

# A smart semi-translucent building-integrated PV module based on integrated-tracking micro-concentration providing high power density and active daylight management



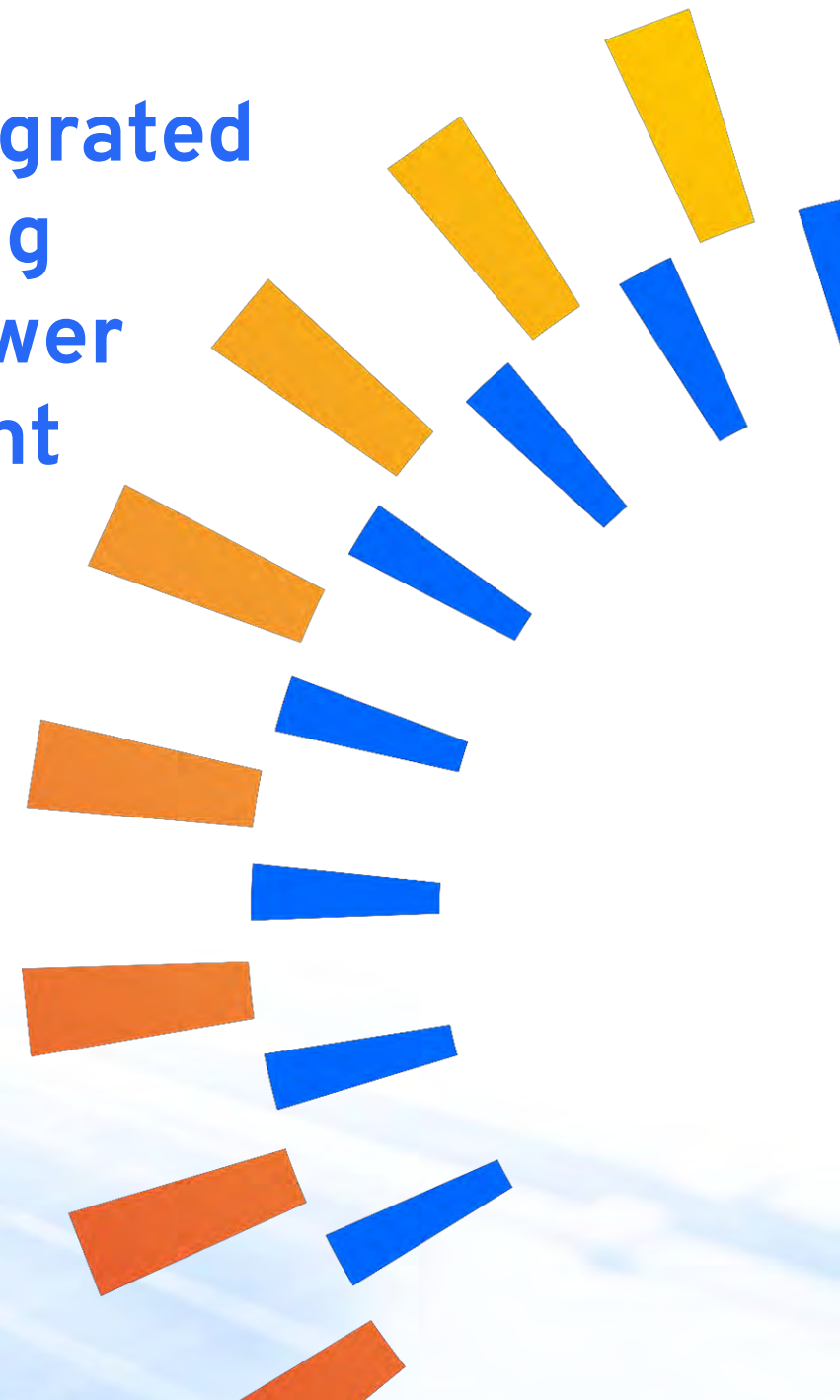
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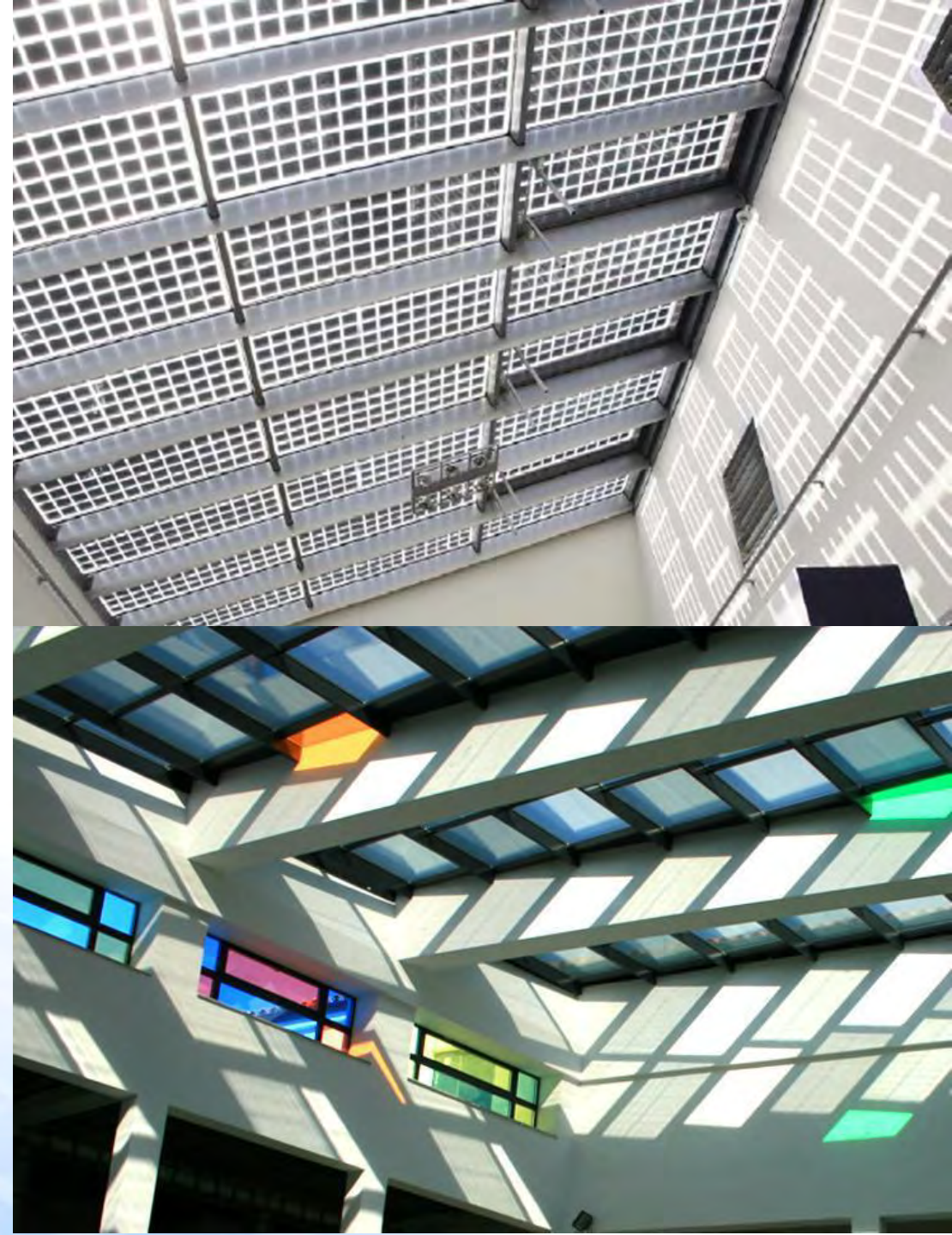
# Outline

- Introduction to the challenge
- Objectives of the innovation
- Technical approach
- Performance and benefits
- Takeaways

# The challenge

BIPV adoption rates need to ramp up, but...

- Low power density of semi-transparent PV
- High-glare daylighting
- No active daylight management



# Objectives of our innovation

## More glazing as PV generators

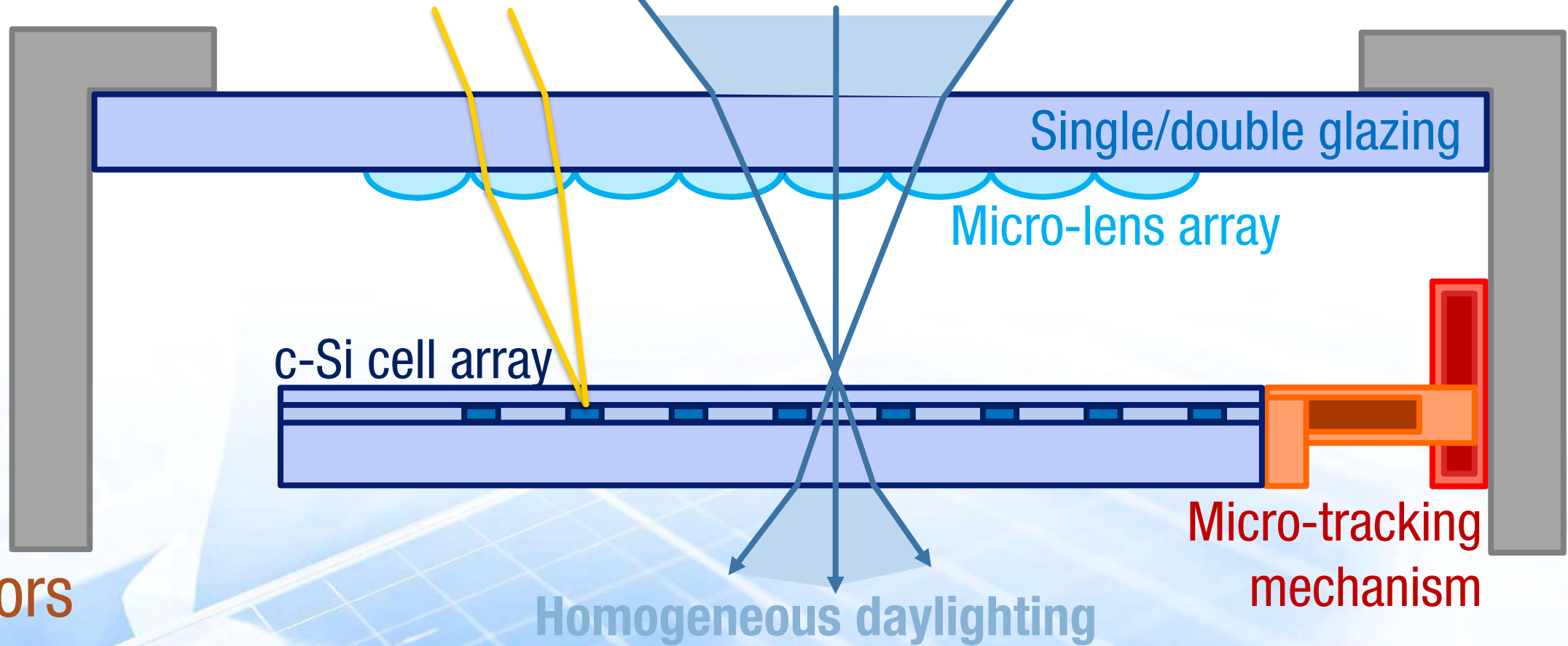
- Active daylight management (high / low transmission)
- Low-glare, natural daylighting
- High PV power density
- Compatible with conventional glazing units

# Technical approach: BICPV/D

Building-Integrated Concentrator PV / Daylighting

Outdoors

Direct irradiance Diffuse irradiance



Indoors

Homogeneous daylighting

Micro-tracking mechanism

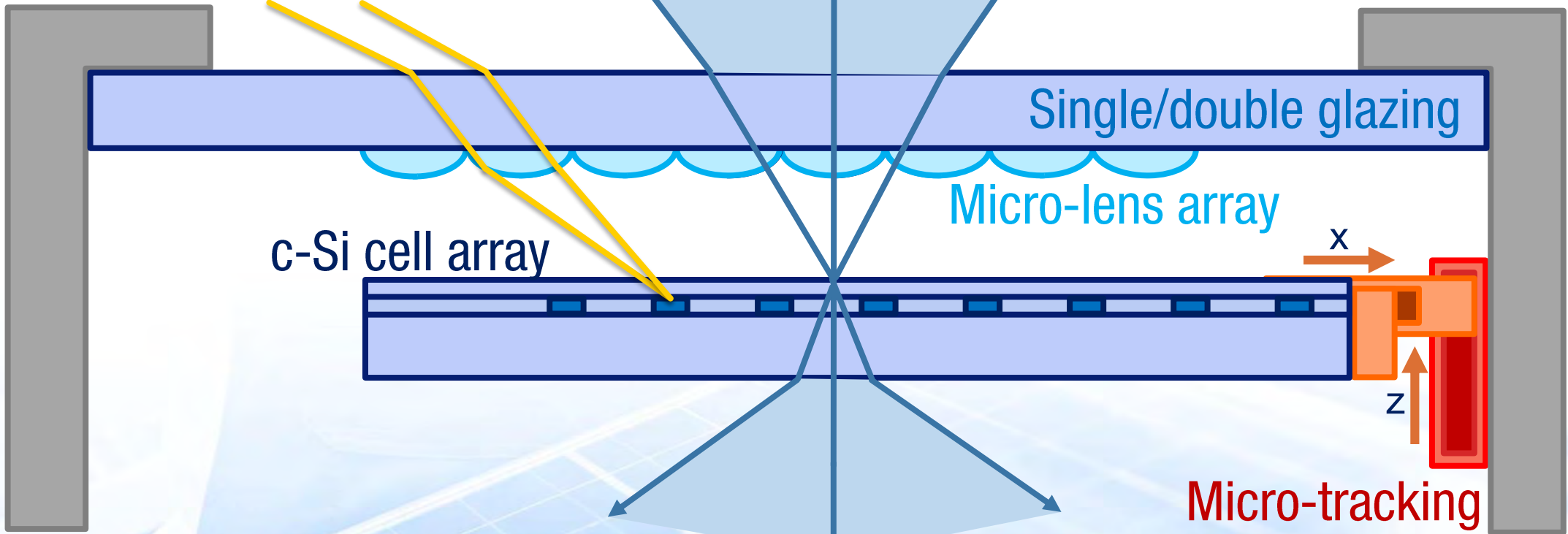
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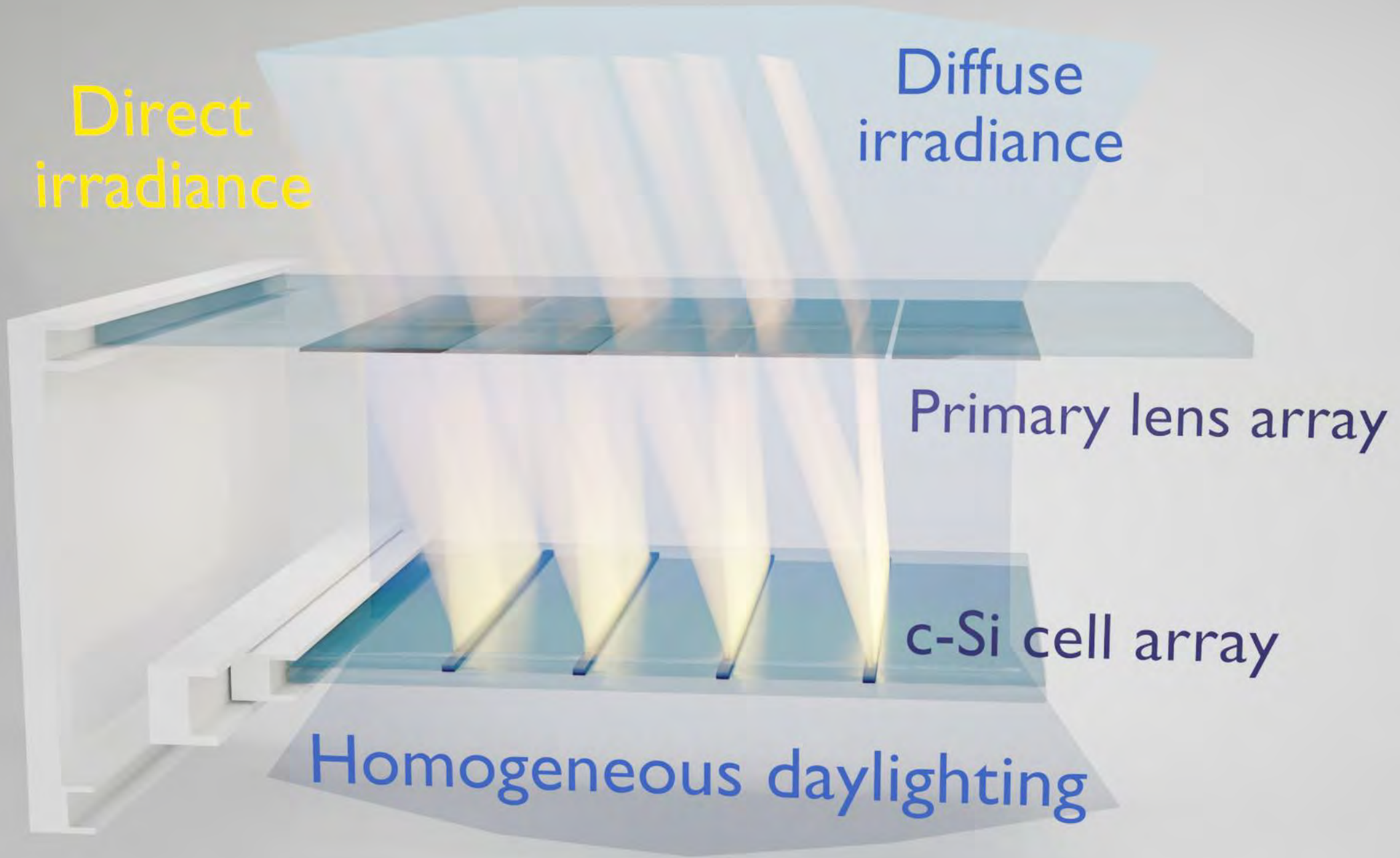
Direct irradiance

Diffuse irradiance

Primary lens array

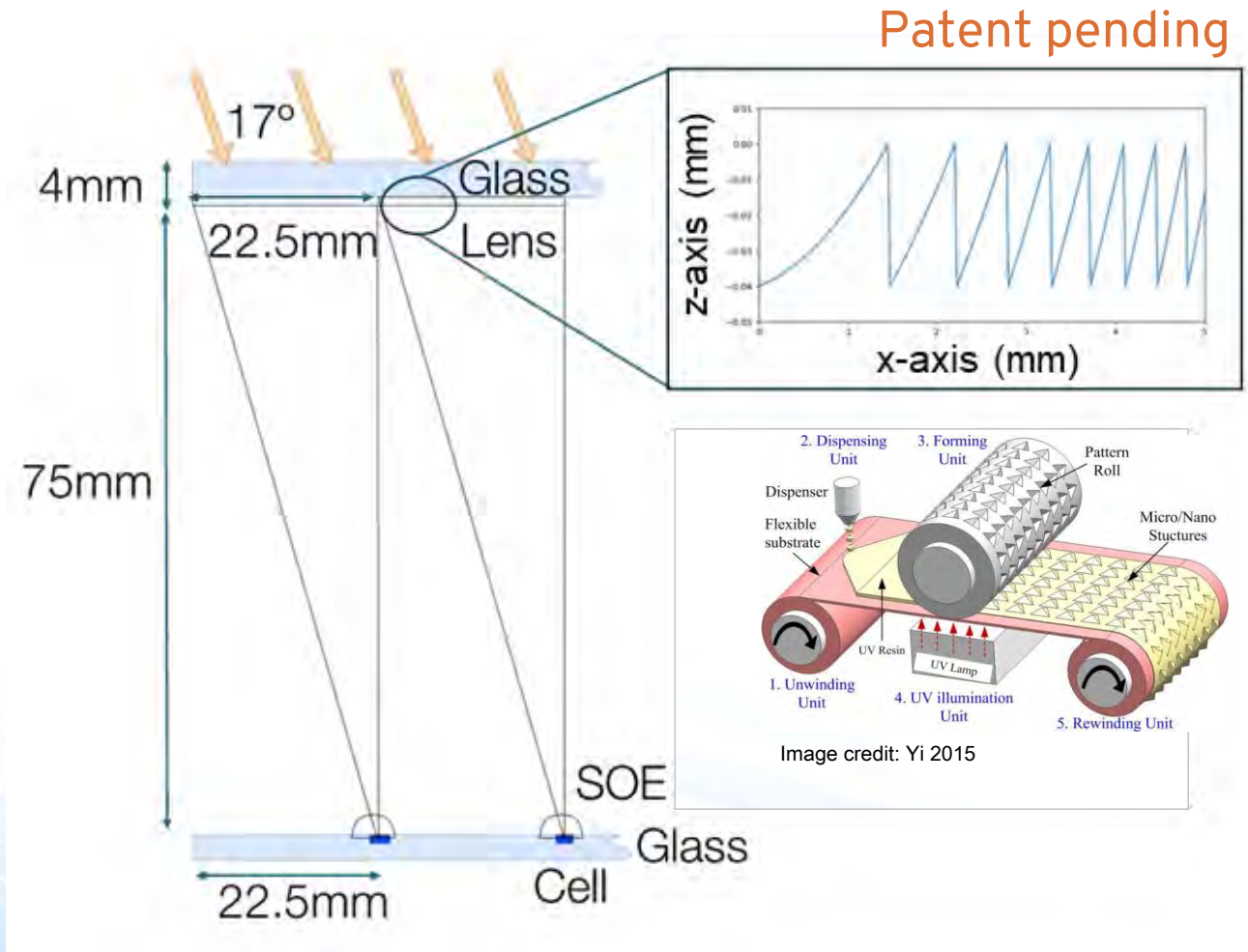
c-Si cell array

Homogeneous daylighting



# Technical approach

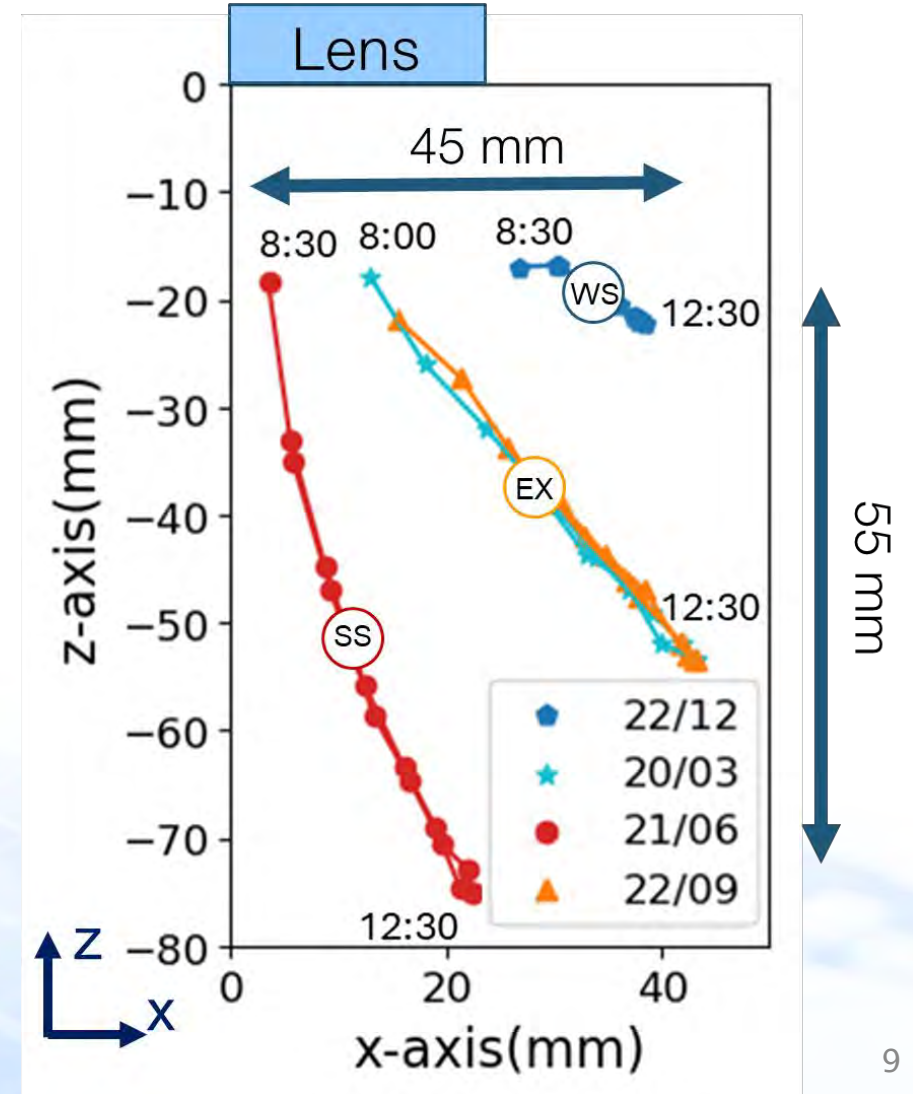
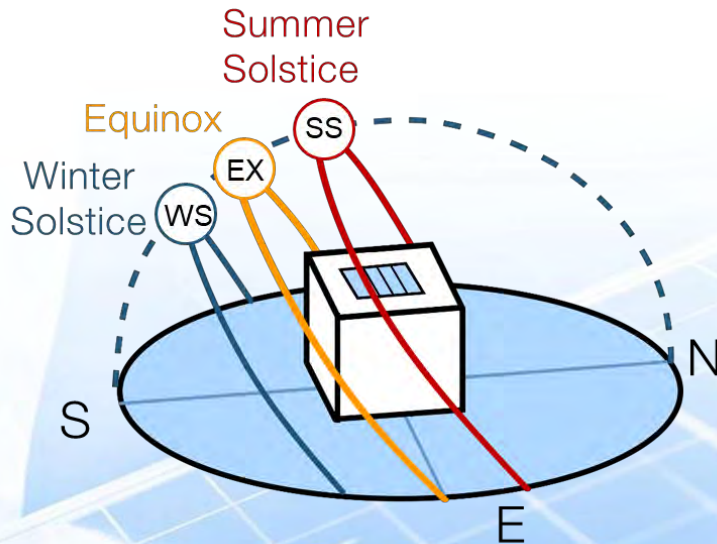
- 10X ultra-thin ( $40\ \mu\text{m}$ ) linear Fresnel array
- Low-cost roll-to-plate manufacturing on conventional glazing
- Strip Si cells





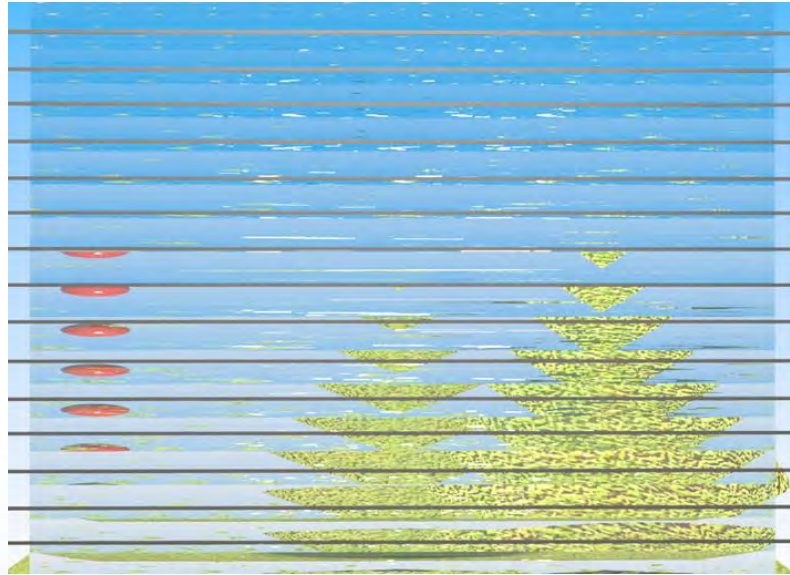
# Technical approach

- Small daily micro tracking displacements (few cm)
  - Based on proven vehicle mirror actuator technology



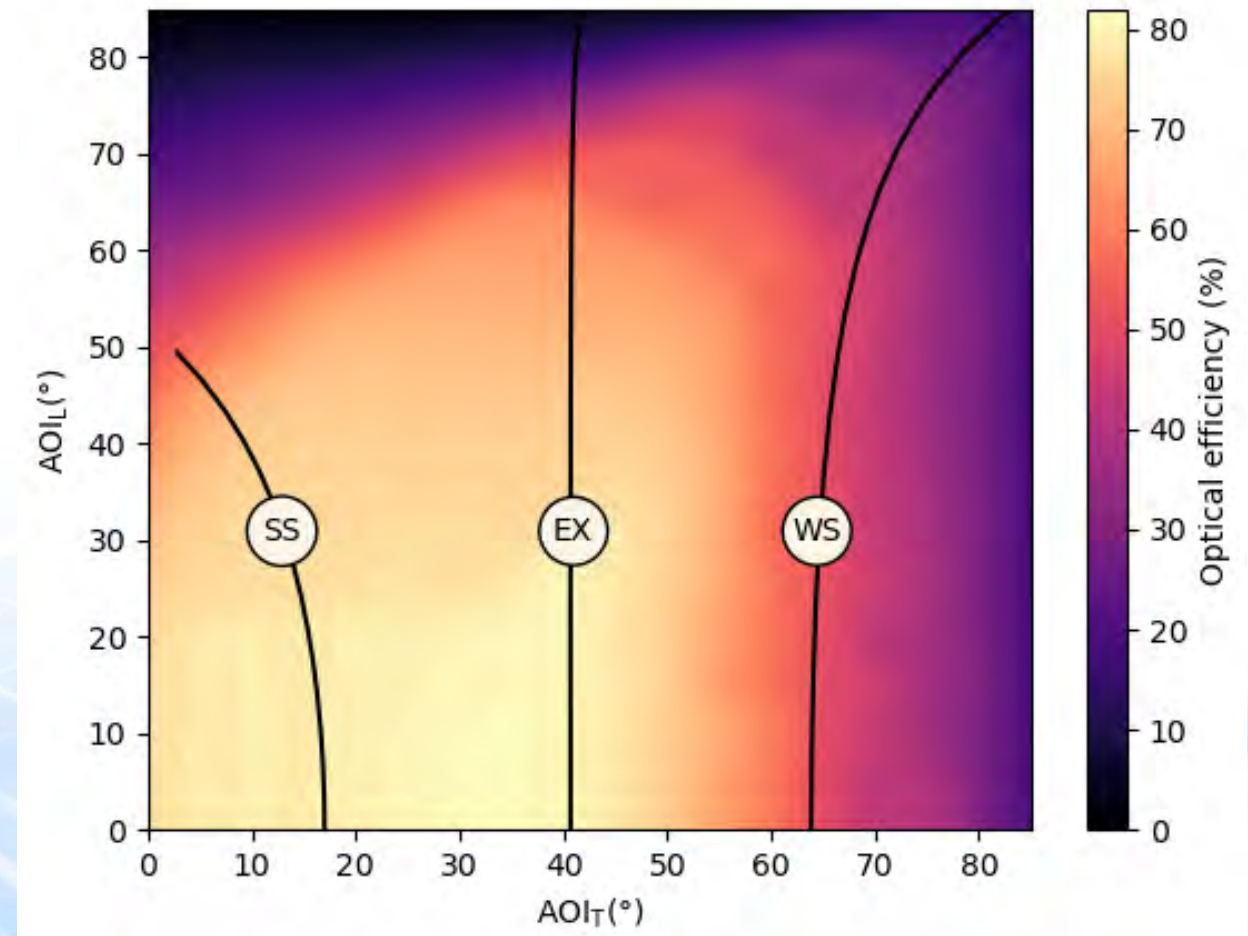
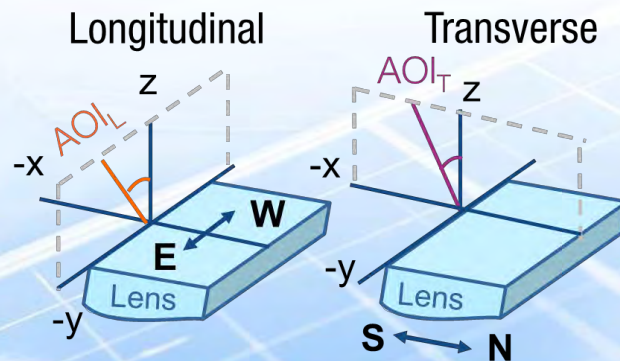
# Applications

- Glazing areas w/out the need of direct view
- Compatible with conventional curtain wall / skylight glazing systems

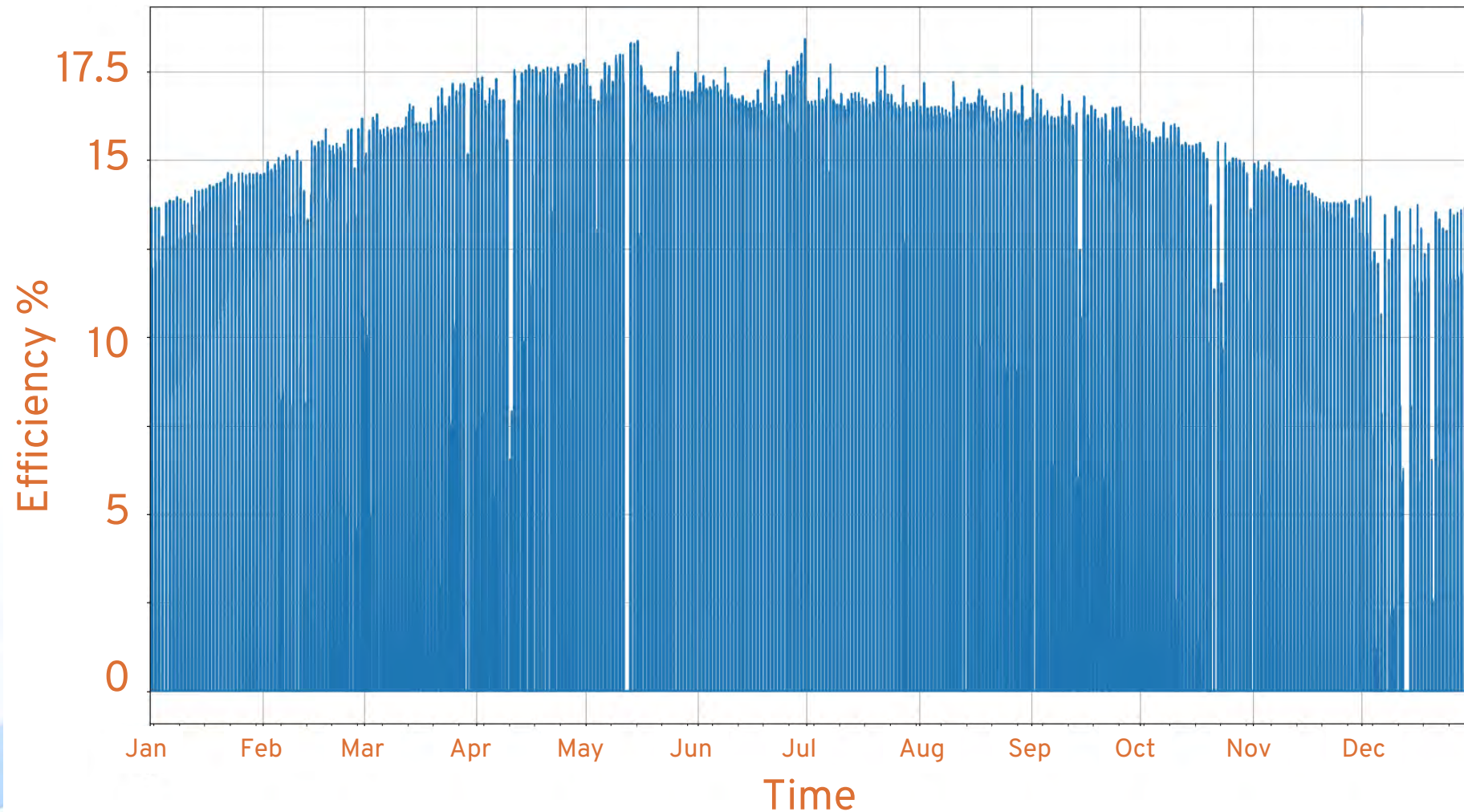


# Performance: direct light capture

- >70% optical efficiency over wide range of solar positions
- High energy yield

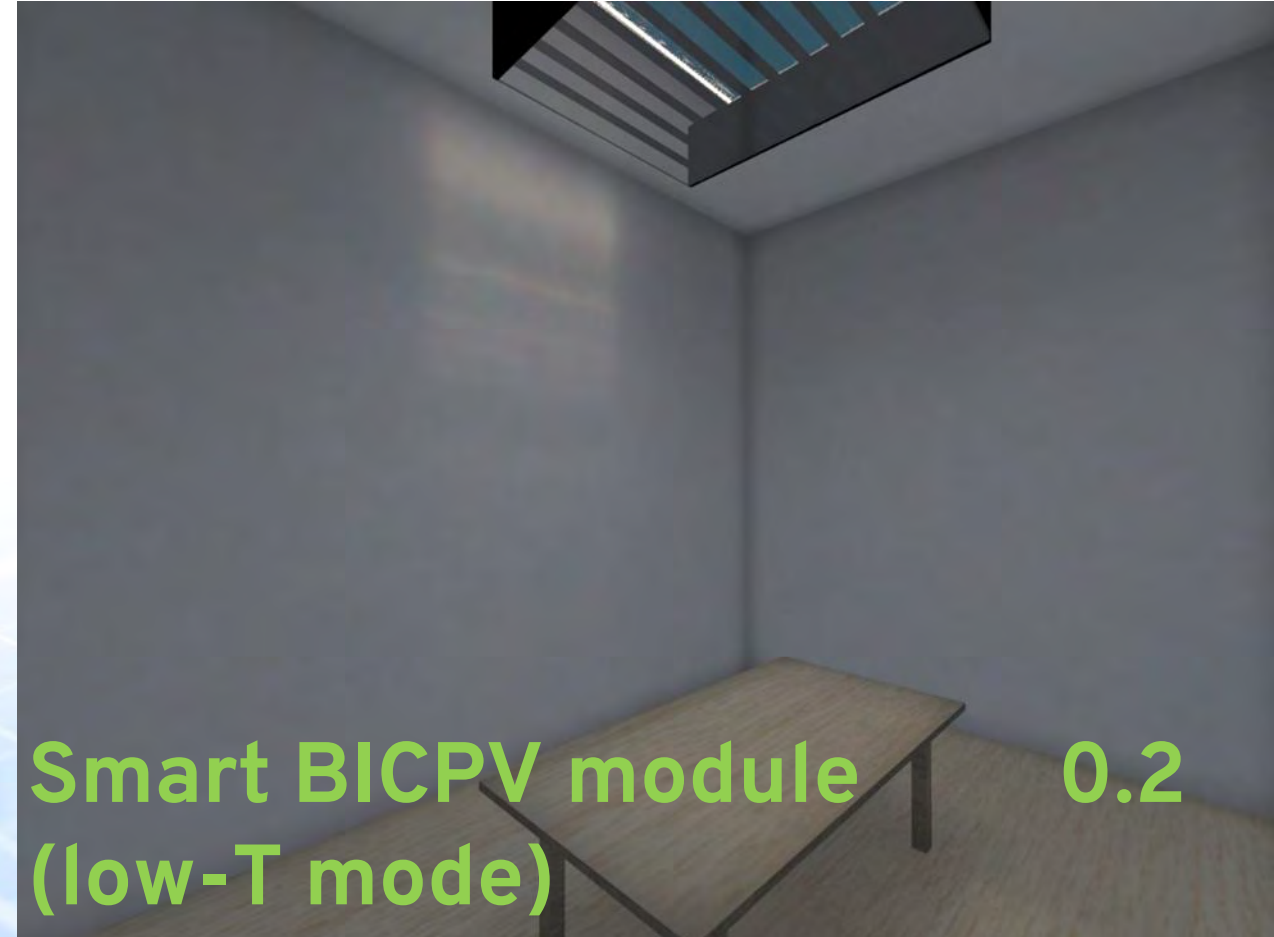


# Performance: electricity generation



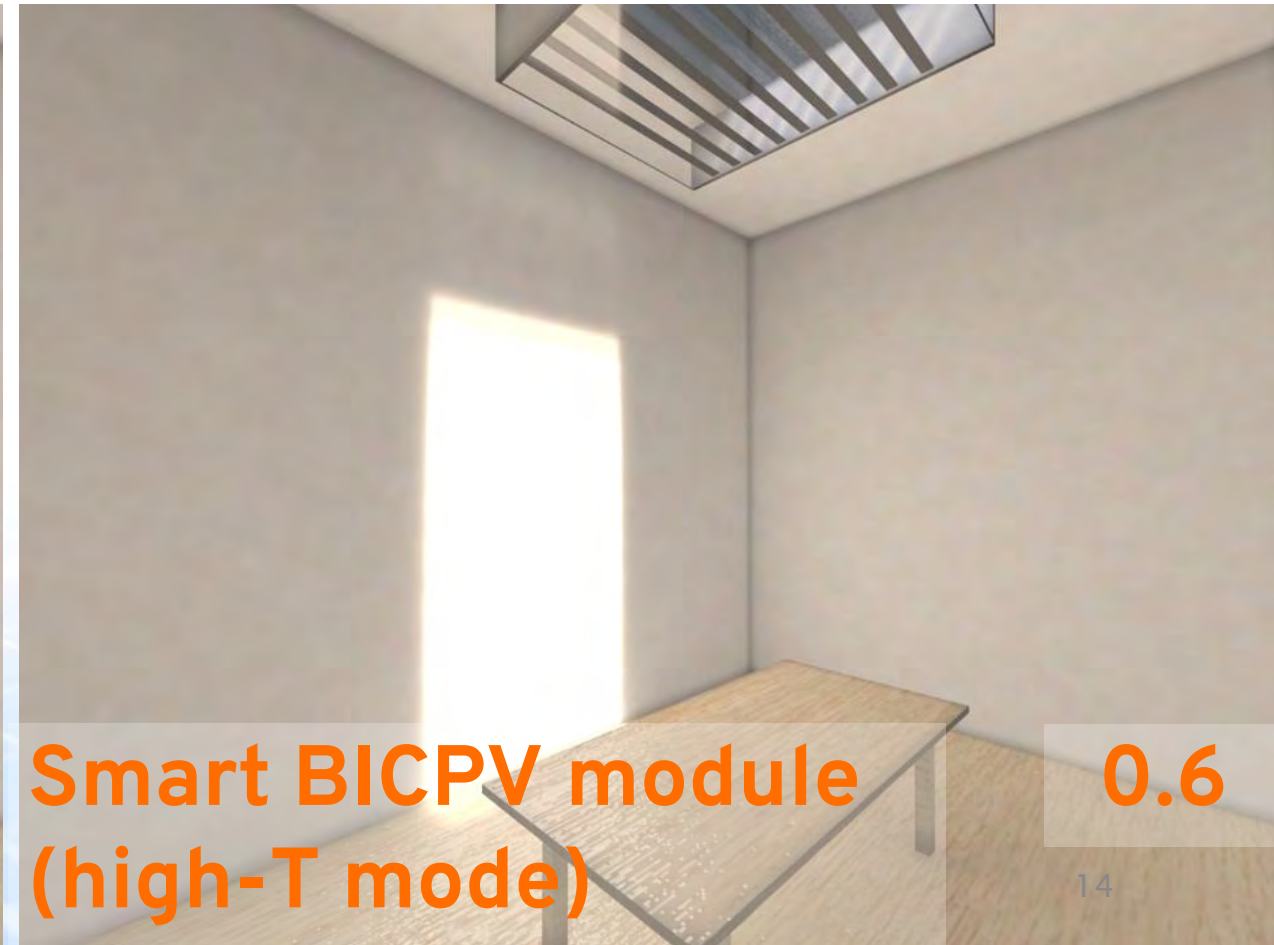
# Performance: daylighting

Daylight glare probability (DGP)



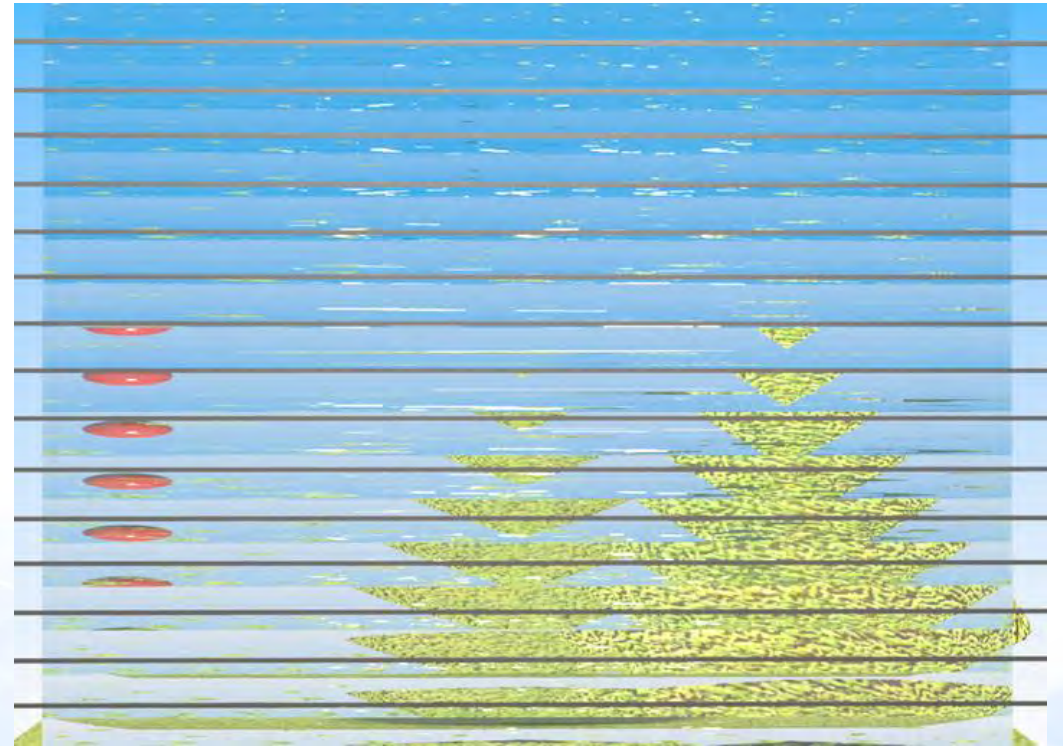
# Performance: daylighting

Daylight glare probability (DGP)



# Performance: color rendering

- Semi-translucent module
  - No image from outdoors, but nice blue-sky appearance
  - No view of direct sunlight (low-T)
- Accurate color rendering
  - CRI  $R_a$  99% in low-T (3X)
  - CRI  $R_a$  98% in high-T



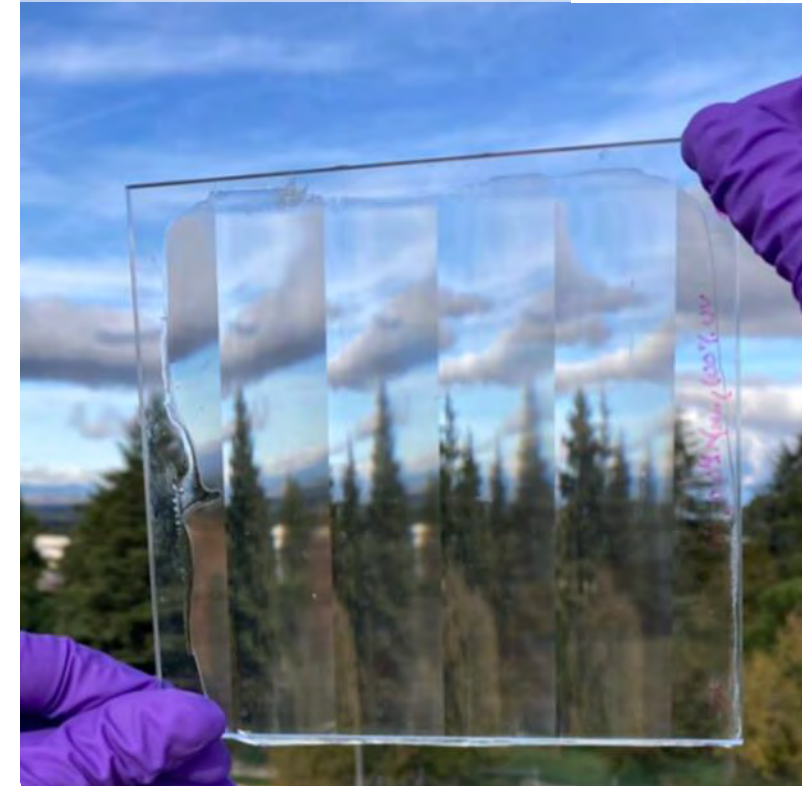
# Performance summary

Parameter	Low-T mode (solar protection)	High-T mode
Peak power density (CSTC)	180 W/m <sup>2</sup>	Off
Solar transmission	9%	68%
Visible light transmission	6% 35%-49% of diffuse light	68%
Reflectivity	19%	19%
Direct light blockage	94%	28%
Daylight glare probability	0.2	0.6
CRI R <sub>a</sub>	99%	98%

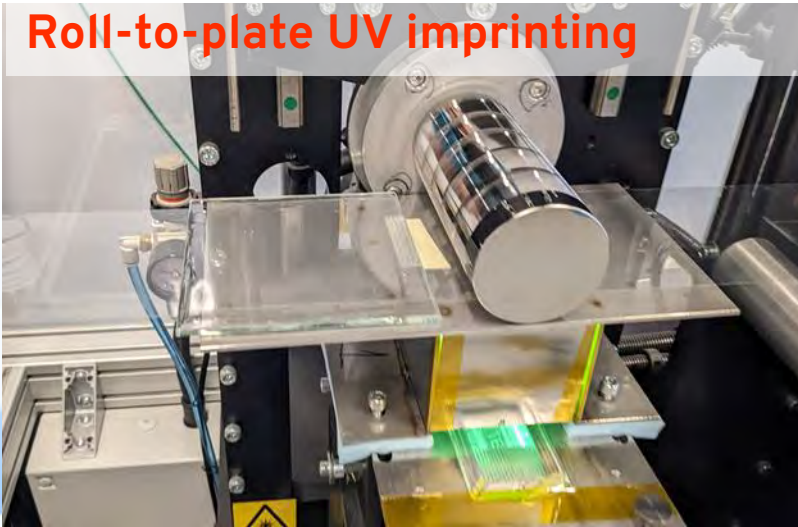


# Ongoing work

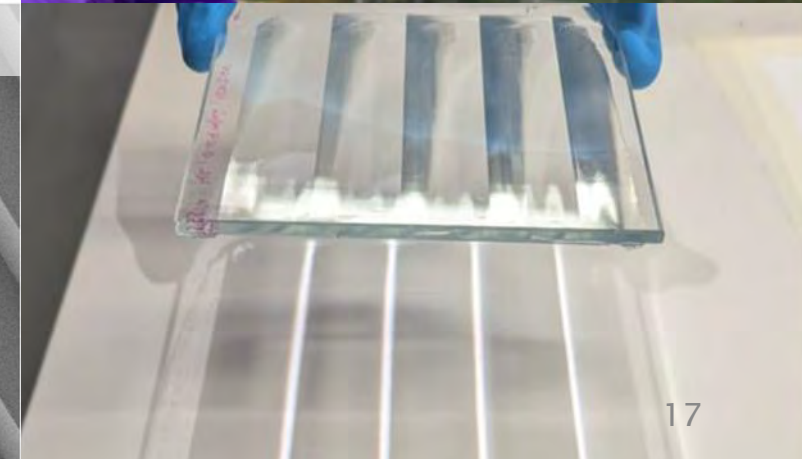
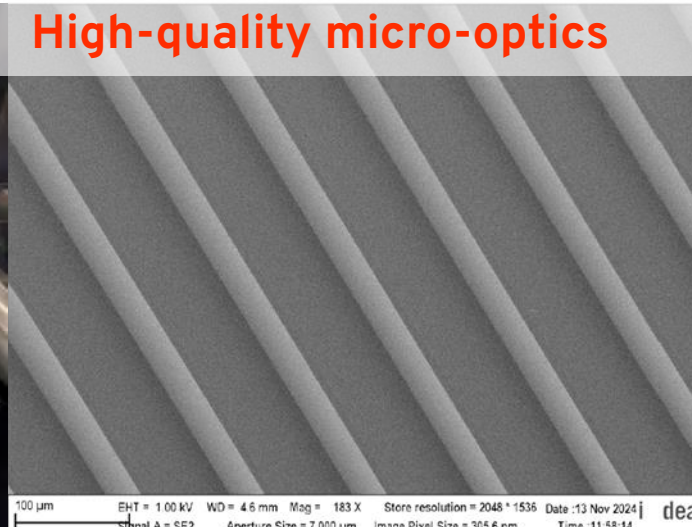
- Development of BIM model (Rhinceros/Honeybee Radiance)
- Mechanical integration
- First prototypes: roll-to-plate UV imprinted lens arrays on glass



Roll-to-plate UV imprinting



High-quality micro-optics



Direct light concentration

# Conclusions / Path ahead

- Glazing with high PV power density
- Low-glare, 'blue sky' daylighting
- Active daylight management
  
- Looking for partners to increase TRL
  - Industry: glazing / building envelope / BIPV manufacturers
  - Architectural / building designers / public demonstrators
  - European consortium



# Thank you!



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**Plan de Recuperación,  
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