according to:

R = D / λ

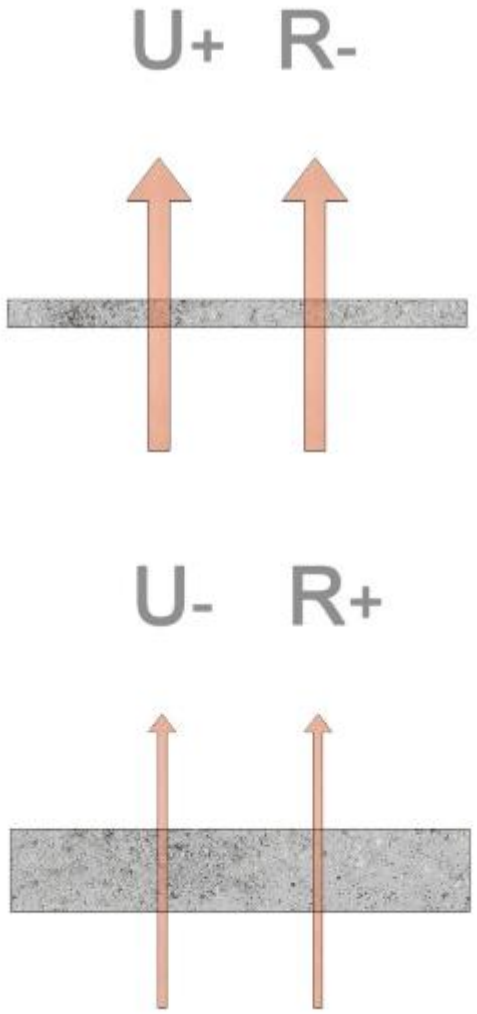
Where:

- D = Material Thickness (m)
- λ = Thermal Conductivity of the Material (W/K·m) (according to each material)

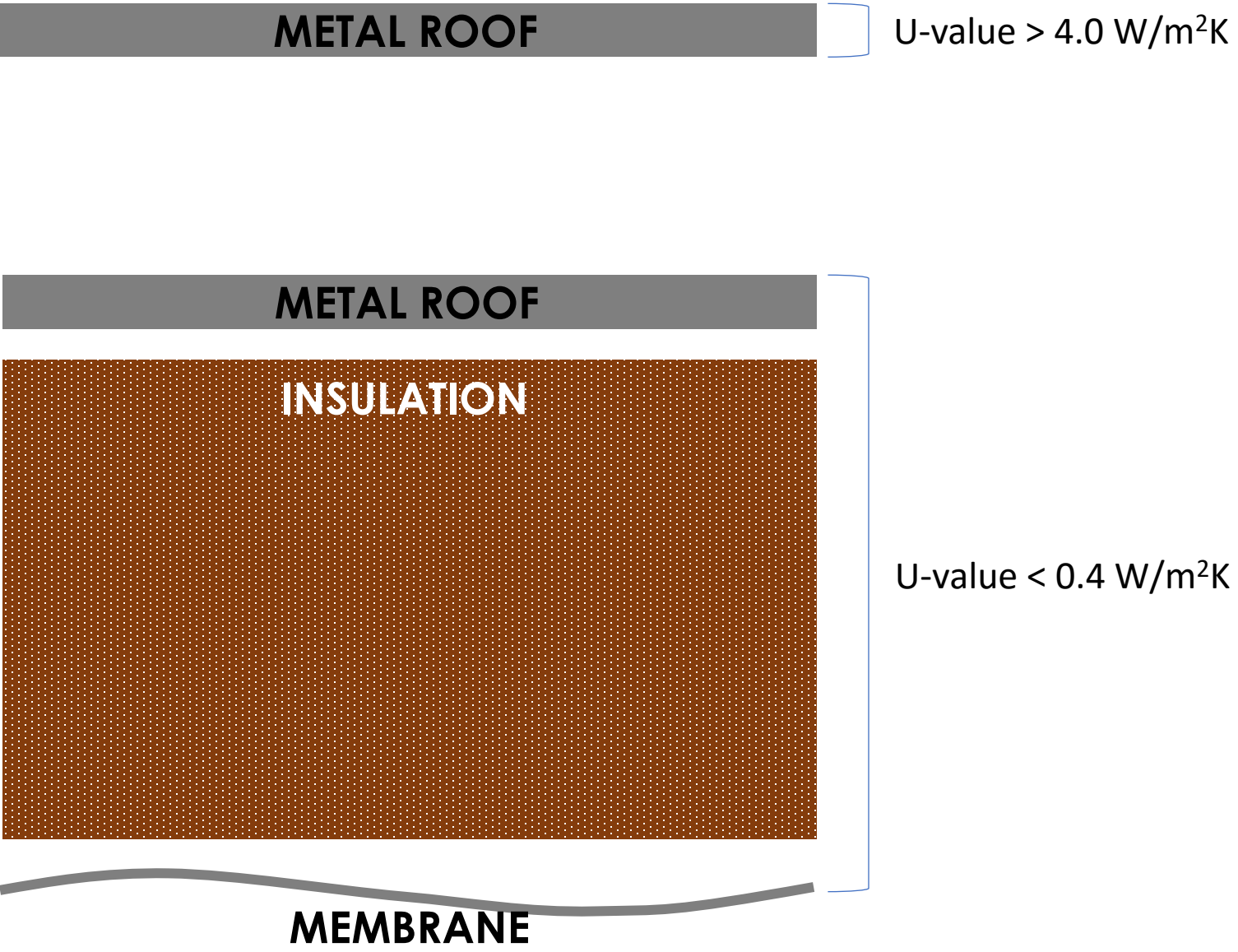
The Thermal Transmittance is inversely proportional to the Thermal Resistance: the greater the resistance of the materials that make up an envelope, the lower the amount of heat that is lost through it.

U = 1/R

R = 1/U



Source: https://www.archdaily.com/898843/how-to-calculate-the-thermal-transmittance-u-value-in-the-envelope-of-a-building



DIFFERENT BUILD-UP LEADS TO DIFFERENT U-VALUE

Source:

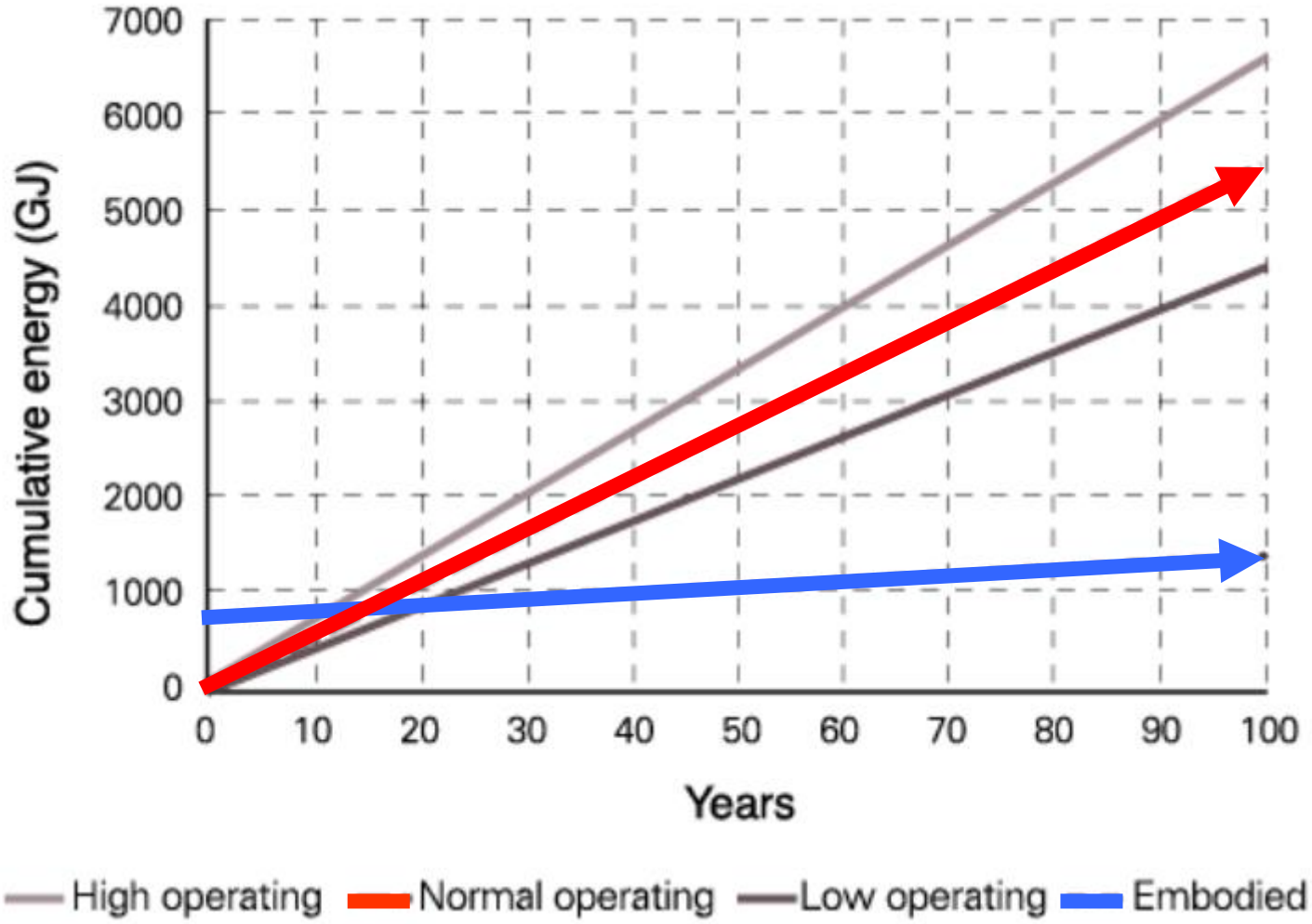
ACHIEVABLE POINTS FOR THERMAL TRANSMITTANCE

	REQUIREMENT ON U VALUE REDUCTION
GBI (MY)	Roof U-value <0.4 W/m^2K
GreenRE (MY)	Roof U-value <0.35 W/m^2K
LEED (US)	ASHRAE 50% Advanced Energy Design Guide
Green Mark (SG)	Roof U-value <0.5 W/m^2K
Green Star (SA)	Roof insulation R-value >2.7m^2K/W

FINANCIAL INCENTIVES

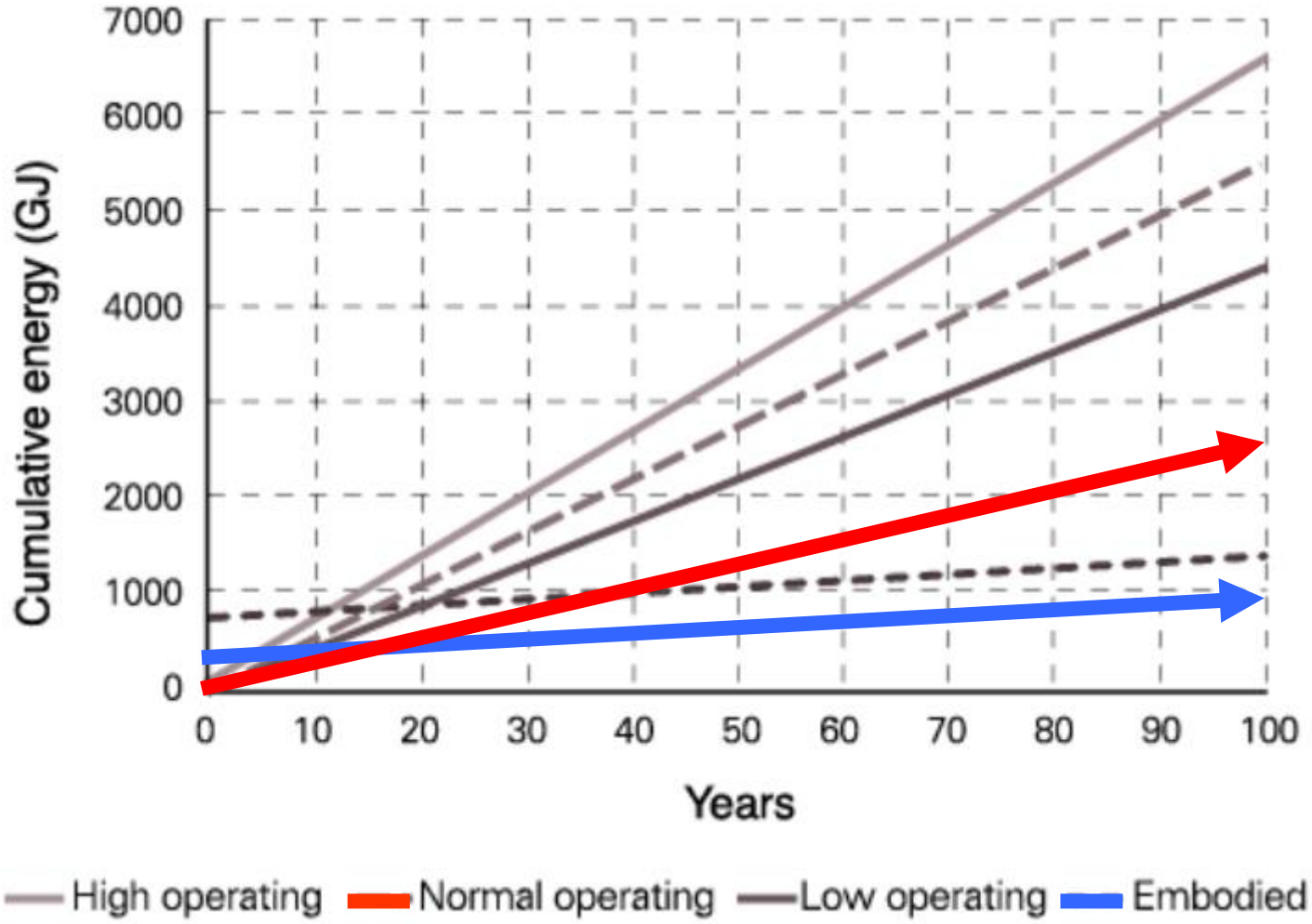
INCENTIVES/ DESCRIPTION	GREEN INVESTMENT TAX ALLOWANCE	GREEN INCOME TAX EXEMPTION	
		Green Technology Services	Solar Leasing Activities
Qualifying activities	Renewable Energy Energy Efficiency Green Building Green Data Centre Integrated Waste Management	Renewable Energy Energy Efficiency Electric Vehicle (EV) Green Building Green Data Centre Green Certification and Verification Green Township	Solar leasing activities
Quantum/ Period	**100%** of qualifying capital expenditure for **three (3) years** from the date of the first qualifying capital expenditure (CAPEX) incurred; offset against **70% of statutory income** in the year of assessment	**70%** on statutory income for qualifying green services where the period of incentive is for **three (3) years** starting from assessment year of the first invoice related to green technology services issued	**70%** on statutory income for solar leasing activity for a period of up to **ten (10) years** of assessment based on the **capacity**: Capacity: >3MW- ≤10MW; >10MW- ≤30MW Incentive Period: 5 years; 10 years

Source: https://www.mida.gov.my/green-technology-incentives-towards-achieving-sustainable-development-in-malaysia/



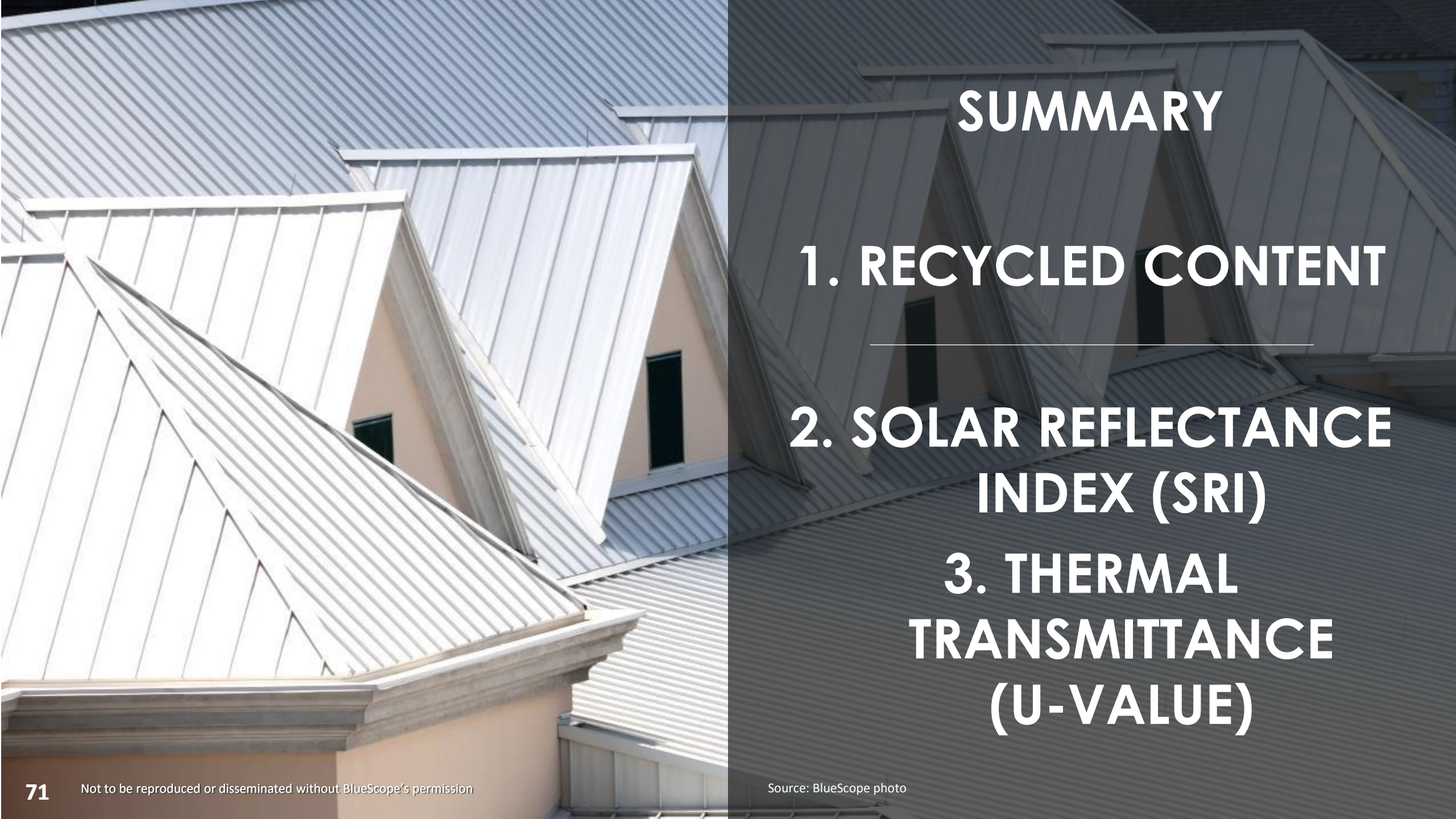
REDUCE EMBODIED ENERGY & OPERATIONAL ENERGY

Source: https://www.yourhome.gov.au/materials/embodied-energy



REDUCING BOTH ENERGIES WILL HAVE POSITIVE FINANCIAL IMPACT

Source: https://www.yourhome.gov.au/materials/embodied-energy



SUMMARY

1. RECYCLED CONTENT

2. SOLAR REFLECTANCE INDEX (SRI)

3. THERMAL TRANSMITTANCE (U-VALUE)

Source: BlueScope photo

QUESTION & ANSWER SESSION

Source: BlueScope photo

BlueScope

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