Schüco Italia Headquarter, Padova, ITA

1. INTRODUCTION

PROJECT SUMMARY

- *Year of construction: 1990*
- *Past energy renovations: None*

SPECIAL FEATURES

- *Glazing facades and shading systems*
- *600 kWp photovoltaic system*
- *solar cooling, absorption chiller 15 kWf*
- *10 m^2 solar collectors for DHW*

ARCHITECT

B+B Associati (Renato Bredariol e Marco Bonariol)

OWNER

Schüco International Italia s.r.l.

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IEA – SHC Task 47

Renovation of Non-Residential Buildings towards Sustainable Standards

SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY

2. CONTEXT AND BACKGROUND

BACKGROUND

- *The building is located in the industrial district of Padova.*
- *20.900 m² net heated floor area (1.300 m² boat office area, 2.500 m²* butterfly office area*).*
- *Occupational profile: the offices are occupied from 08:00 to 20:00.*

OBJECTIVES OF THE RENOVATION

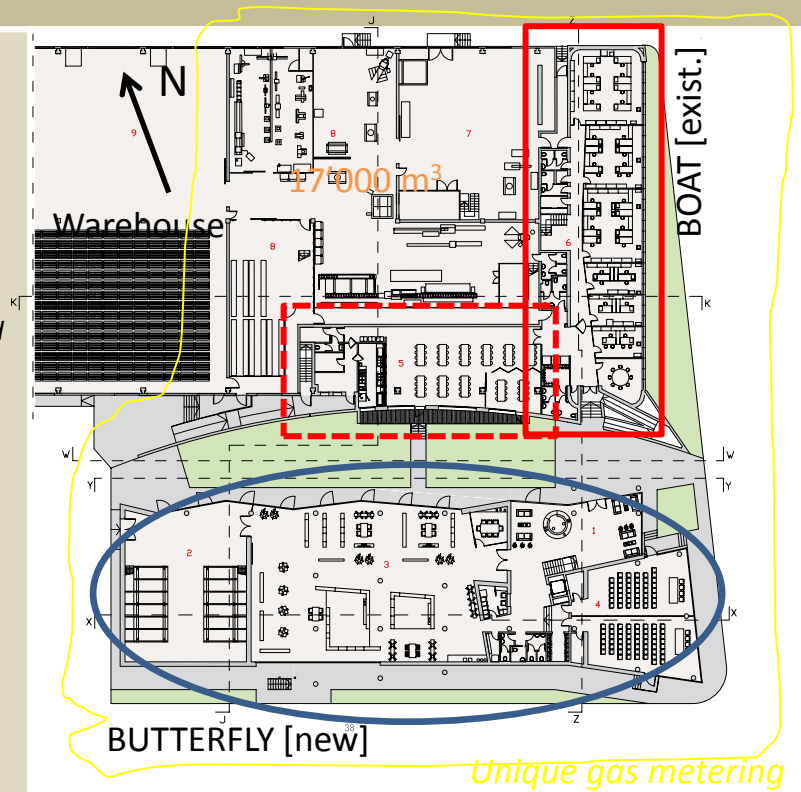
- *Increased office area.*
- *Creation of a restaurant area.*
- *Creation of a showroom area.*
- *Reduction of heating and cooling energy consumption to obtain Energy Label A certification for both the new and renovated building.*

Critical points

- *No measured data available.*
- *Problematic split of consumptions between renovated and new building.*
- *No information on the energy consumption of the original building.*

SUMMARY OF THE RENOVATION

- *Considerable energy reduction for heating and cooling.*
- *600 kWp photovoltaic system.*
- *Costs: approximately 7,2 M€ (renovation and new construction).*



3. DECISION MAKING PROCESSES

- The project was initiated by the General Manager, Technical Director and German parent company.
- A need for more space and the decision to restore a building on an industrial estate at Padua: a challenge.
- Good level of energy efficiency together with high indoor comfort, without exceeding a reasonable economic budget.
- Serve as an exemplary case.
- Up-to-date technologies and products [building envelopes and renewable energy] to build a construction where the mission to save and produce energy is clear and visible.
- To create a large structure for the training and for showroom.
- To use the same building components both in the refurbished and new building.
- No public funding programs involved.
- No changes in the ambition level during the process. No reduced operational costs were used for payback.
- No information available about the selection of contractor and subcontractors.

Timeline for the decision making process

Idea was born
2008

↓

First brief project description completed
Mar 2008

↓

Detailed project description completed
Jun 2008

↓

Tendering process started
No tendering process

↓

Signing of contract with main contractor
xx

↓

Start renovation
Nov 2008

↓

Renovation completed
Oct 2009

↓

Evaluation among occupants
dd.mm.year

4. BUILDING ENVELOPE BOAT

Roof construction: *U-value: 0,296 W/m²K*

Materials: (Exterior to interior): ***example:***

Gravel tiles	*30 mm*
Waterproofing	
Concrete	*40 mm*
Polystyrene insulation	*120 mm*
Concrete slab	*400 mm*
Air space	*70 mm*
Plasterboard	*20 mm*
Total	*680 mm*

Wall construction: *U-value: 0,56 – 0,25 W/m²K*

Materials: (Interior to exterior): ***example:***

Polystyrene insulation	*60 mm*
Concrete	*200 mm*
Rockwool insulation	*80 mm*

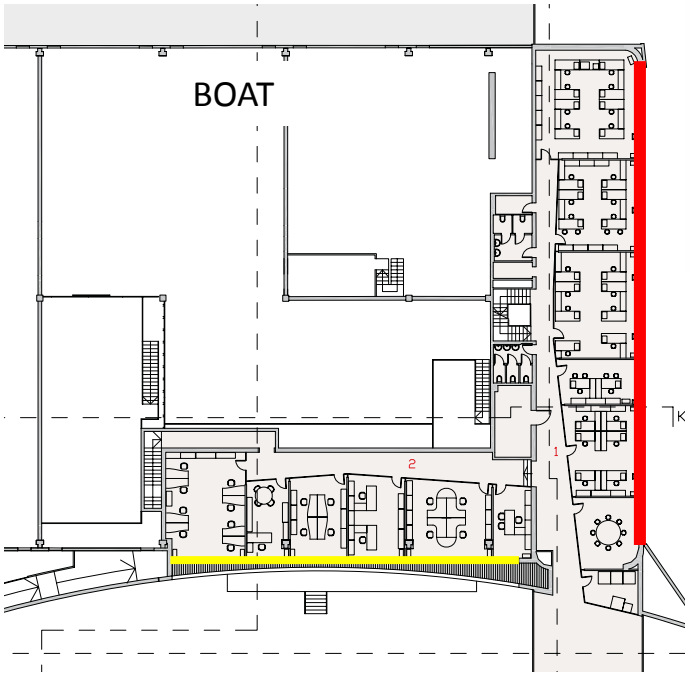
Windows: : *U-value: 1,25 - 1,6 W/m²K*

Materials: Low-emissivity glass
Aluminum frame

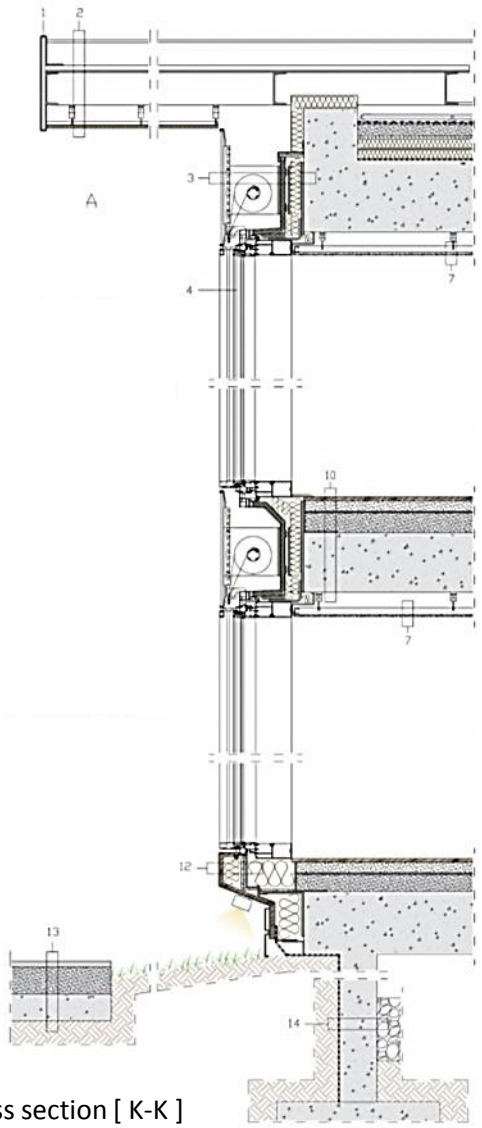
Summary of U-values [W/m²K]

BOAT	Before	After
Roof/attic	1,48	0,296
Walls	1,25	0,378
Windows	4,0	1,6

BUTTERFLY	Before	After
Roof/attic	-	0,296
Walls	-	0,250
Windows	-	1,6



Window : AWS65 [U_w: 1,25 W/m²K]
Shielding : external louvers, internal roller blind
Window: E2 [U_w: 1,6 W/m²K]
Shielding: automated sun blind control system (external roller micro-louver) [$g_{glaz+shad}$ = 0,06]



Cross section [K-K]

4. BUILDING ENVELOPE
BUTTERFLY

Roof construction: *U-value: 0,296 W/m²K*

Materials: (Exterior to interior): ***example:***

Gravel tiles	*30 mm*
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Concrete	*40 mm*
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Windows: *U-value: 1,25 - 1,6 W/m²K*

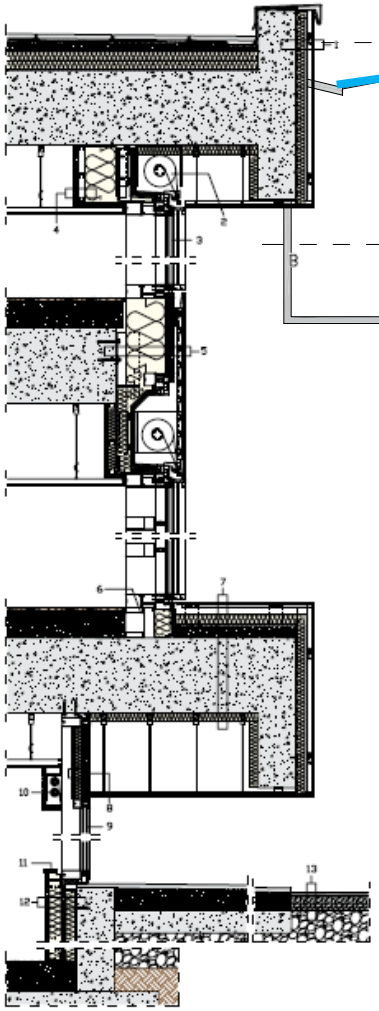
Materials: Low-emissivity glass

Aluminum frame with thermal break

Summary of U-values [W/m²K]

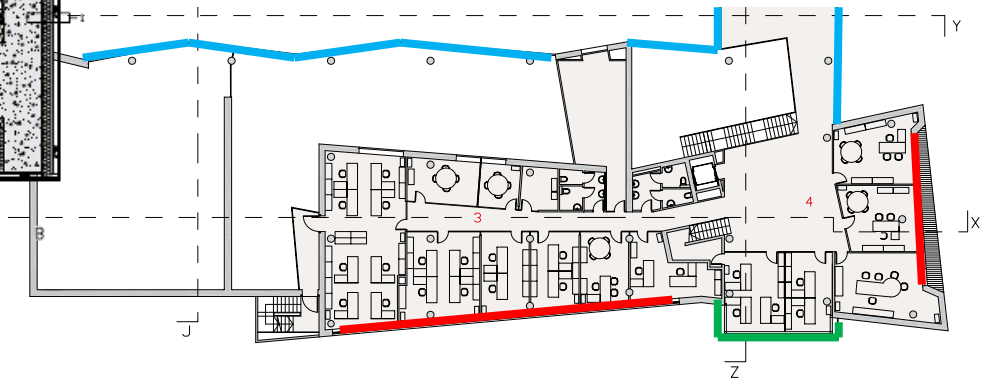
BOAT	Before	After
Roof/attic	1,48	0,296
Walls	1,20	0,378
Windows	4,0	1,6

BUTTERFLY	Before	After
Roof/attic	-	0,296
Walls	-	0,250
Windows	-	1,6



Cross section [X-X]

BUTTERFLY



Window: E2 [U_w: 1,6 W/m²K]
Shadings: automated sun blind control system (external roller blinds) [$g_{glaz+shad}$ = 0,06]

Window: FW 60 [U_w: 1,5 – 1,8 W/m²K]

Bow-window: double skin facade
Internal window: AWS 70HI [U_w: 1,55 W/m²K]
External window: FW 60 [U_w: 1,5 W/m²K] with integrated thin film glass-glass photovoltaic modules (amorphous thin-film)
Shadings: automatic internal roller blinds [$g_{total\ (double\ skin\ facade)}$ = 0,1]

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5. BUILDING SERVICES SYSTEM

OVERALL DESIGN STRATEGY

Real-life demonstration of Schuco components and technology (example for other projects).

LIGHTING SYSTEM

- *Lighting power: 28,5 kW (boat), 33,5 kW (butterfly), 4,5 kW (external).*
- *Internal heat gains: 24 W/m² (overall).*

HEATING SYSTEM

- *Existing: n°2 condensing boiler (615 kW).*
- *New: ground-coupled heat pumps (17 kW), 7 DN32 vertical pipe probes (depth 80 m) (10 m² solar panels integration).*

HOT WATER PRODUCTION

- *Existing: electric boiler.*
- *New: 10 m² solar thermal collectors [4 Schüco CTE 520 OF2 glazed flat collectors].*
- *(geothermal heat pumps integration in winter; (regeneration of heat probes in summer).*

COOLING SYSTEM

- *Existing: n°2 chiller (536 kWf).*
- *New: solar cooling, absorption chiller (15 kWf), 18 solar collectors (45 m²) [Argon filled double glazed top unit].*

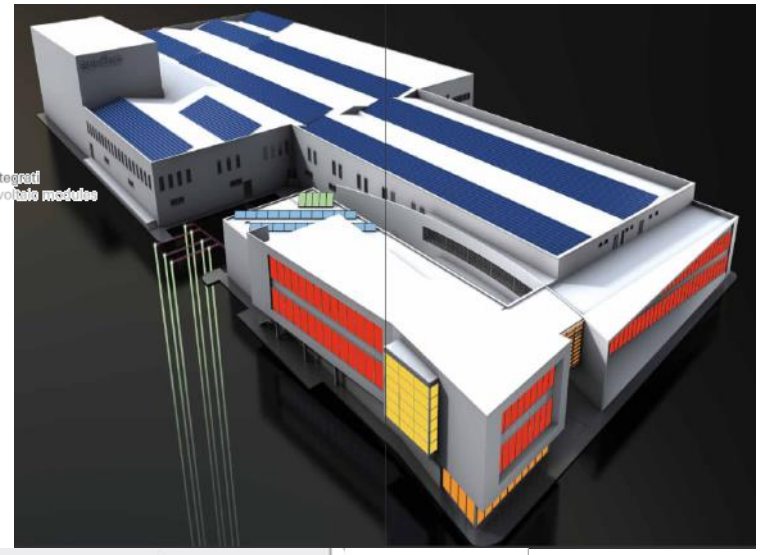
VENTILATION

- *UTA system (offices and canteen).*

RENEWABLE ENERGY SYSTEMS

- *600 kWp PV plant on the warehouse's roof (4 550 m², 3 570 monocrystalline modules).*
- *PV clad double skin bow-windows façade (amorphous thin-film, 3 kWp).*
- *9 + 1,8 kWp for test.*

- Opening mechanism of the windows: horizontal pantograph movement opening outwards.
- Automated shielding for exploitation of natural light and reduction of thermal load through the windows façade.



New (SHOWROOM):

- Radiant panels (heating + cooling)
- Ground coupled heat pump + tank-in tank storage
- Solar cooling plant
- Solar thermal collectors (DHW + heating support)

Existing:

- Heating and cooling power plant
- Fancoil system (even for butterfly office)
- UTA system (boat office)

New (Floor1 and Floor2):

- Fancoil system
- UTA system (showroom, office and conference room)

6. ENERGY PERFORMANCES

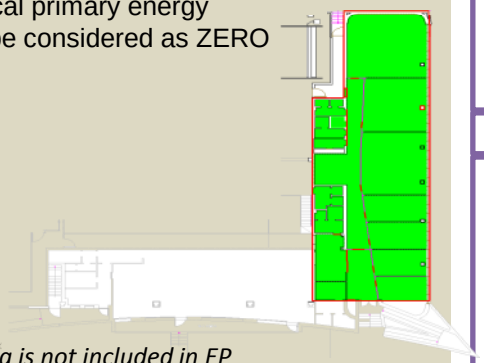
- Purchased energy consumption:
  40 000 m^3 gas (± 30%); 1.0 GWh electric
- Conditioned S_U = 5 956 m^2
  (1 334 exist, 2 461 new, 2 161 warehouse)

THERMAL

- Energy performance (kWh/m^2)
  EP =102.7 kWh/m2/y (declared)
- Primary energy consumption (*):
  EP = 21.6 kWh/m^2/y (calc.) [- 47%]
- ... + (warehouse, 2 conditioned floors of the new building, kitchen)

ELECTRICAL

- Photovoltaic production: 650 000 kWh/y
- Electrical primary energy could be considered as ZERO



(*) lighting is not included in EP

Naturally ventilated, NO cooling

Primary energy factor:
1.0 (gas), 2.18 (electricity)

No measurements available!

Dynamic simulation [TRNSYS]. Heating, cooling, ventilation and hot water. Lighting is not included.

No data about former energy consumptions!

		S_U = 1'334 m^2 AFTER		S_U = 818 m^2 BEFORE	
		Delivered en. kWh/m^2/y	**Primary en.** $kWh_{FPh}/m^2/y$	**Delivered en.** kWh/m^2/y	**Primary en.** $kWh_{FPh}/m^2/y$
HOT WATER	Fancoils-offices	10.22	10.22	93.60	93.60
	Fancoils-canteen	0.85	0.85		
	AHU-offices,heating	15.71	15.71		
	AHU-offices,post-heating	7.90	7.90		
	AHU-canteen,heating	9.58	9.58		
	AHU-canteen,post-heating	2.69	2.69		
	Radiators	0.58	0.58	3.41	3.41
	Kitchen	11.93	11.93		
	Dressing room	1.98	1.98		
	kWh/m^2/y	**61.46**	**61.46**	**97.01**	**97.01**
COLD WATER	Fancoils-office	3.34	7.26		
	Fancoils-canteen	0.20	0.44		
	AHU-offices,cooling&dehum	4.02	8.73		
	AHU-canteen,cooling&dehum	1.36	2.96		
DHW	Domestic Hot Water	3.59	7.80	4.83	10.51
ELECTRICAL CONSUMPTIONS	Fans AHU-offices	12.98	28.22		
	Fans-AHU-canteen	3.15	6.85		
	Fans, Fancoils-office	0.60	1.30	0.93	2.03
	Fans, Fancoils-canteen	0.03	0.06		
	Fans, Kitchen	3.10	6.73		
	Fans, Dressing room	0.40	0.88		
	Pumps, fancoils	1.52	3.31	2.51	5.47
	Pumps, AHU	6.02	13.10		
	Pumps, AHU post-heating	0.75	1.63		
	kWh/m^2/y	**41.06**	**89.27**	**8.28**	**18.00**

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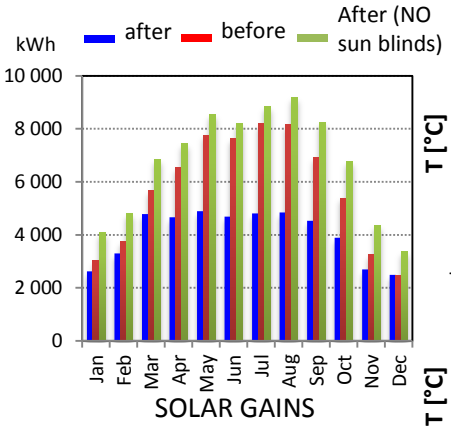
CLARIFICATION: the energy calculations and given energy numbers will be according to the national standards which might vary between countries., i.e. numbers are not always comparable

7 ENVIRONMENTAL PERFORMANCE

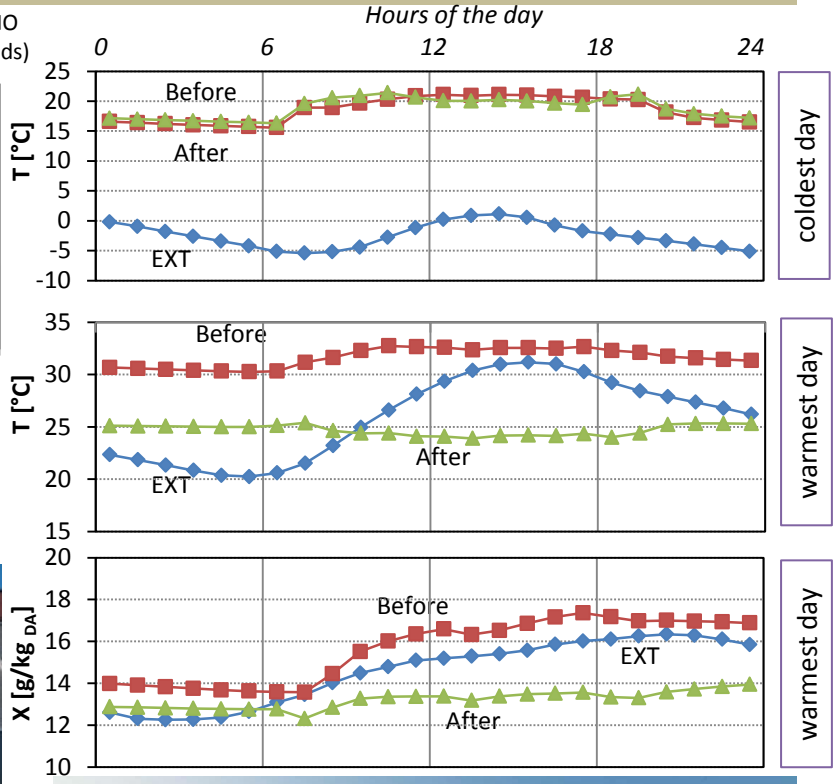
Indoor climate

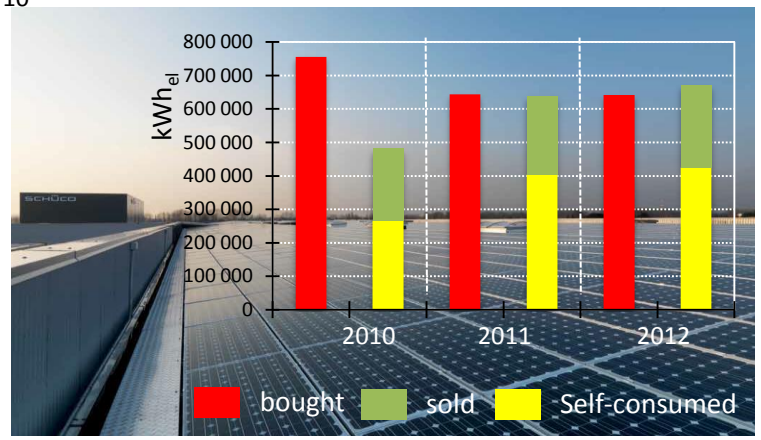
As the figures on the right show, the thermal conditions during the summer season have improved significantly.



AFTER – BEFORE: -30%
(-14% winter, -39% summer)

AFTER – AFTER without blinds: -40%
(-35% winter, -45% summer)





8. MORE INFORMATIONS

RENOVATION COSTS

- *7,2 M€ renovation and new constr. (+ 0.81 M€ automated warehouse)*

	M€
Building (Existing)	0.92
Building (New)	4.28
HVAC system	0.78
Electrical system	0.64
Design & project management	0.50
Others	0.10

Gross conditioned area:
1 515 m² exist. building, 2 796 m² new building

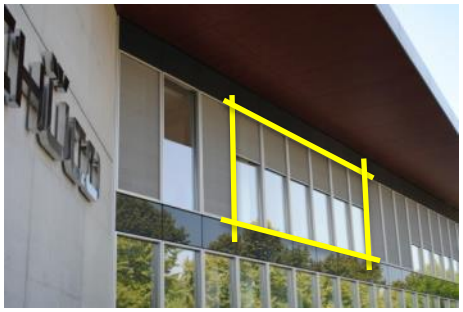
- *Cost of renovation: 1 120 €/m²*
- *Cost for the new build: ≈ 2 000 €/m²*
- *Overall cost: 1 680 €/m²*

FINANCING MODEL

- No information (no subsidized loans, no grants, no ESCO contracts).

OTHER INTERESTING ASPECTS

- Solar gains and solar shading systems.



micro-louvres

Irradiation threshold on external surfaces (120 W/m² in summer, 200 W/m² in winter).

In winter the shading system does not fully close

Users can control the shadings.