Future-Ready Façades:

Balancing Energy, Emissions, and Wellbeing with Dynamic Glass

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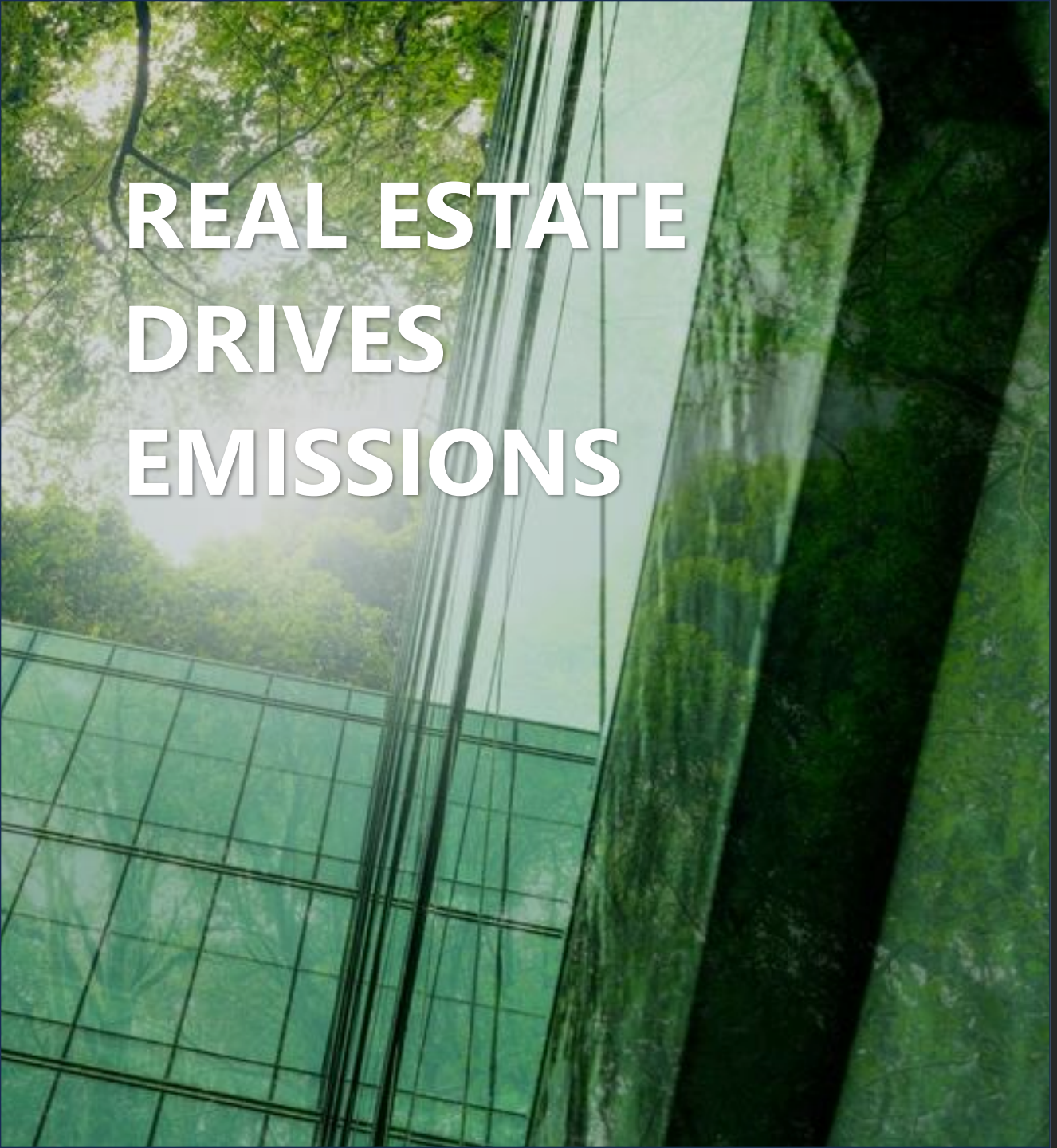

REAL ESTATE DRIVES EMISSIONS

- 36% of global energy use
- One-third of global CO_2 emissions
- Projected 50% increase in building energy demand by 2050
- New technology essential to bend the curve

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CHROMOGENICS POWERING CONVERLIGHT®

- Founded in 2003 in Sweden
- Produces switchable dynamic glass for real estate
- Electrochromic foil laminated in glass
- Designed to improve comfort and reduce energy use
- Stable & long term ownership by Systemair founder

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WHY DYNAMIC GLASS?

Effective solar control

And:

- Achieve daylight compliance
- Block or use solar heat
- Clear, unobstructed views
- Clean, attractive façades without maintenance

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PROVEN ESG IMPACT OF DYNAMIC GLASS

Environmental impact

- 20-40 % reduced energy consumption
- Reduced CO2 footprint
- Reduced operational costs
- Improve LEED, BREEAM, ESG scores

Source: US Department of Energy

Comparison of the Energy Saving Potential of Adaptive and Controllable Smart Windows, Norwegian University of Science and Technology 2018

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PROVEN ESG IMPACT OF DYNAMIC GLASS

Social aspects & wellbeing

- More productive office workers
- Improved student performance and morale
- Improved sleep, cognitive function and overall wellbeing
- Reduced risk of depression

Source: Boubekri, M. et. al., The Impact of Optimized Daylight and Views on the Sleep Duration and Cognitive Performance of Office Workers, 2020.

International Journal of Environmental Research and Public Health, 2021

California Energy Commission, Windows and Offices: A Study of Office Worker Performance and the Indoor Environment, 2003.

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THE CHALLENGE

Innovative and advanced façade solutions improving energy performance

Tend to come with a high carbon footprint

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THE CHALLENGE

Improve building energy performance, but also:

- Low CO2 footprint in production
- Aligned with the industry's way of working
- Reliable and cost-effective

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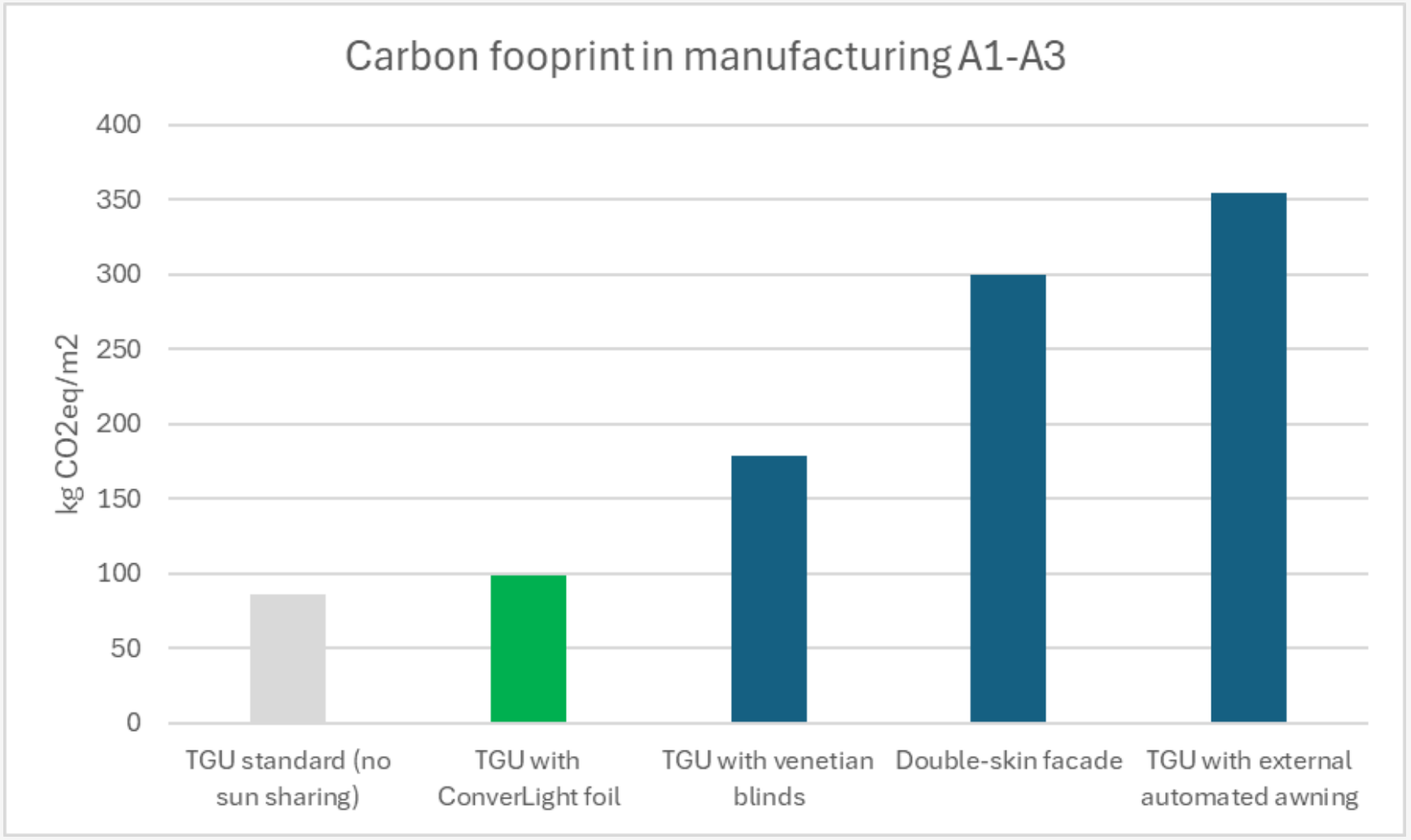
Foil-based technology can reduce CO2 footprint



Global Warming Potential (GWP) in manufacturing (A1-A3) kg CO2eq/m2 per m2 glass.
Data from suppliers Environmental Product Declarations in a three-glass solution.

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REPLACING DOUBLE SKIN FACADE

Karlskrona, Sweden

- The National Board of Housing, Building and Planning – new HQ
- “The office of the future”
- Zero-CO_2 , BREEAM Outstanding, Energy class A, Well Platinum
- Replaced double skin façade with dynamic glass and reducing CO_2
- Architects: SandellSandberg
- General constructor: Skanska

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Karlskrona, Sweden
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Karlskrona, Sweden

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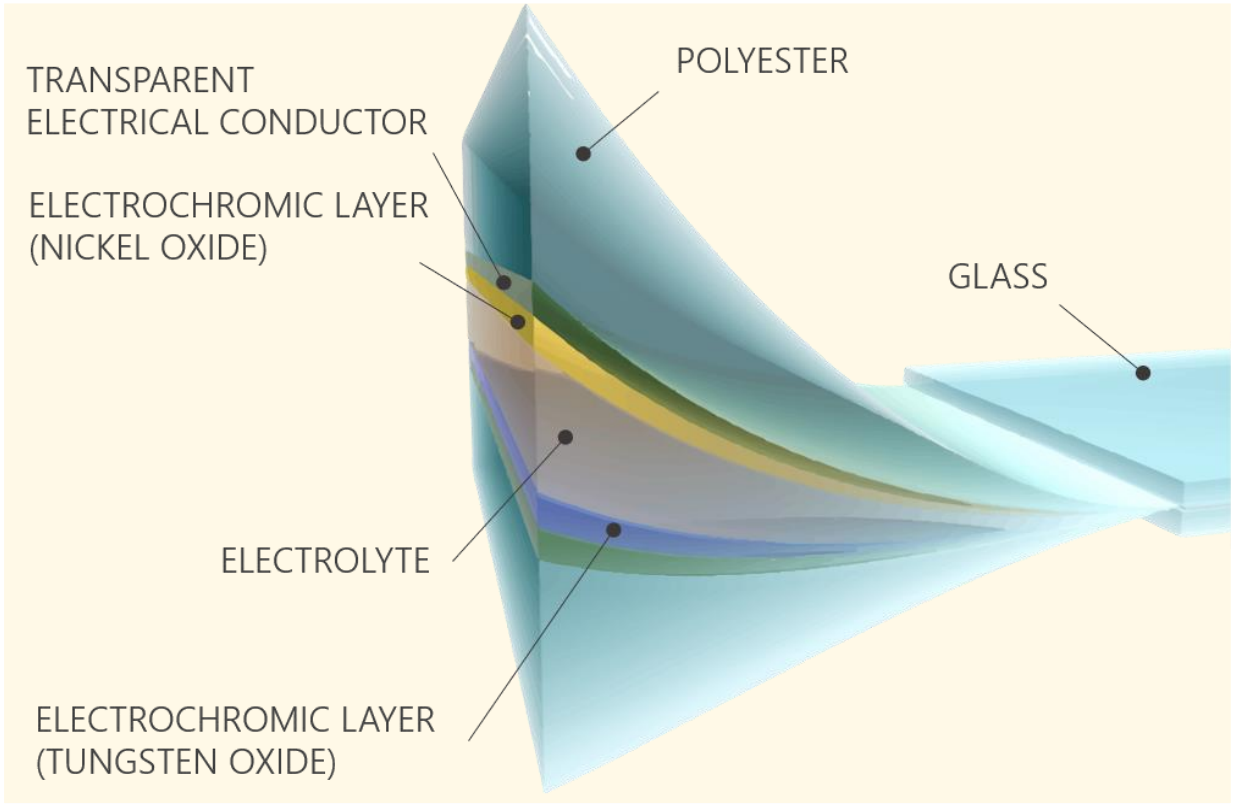
ConverLight® - A foil-based electrochromic technology



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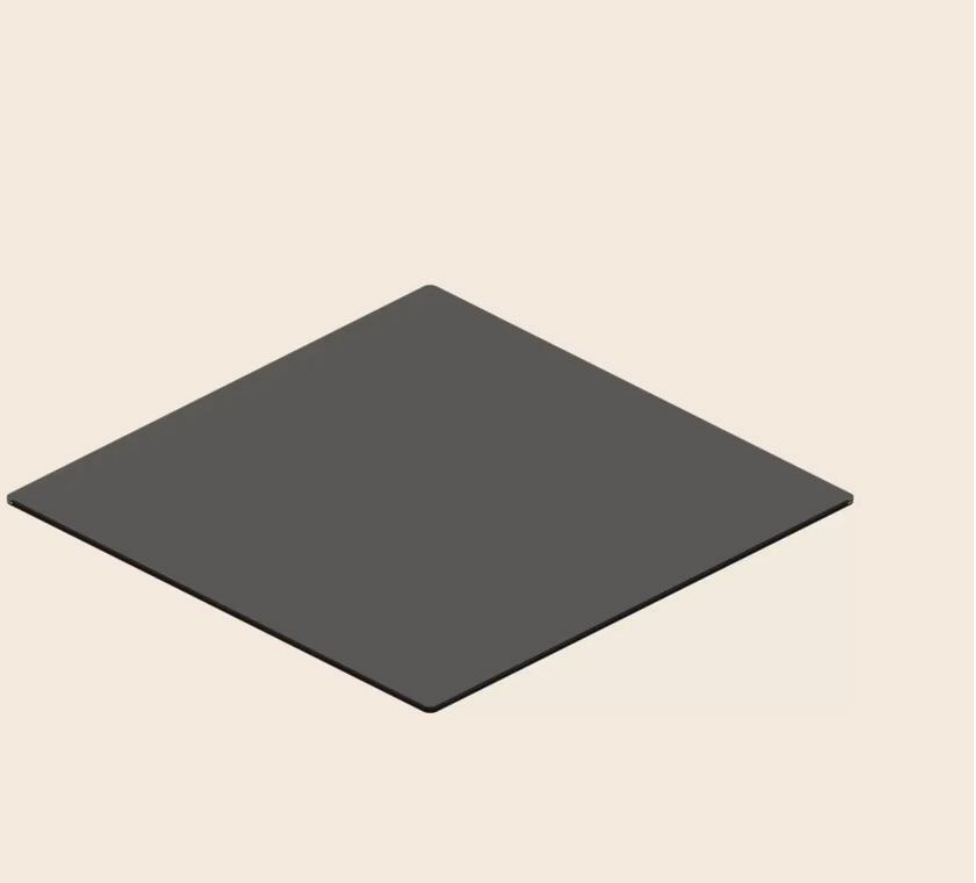
ConverLight® - A foil-based electrochromic technology



- Energy efficient production using roll-to-roll coating of PET film
- Lightweight, minimizing transportation costs & CO2
- Glass processed close to the user, reducing freight & lead times
- Low energy use – only 0.05 W/m² when switching enables wireless control
- Approved in ISO accelerated aging tests

Accelerated ageing test and requirements

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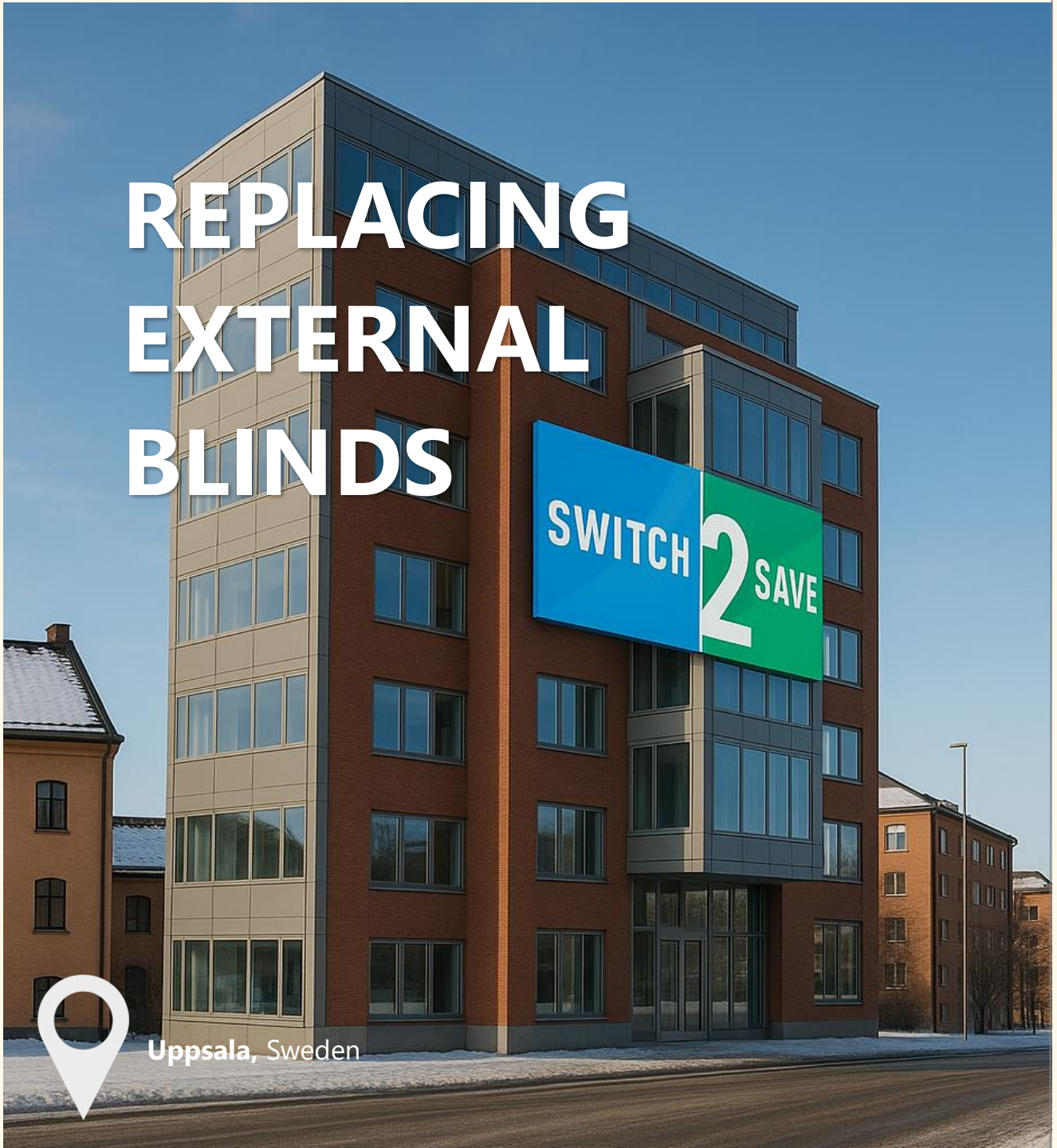

REPLACING EXTERNAL BLINDS

Uppsala, Sweden

- Vasakronan
- 2022: Standard windows with external sunshading
- 2023: ConverLight® equipped windows
- 200 m2 south façade

Results

- 80% reduction of electricity for cooling in March.

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VASAKRONAN

Switch2Save

Rooms

001-Plan-04-1327 (ÖPPET L...

Period

- [x] 2022 year
- [x] 2023 year

Type of data (Energy)

- [x] Cooling
- [ ] Electricity
- [ ] Heating
- [ ] Total

Type of data (Temperature)

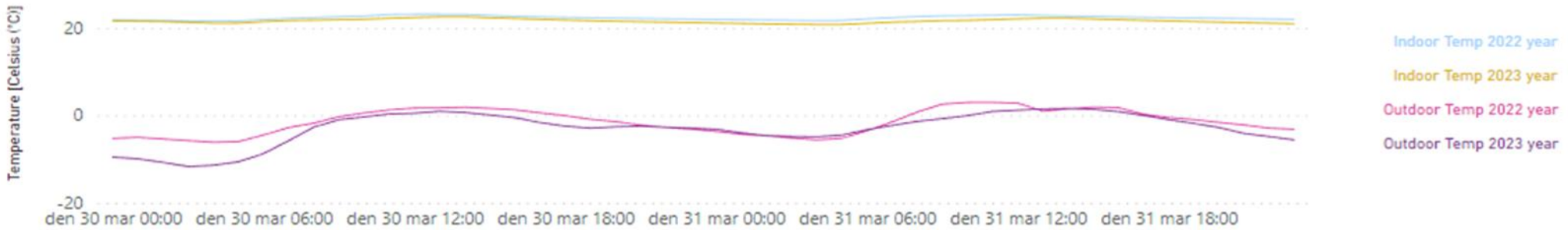
- [x] Indoor temperature
- [x] Outdoor temperature

Type of data (Illuminance)

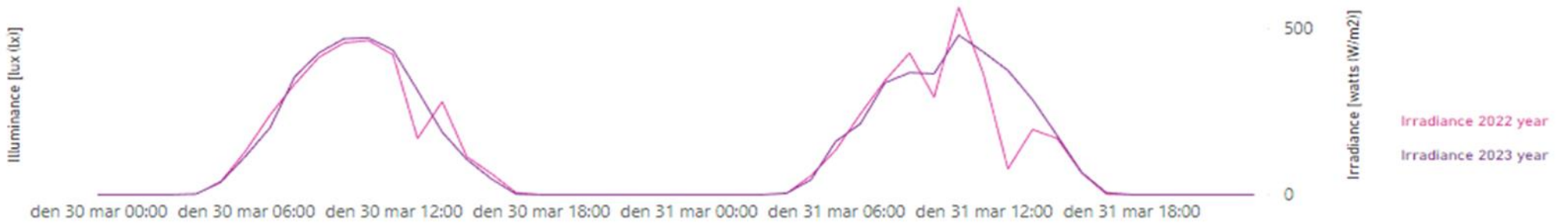
- [ ] Illuminance
- [x] Irradiance

Energy

Temperature



Illuminance \ Irradiance



2023-03-30 2023-03-31

ProptechOS

RealEstateCore

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ELIMINATING ACTIVE COOLING

Copenhagen, Denmark

Objectives

- Achieve prescribed daylight levels
- Ensure indoor comfort
- Minimise Energy & CO2 footprint

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Copenhagen, Denmark

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Benchmarking by prof Christian A. Hviid:

1. Regular AC & TGU
2. TGU with solar protection layer. Cooling coil in central air handling & night ventilation.
3. ConverLight with night ventilation
4. EC-glass with night ventilation
5. TGU with External screen with night ventilation

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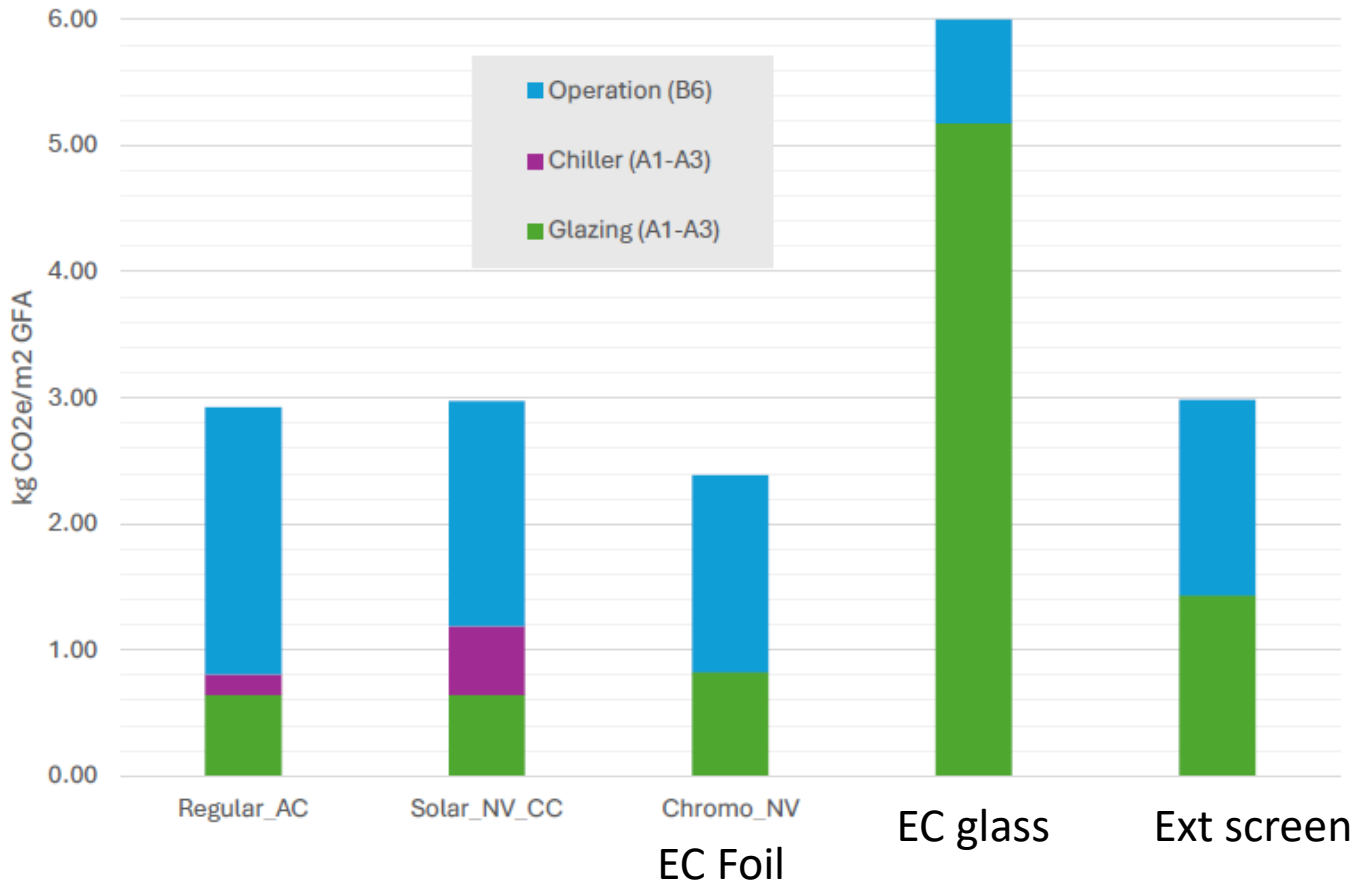
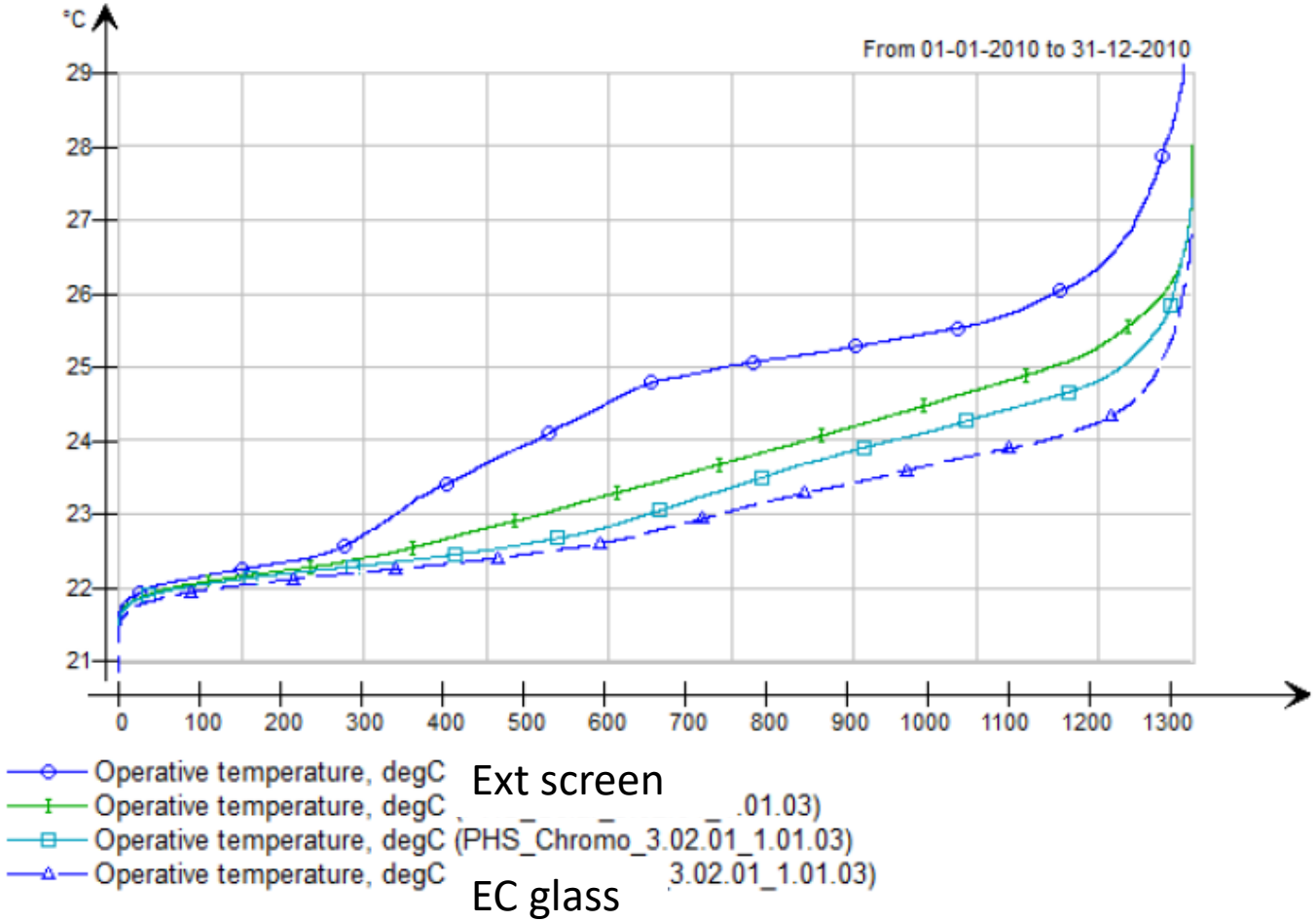
Comparing carbon emissions



Comparing thermal comfort



All strategies do the job

Comparing daylight compliance with activated shading

EC Foil

	1.01.03 sDA300,50%	3.02.01 sDA300,50%
Regular_AC	98%	99%
Solar_NV_CC	86%	96%
Chromo_NV	67%	88%
EC glass	31%	61%
Ext screen	43%	81%

ConverLight Dynamic Clear state (Left)
Standard Glass (Right)

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ConverLight Dynamic Dark state (Right)

Standard Glass (Left)

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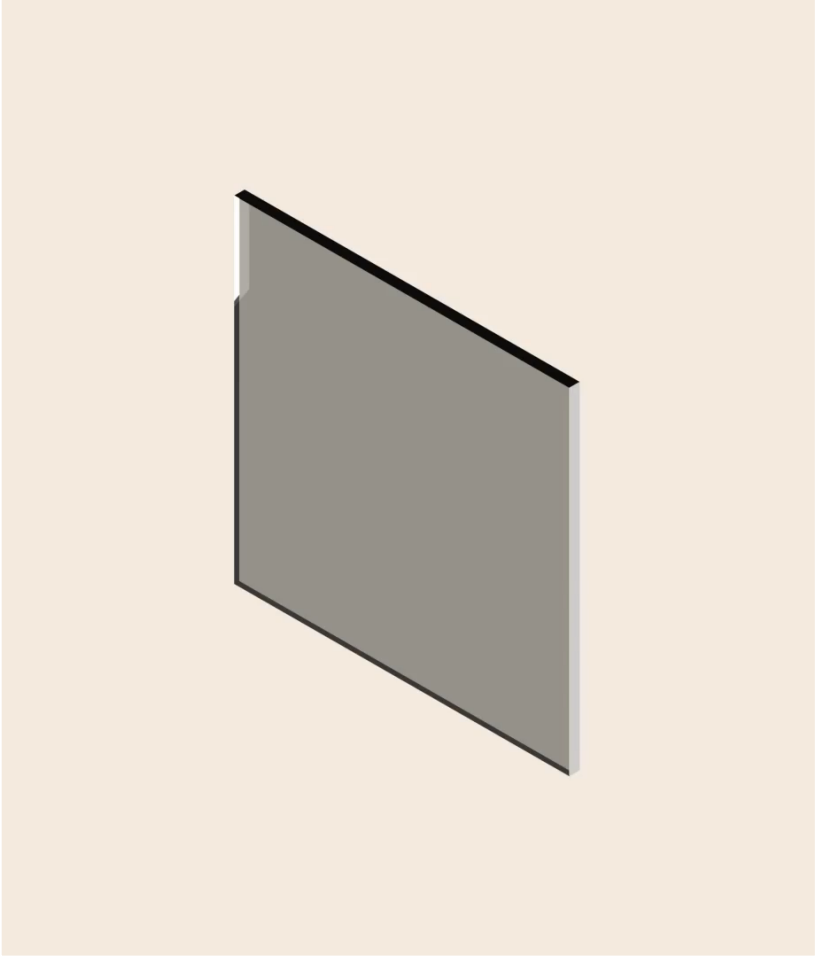
Working with a foil create design possibilities



- LT > 75% or g-value < 0.10 possible
- Virtually any height. Widths up to 1550 mm
- Shapes: curved, round, triangles, cut-outs, …
- Choice of glass coating, brand, supplier, …
- IGU configuration 2, 3 or 4-glass. Ug down to 0.3 W/m^2K
- Combine with other functions: sound, safety, fire, anti-cond, Low-E, Vanceva, mesh, …

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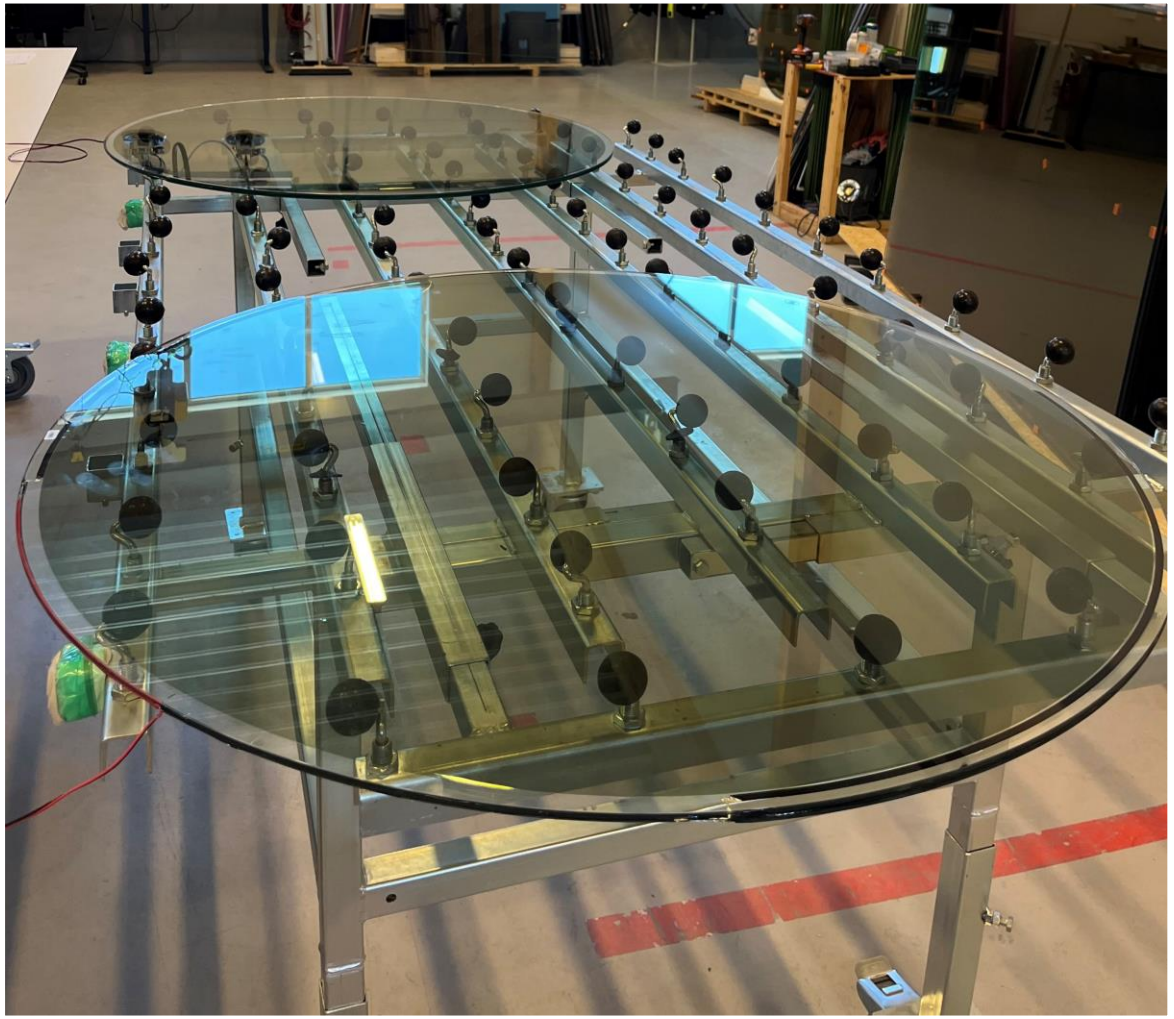

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FREEDOM OF DESIGN

- Tranquility & natural light
- Contact with nature through 4.4m dynamic glass arch
- Effective solar control without external shading
- Unique shapes expressing architectural vision
- Kristine Jensens Tegnestue & Poul Ingemann.

Stockholm, Sweden

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CLOUDY DAY - BRIGHT

Indoor Conditions

67% Light Transmission
42% g-value

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SUNNY DAY - TINTED

Indoor Conditions

25% Light Transmission
18% g-value

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CLOUDY DAY - BRIGHT

Outdoor Conditions

67% Light Transmission
42 % g-value

CONVERLIGHT®
by ChromoGenics

SUNNY DAY - TINTED

Outdoor Conditions

25% Light Transmission
18% g-value

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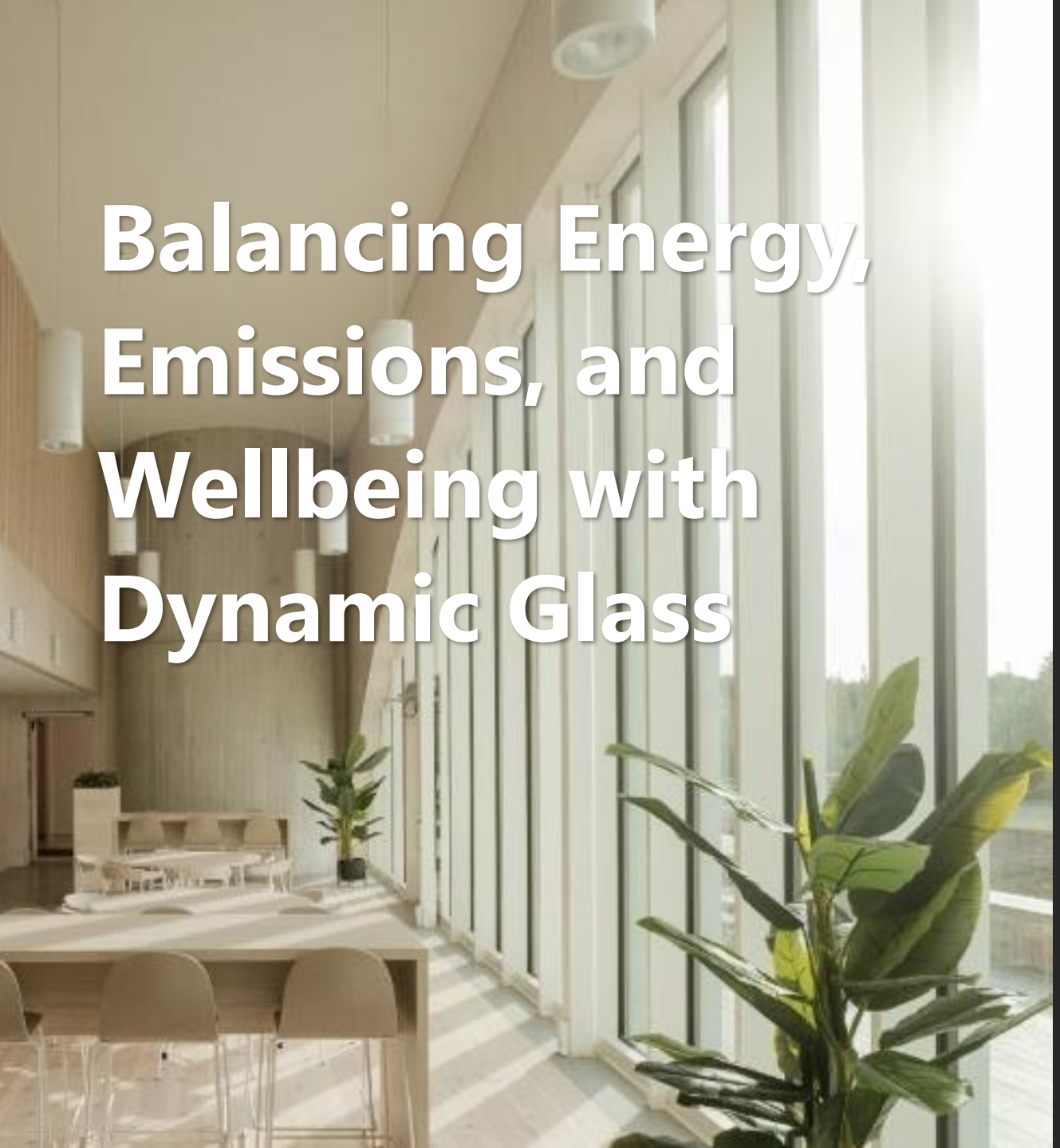
by ChromoGenics



Balancing Energy, Emissions, and Wellbeing with Dynamic Glass

Foil-based technology can improve building energy performance, but also:

- Reduce CO2 footprint
- Achieve daylight levels & architectural ambitions
- Align with the industry's way of working
- Be reliable and cost-effective

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