Improving Energy Efficiency through Inexpensive Building Envelope Retrofits

Green Buildings &
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I | E | N CONSULTANTS

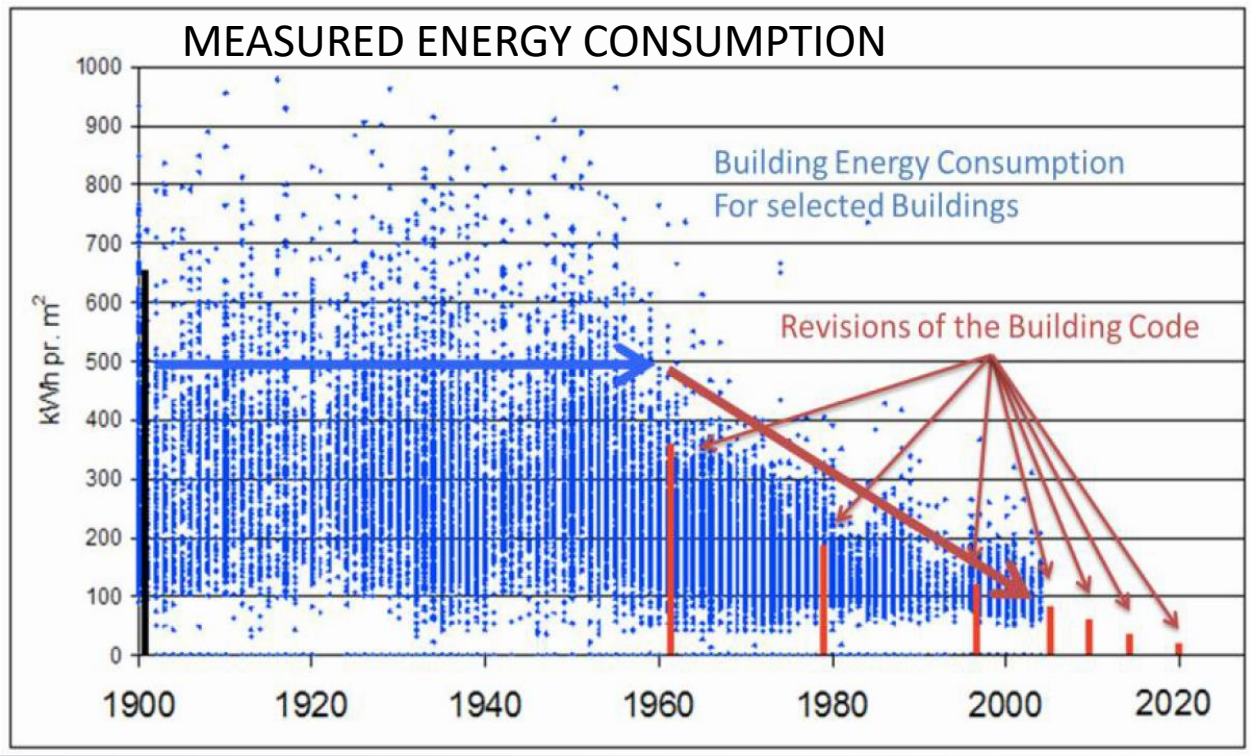
GREEN BUILDINGS & PARKS WORLD

INEXPENSIVE??

- Cost?
- Payback Period?
- Hidden Aspects

RETROFIT POTENTIAL

50% reduction in heating per square meter



Measured Energy Consumption in Danish Buildings

RETROFIT STRATEGIES

1. BUILDING ENVELOPE

- Large recipient of Solar Heat Gains
- Contributes to Heat Island Effect and Increased Cooling Load

SOLUTION

The COLOUR!!

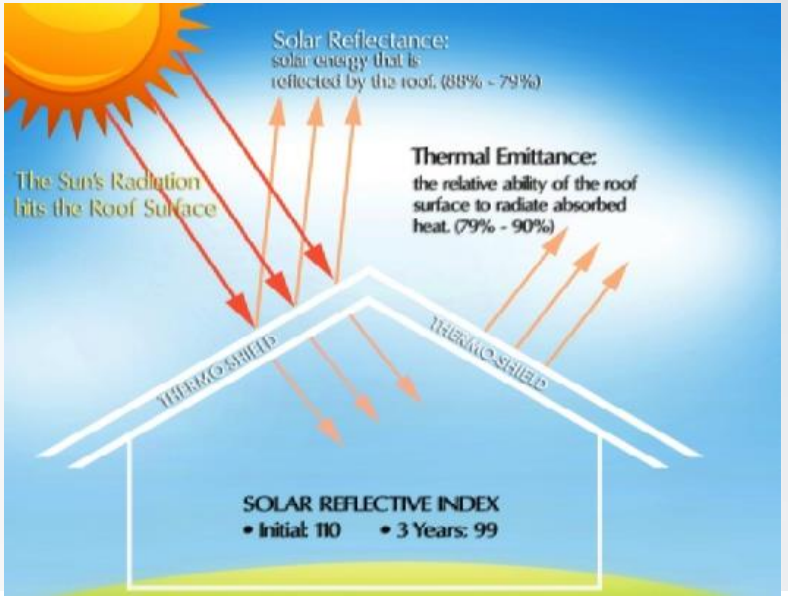
RETROFIT STRATEGIES

SRI

Single value representing solar reflectance and thermal emissivity. Standard black = 0. Standard white = 100.

GBI recommends an SRI of

- > 78 for low pitch roof
- > 29 for steep pitch roof



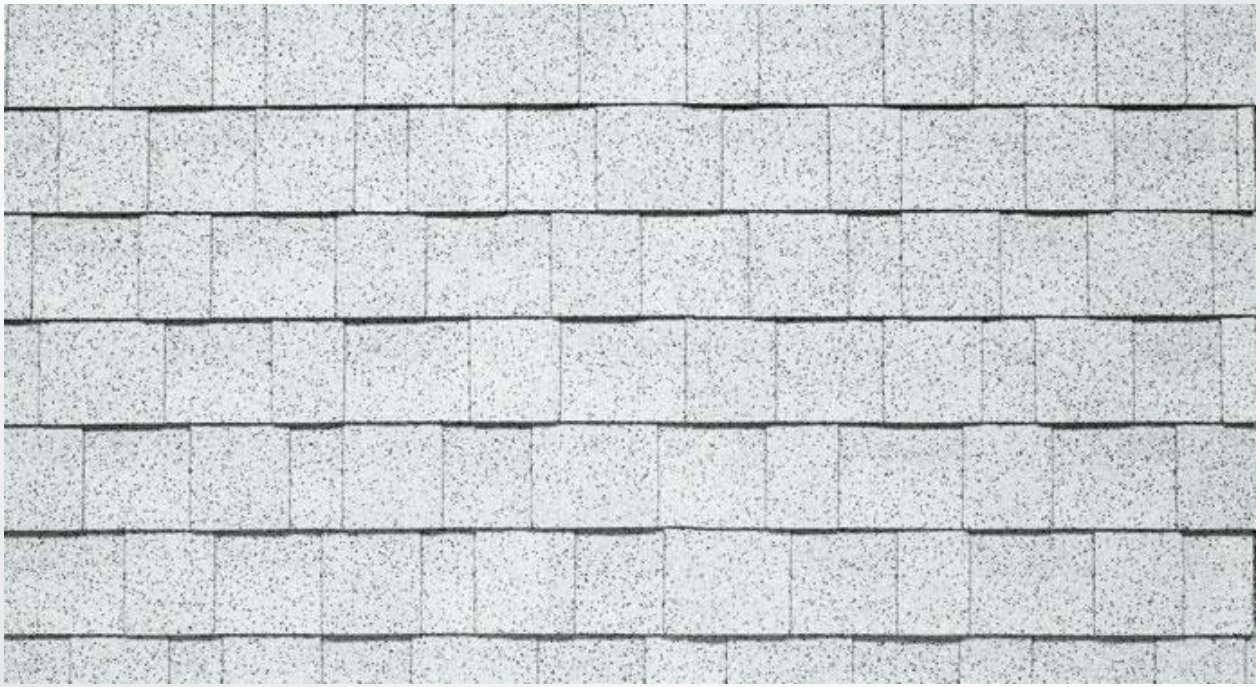
RETROFIT STRATEGIES

SRI

Dark colour roof with low SRI ~ 20.

RETROFIT STRATEGIES

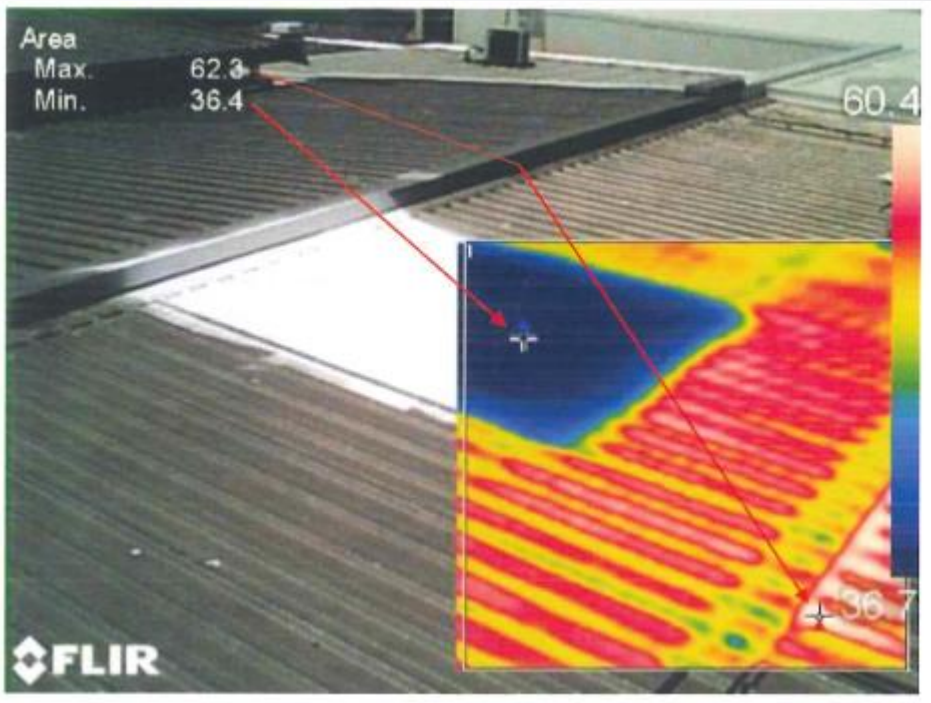
SRI



Light colour roof with high SRI ~ 70.

RETROFIT STRATEGIES

SRI



High SRI roof coating

Source: SkyCool

RETROFIT STRATEGIES

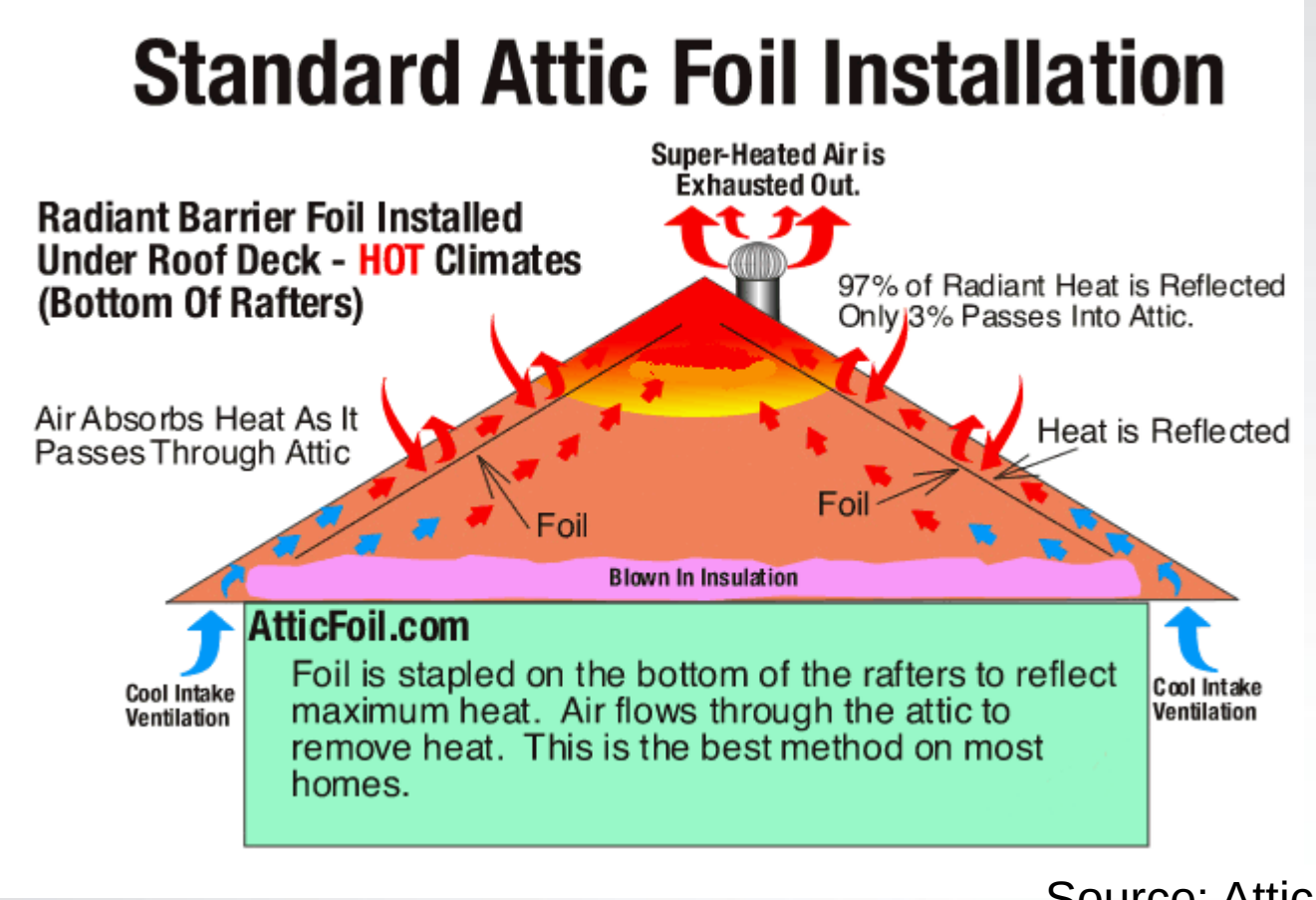
2. INSULATION

Utilize BOTH Radiant Barrier and Polystyrene/Mineral Wool Insulation.

- U-Value < 0.4 W/m^2K for Lightweight Roof (< 50kg/m^3)
- U-Value < 0.6 W/m^2K for Heavyweight Roof (> 50kg/m^3)

*Radiant Barrier ONLY used for Pitch Roof

RETROFIT STRATEGIES



Source: AtticFoil.com

RETROFIT STRATEGIES

Radiant Barrier

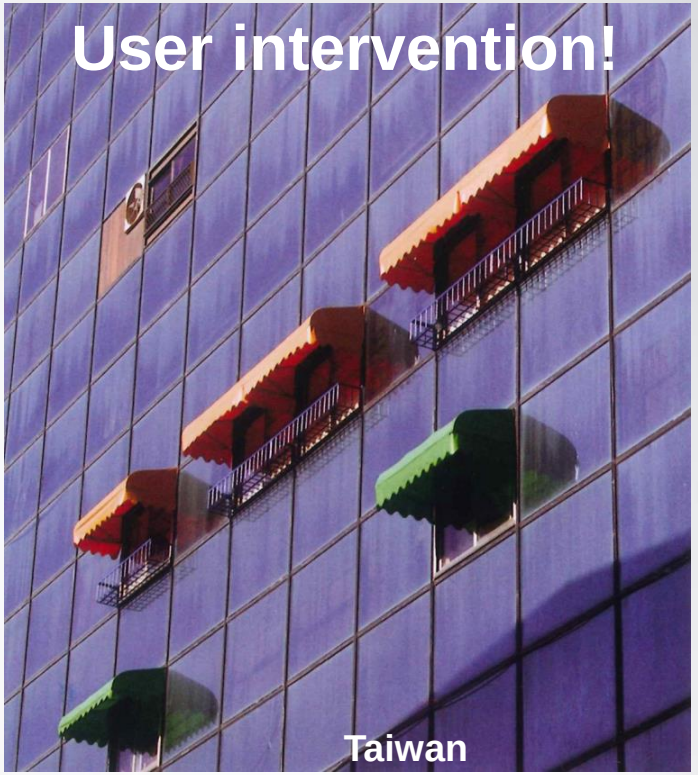
Insulation

RETROFIT STRATEGIES

3. SHADING DEVICES

Can

- Reduce Heat Gain
- Improve Living/Working Environment



RETROFIT STRATEGIES

3. SHADING DEVICES (Case Studies)

Calle de Apolonio Morales, 13 (Madrid, Spain) video

RETROFIT STRATEGIES

3. SHADING DEVICES (Case Studies)

- Façade surface temperature drops from 51C to 34C.
- Minimal impact on daylight and view out.

640 lux (lights ON)

480 lux (lights OFF)

Calle de Apolonio Morales, 13 (Madrid, Spain)

RETROFIT STRATEGIES

4. LIGHT SHELVES

Can

- Reduce Heat Gain
- Increase Daylight Penetration
- Improve Living/Working Environment
- Reduce Lighting Power Consumption

RETROFIT STRATEGIES

4. LIGHT SHELVES (Case Studies)

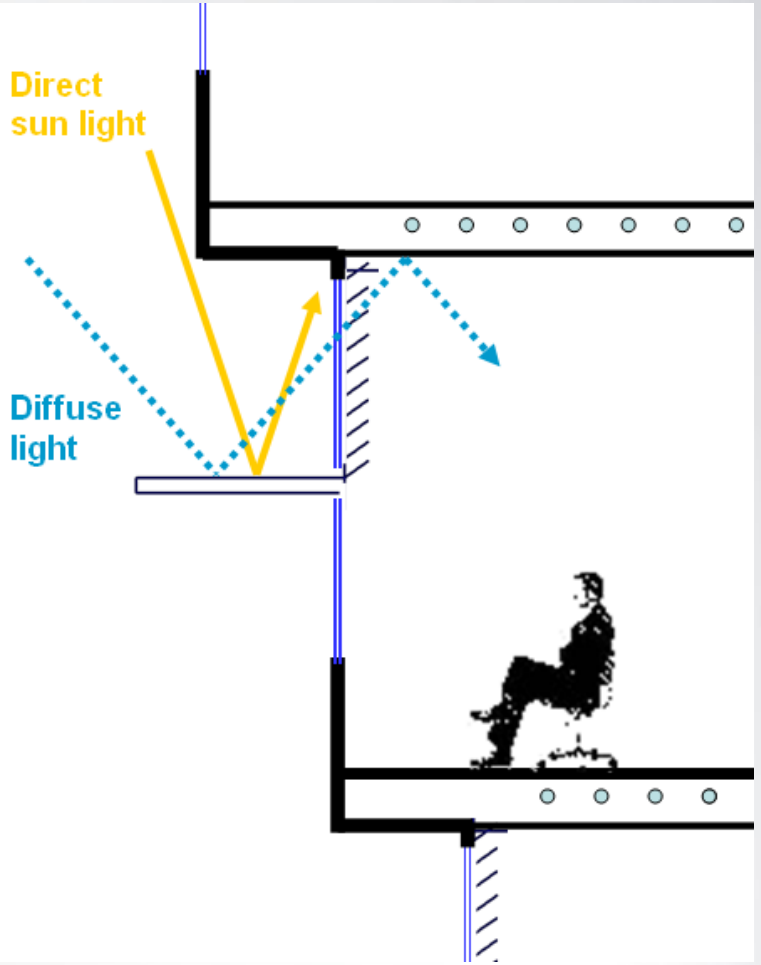
Daylight Façade
w Mirror Light Shelves

GEO Building, Bangi

RETROFIT STRATEGIES

4. LIGHT SHELVES (Case Studies)

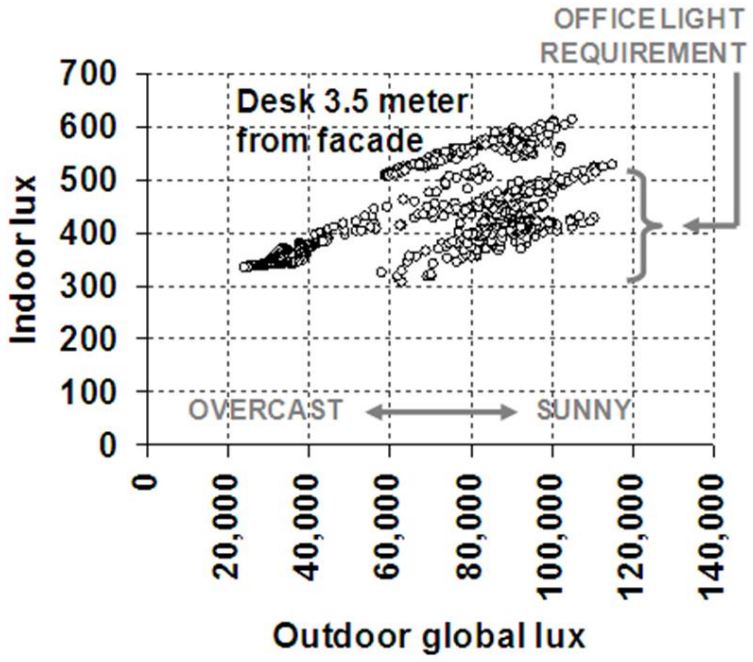
Diffused Light ONLY



GEO Building, Bangi

RETROFIT STRATEGIES

4. LIGHT SHELVES (Case Studies)



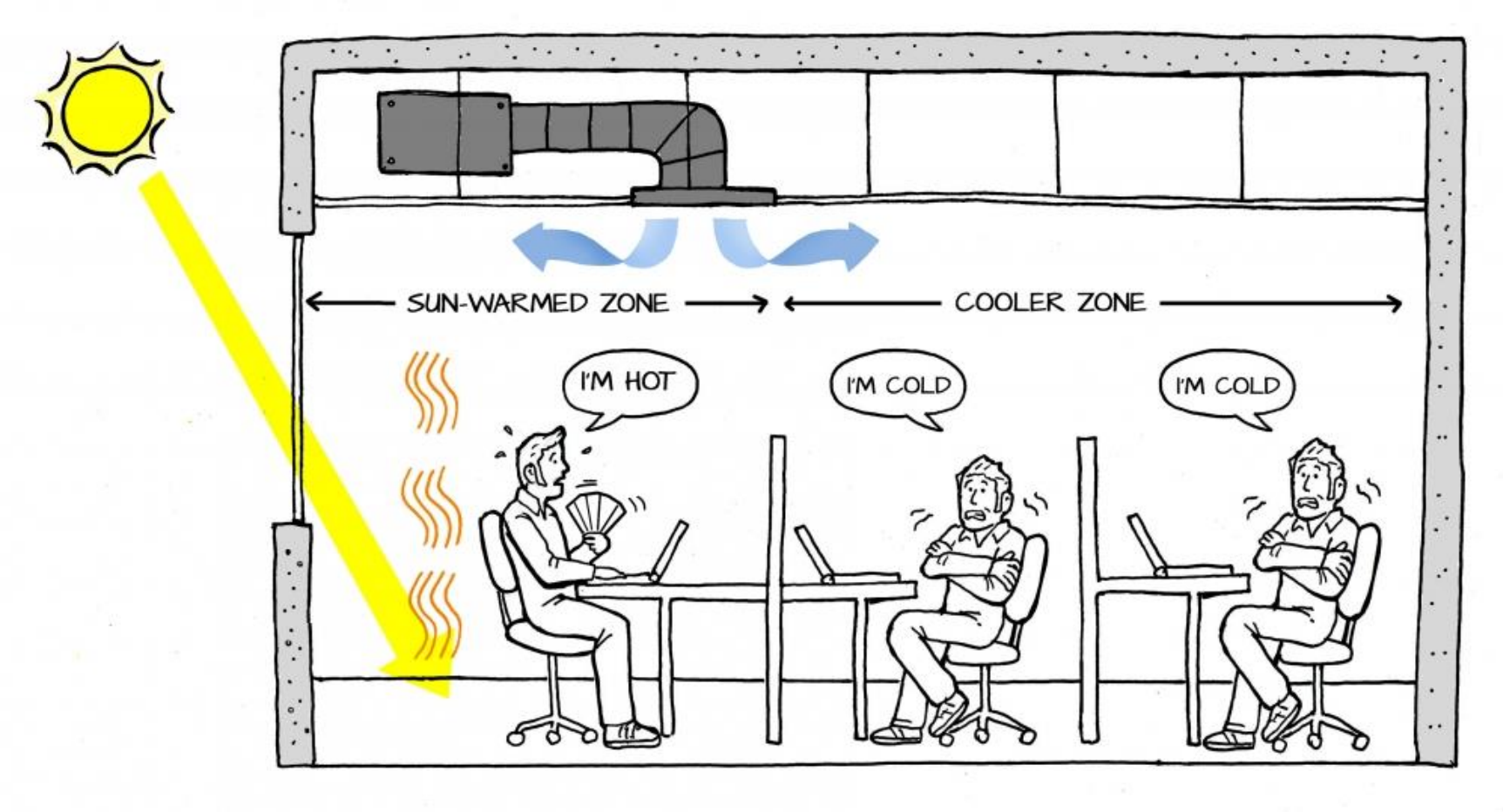
Measured lighting consumption during office hours is only **0.56 W/m²** (or 0.052 W/square foot) based on 6 months data

1. Occupants prefer working in daylight
2. Electrical lighting consumption is 25 times lower than the code requirement


Daylight design by IEN Consultants

GEO Building, Bangi

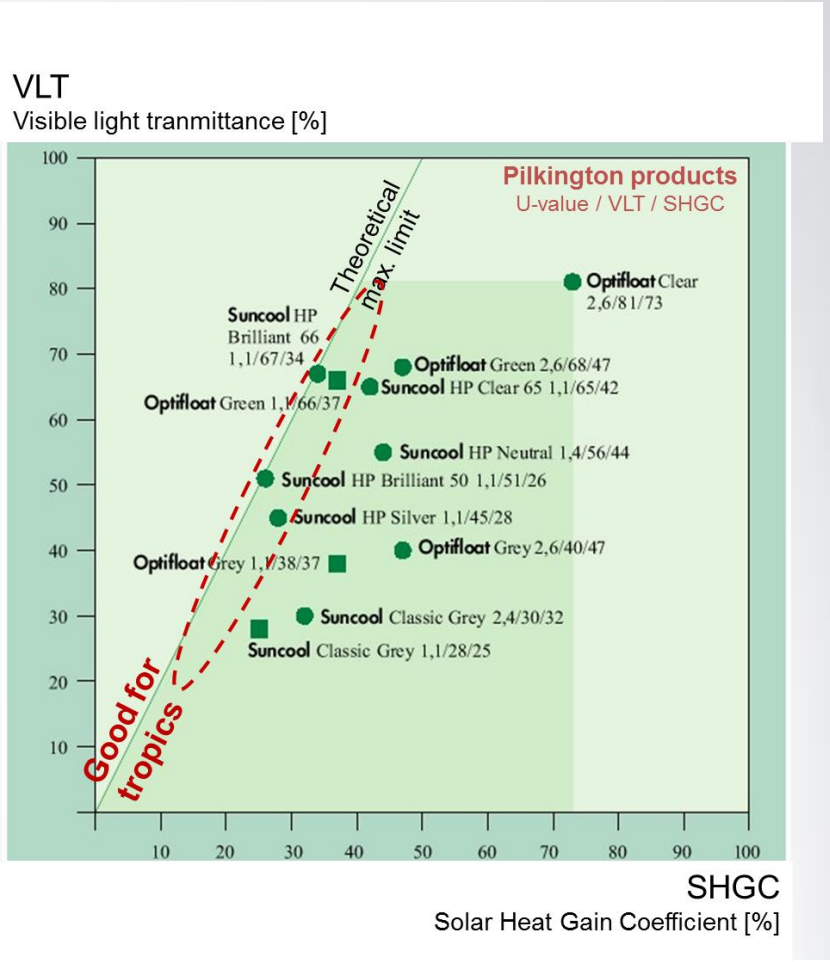
RETROFIT STRATEGIES



RETROFIT STRATEGIES

5. BETTER GLAZING

1. Low SHGC
2. Low-e Coating
3. Low U-Value



RETROFIT STRATEGIES

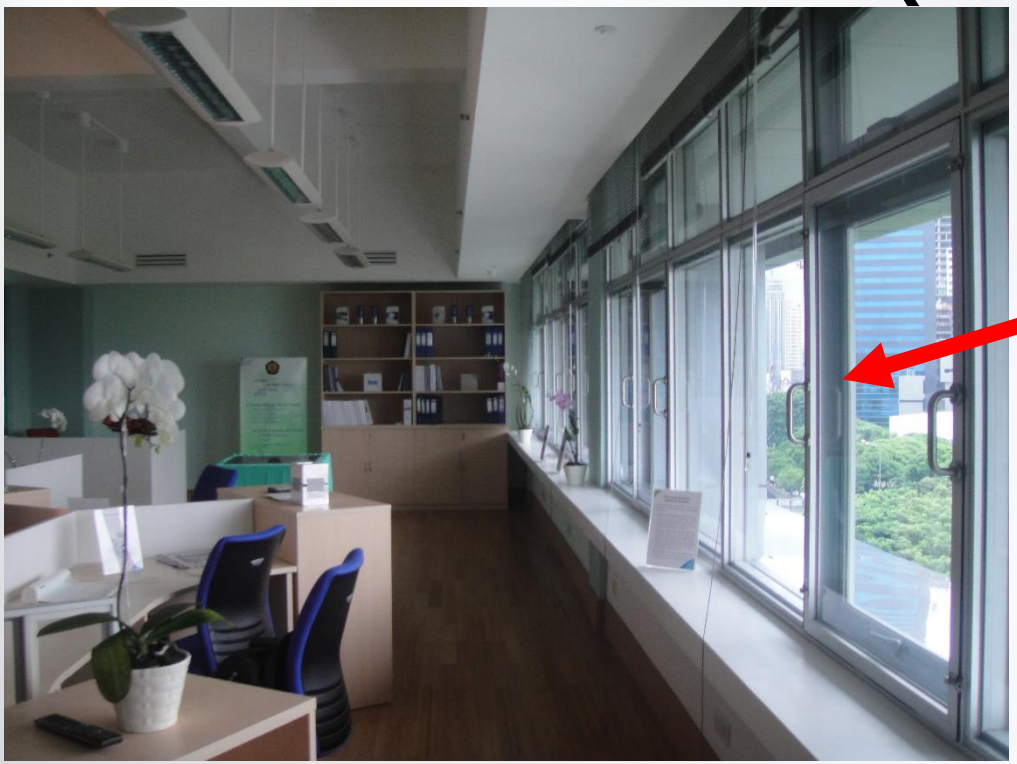
5. BETTER GLAZING (Case Study)

Innovative Solution
Light Shelf

EECCHI Office, Jakarta

RETROFIT STRATEGIES

5. BETTER GLAZING (Case Study)



Single Layer
Acrylic Glass

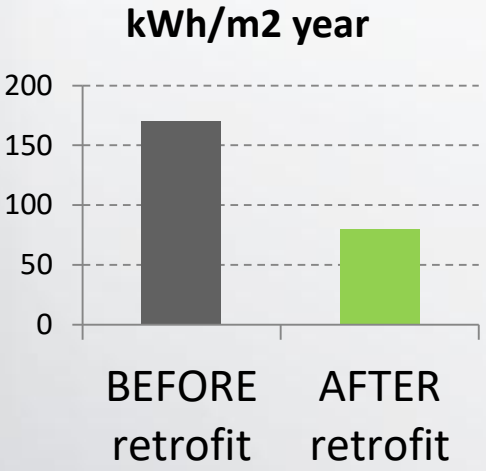
Reduced noise transmission & heat gain

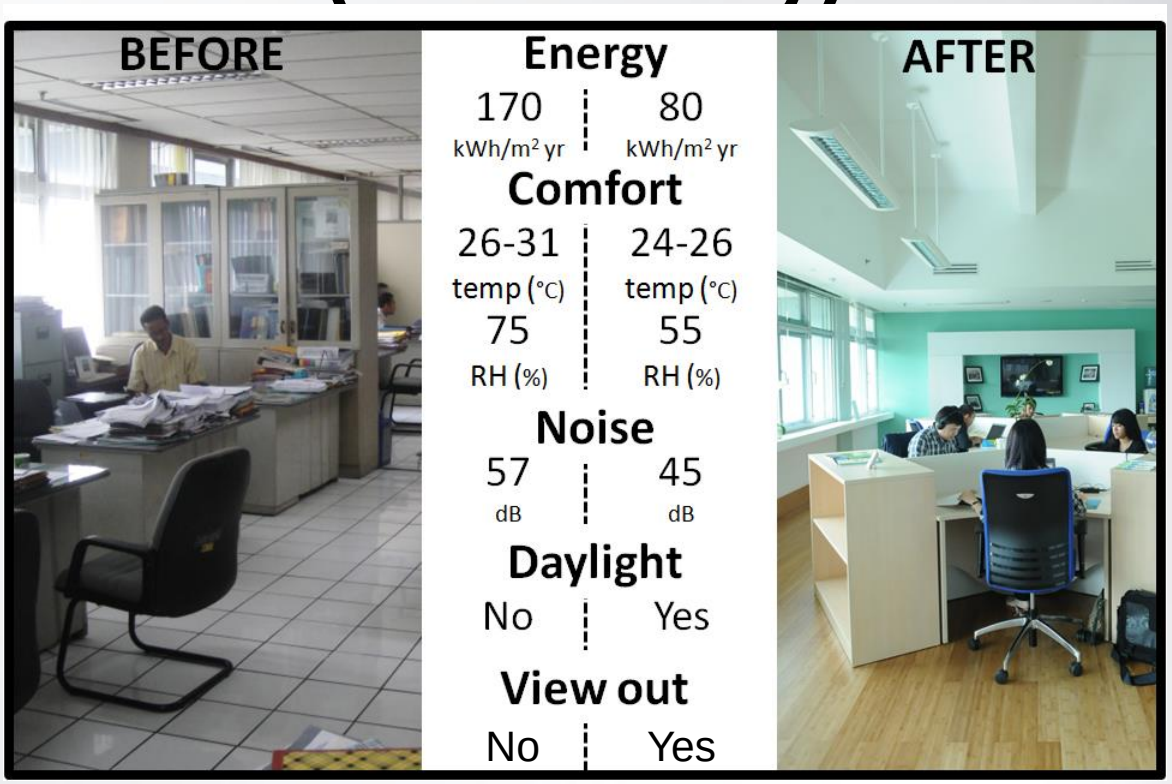
EECCHI Office, Jakarta

RETROFIT STRATEGIES

5. BETTER GLAZING (Case Study)

53% Measured Energy Savings!!





EECCHI Office, Jakarta

HIDDEN ASPECTS

Studies have proven that a **good indoor environment** leads to:

- Less sick leave
- Higher well-being
- More productive employees
- Higher exam scores
- Shops have higher sales
- Hospitals can discharge patients faster

SUMMARY

- Inexpensive is SUBJECTIVE
- 5 Potential Retrofit Strategies
  1. Surface Reflectivity
  2. Insulation
  3. Shading Devices
  4. Light Shelves
  5. Better Glazing
- Hidden Aspects!

SUMMARY

Energy Efficiency 

Living/Work Environment

Savings 

Thank You

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