

LIMA – Low Impact Mediterranean Architecture

SaAS

Sabaté associats
Arquitectura i Sostenibilitat

Joan Sabaté / Christoph Peters

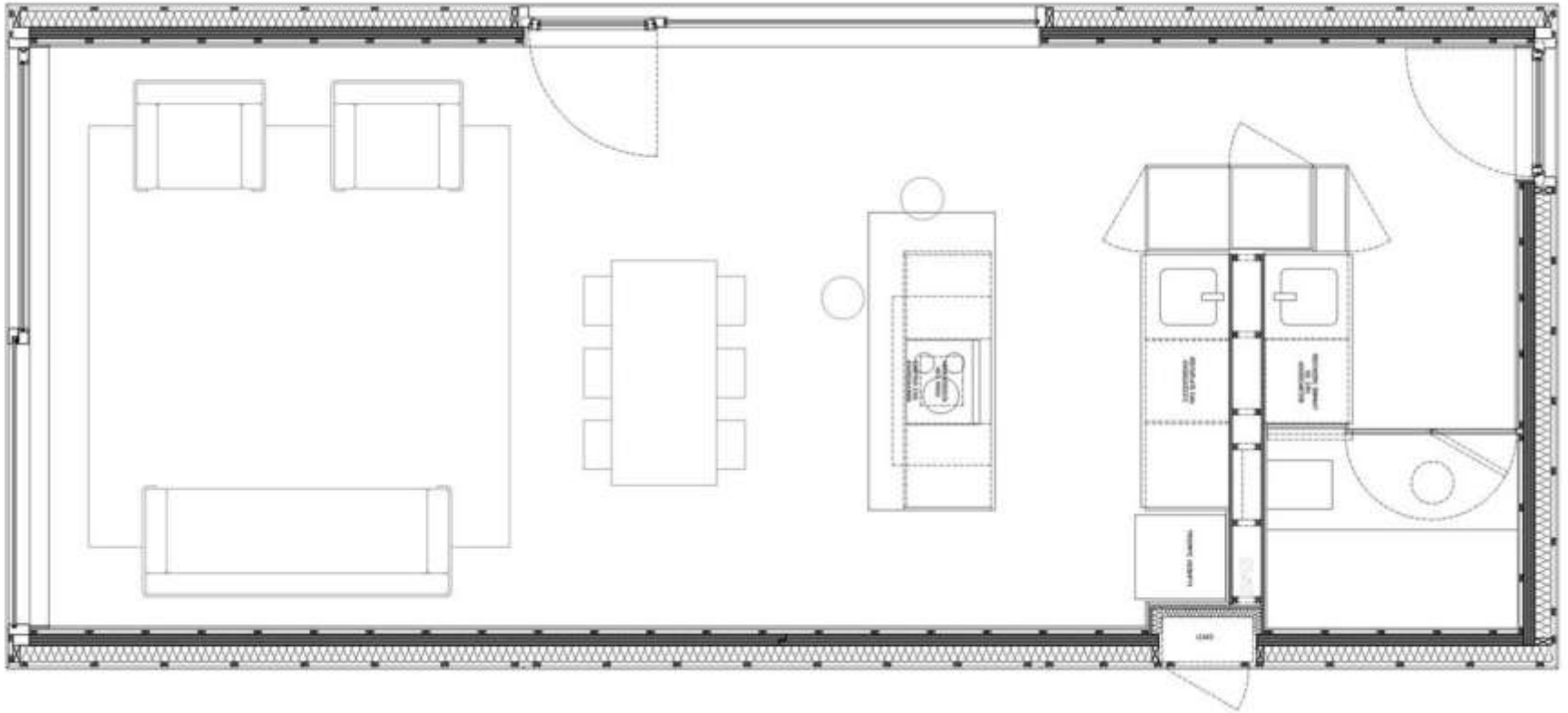


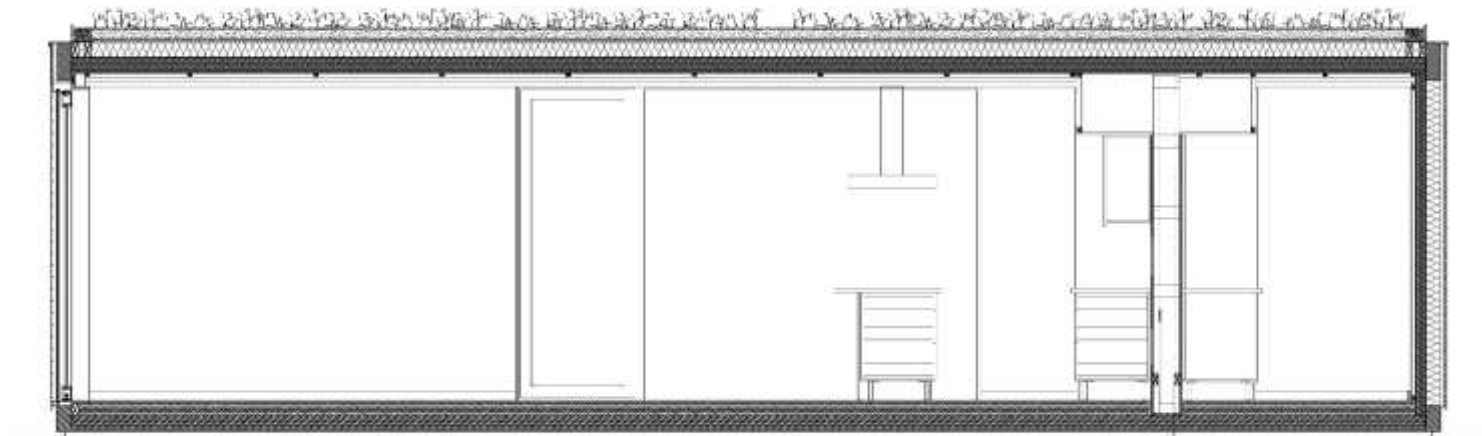
Workshop “Experiences on Net Zero Energy Buildings”

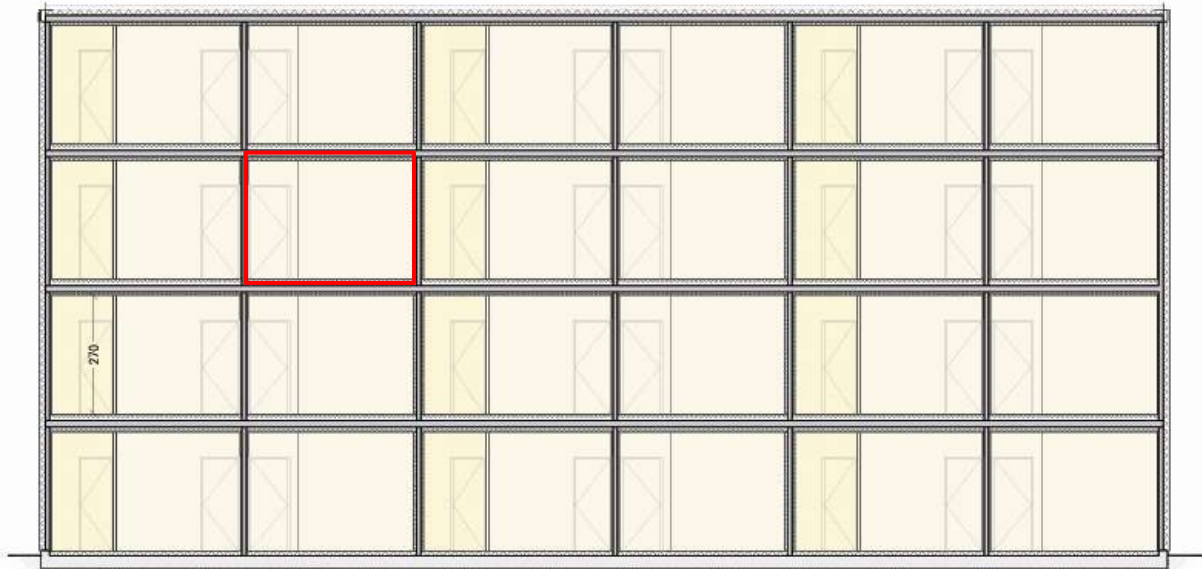
Barcelona - 03-10-2012 – LIMA housing prototype



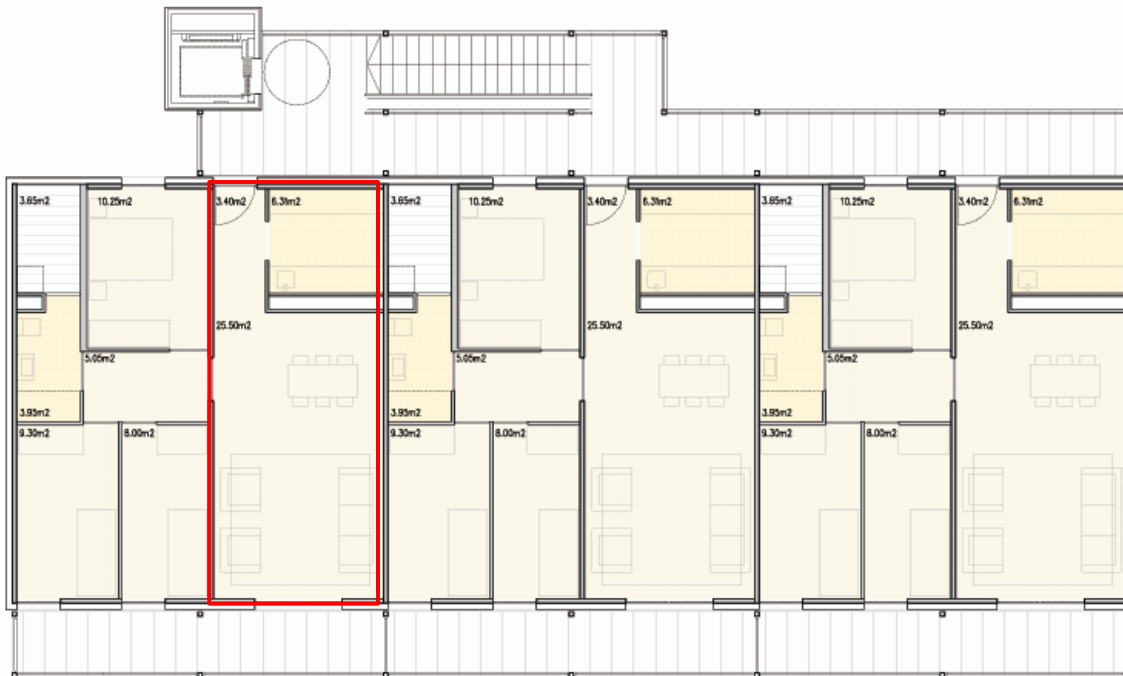
An initiative to demonstrate the technical and economical feasibility to reduce drastically the environmental impact of buildings in the Mediterranean, increasing quality of life







LIMA, reference 12 apartment block, ground floor + 3









LMA
LOW IMPACT
MEDITERRANEAN
ARCHITECTURE

LOW IMPACT MEDITERRANEAN ARCHITECTURE

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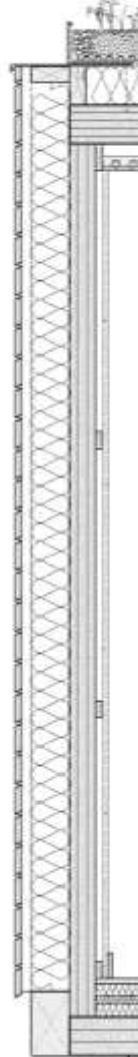
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Façade

- sol-silicate mineral paint on plasterboard
- plasterboard cladding, 15 mm
- pine^{FCS} rails, 30x50 mm
- cross grain laminated conifer ^{PEFC} wood panels, 78 mm
- fastenings with non-chrome self tapping screws
- wood fibre ^{FSC} insulating board, 4% PUR glue, 120 mm
- semi-permeable polypropylene membrane 100gr/m²
- pine ^{FSC} confining batons, 120x50 mm
- pine ^{FSC} substructure, 30x50 mm
- fibreglass mosquito netting
- propylene interior insect protection screen
- larch ^{FSC} panelled finishing, 19x95 mm
- exterior and interior woods treated with natural oils

Width	000.26	m
Weight	108.02	Kg/m ²
Thermal transmittance	000.26	W/m ² ·K
Prime energy	607.96	MJ/m ²
Greenhouse gas emissions	- 51.26	Kg CO _{2eq} /m ²
Acidification potential	000.26	Kg SO _{2eq} /m ²
Cost	126.91	€/m ²

Construction and insulation

Windows: High efficient double glazing ($U_{\text{glazing}} = 1.1 \text{ W/m}^2\text{K}$, $g = 0.53$)
Sun shading All façades: daylight optimised high efficient movable sun shading

Walls, floor and roof: **12 cm** insulation



Element	Unit	CTE maximum	WEO economic optimum	LIMA implemented	Reduction LIMA to CTE
wall	$\text{W/m}^2\cdot\text{K}$	0.73	0.35	0.26	64%
roof	$\text{W/m}^2\cdot\text{K}$	0.41	0.27	0.25	39%
floor	$\text{W/m}^2\cdot\text{K}$	0.50	0.85	0.36	28%

Ventilation system:

Infiltration air exchange rate: 0.20 /h
Air exchange rate during occupation summer: 0.52 /h
Air exchange rate during occupation winter: 0.40 /h

Setpoints heating and cooling system

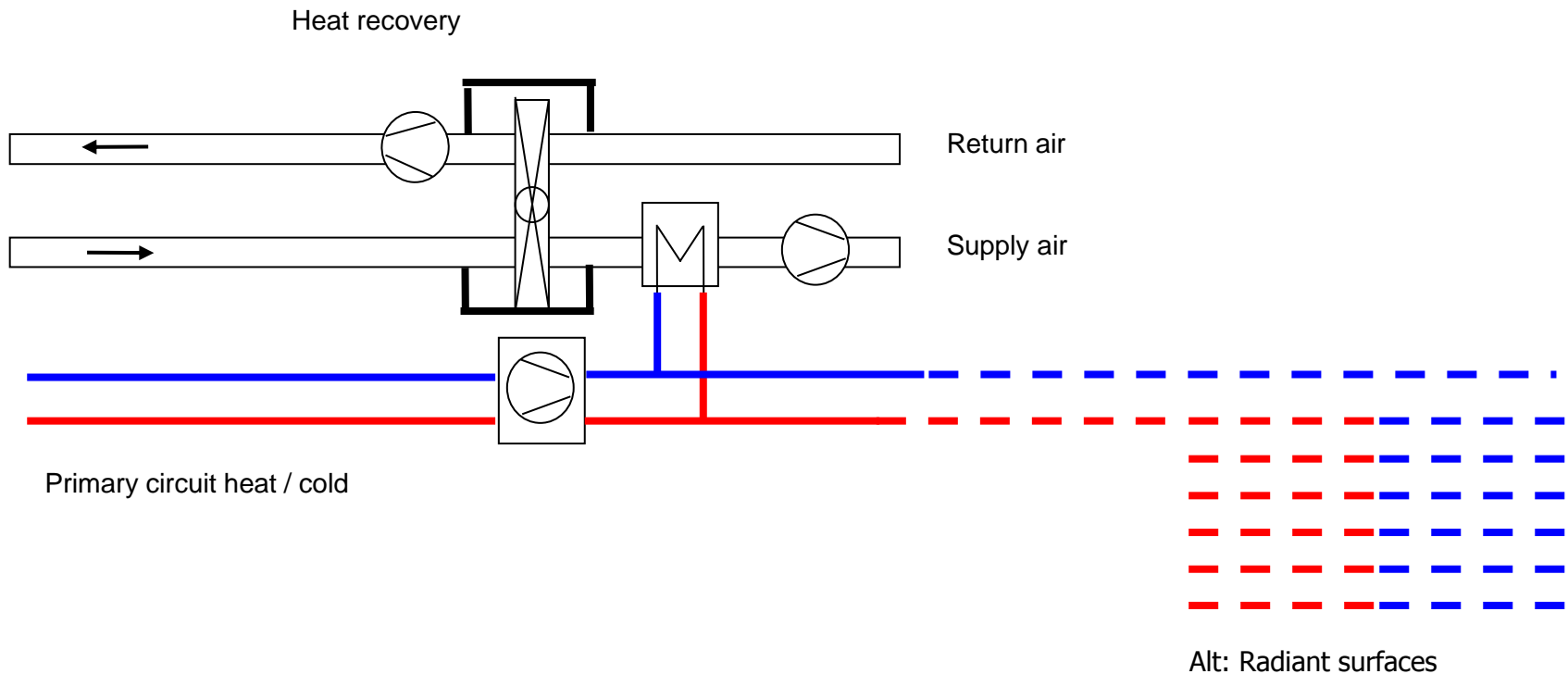
- Heating system:

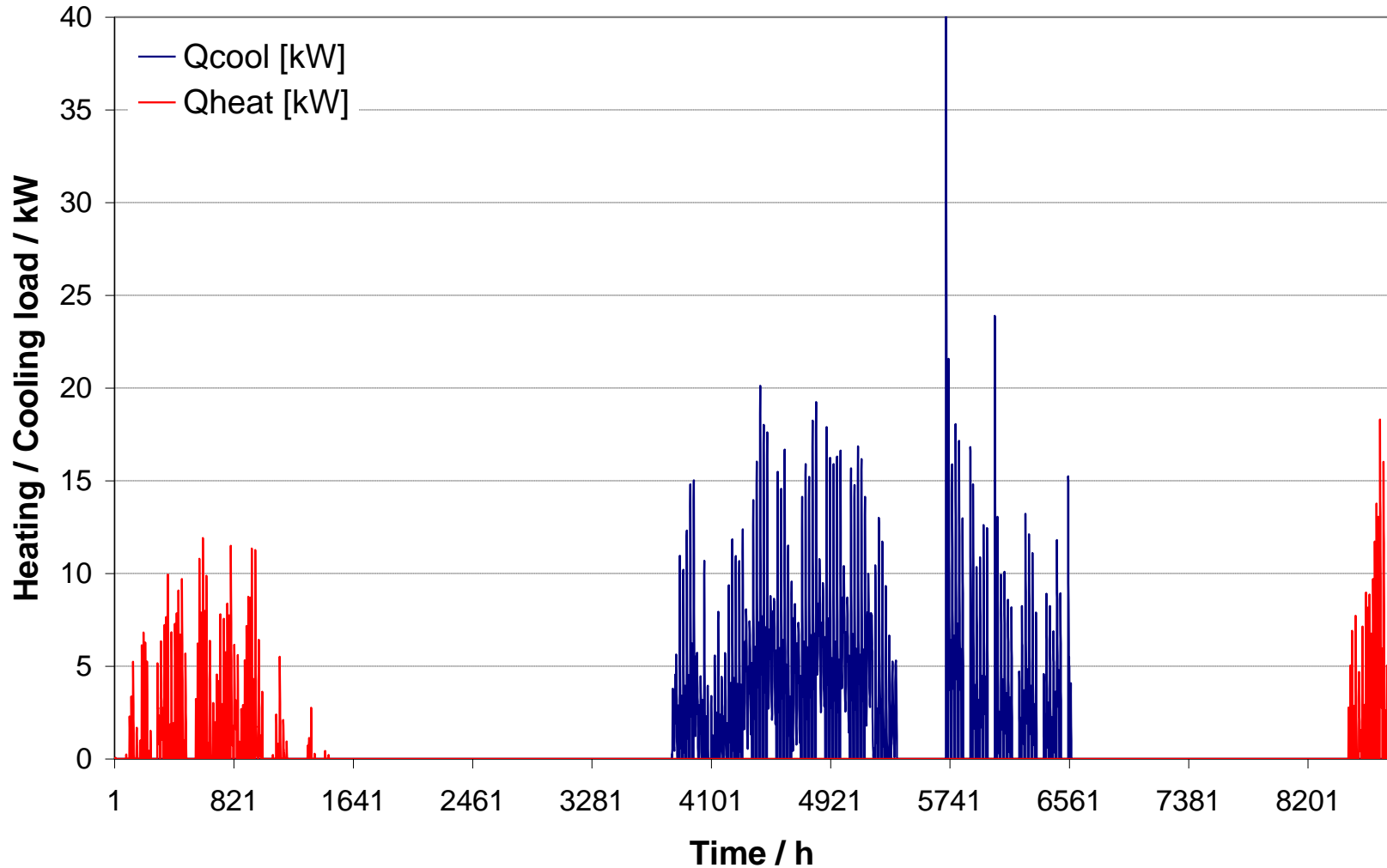
- Cooling system

During occupation:
Otherwise:

20°C
15°C

26°C
32°C





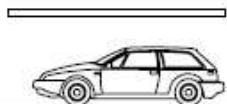
Month	Q-heating without HX [kWh]	Q-heating with HX [kWh]	Q-cooling 26°C [kWh]	
January	2,219.1	777.6	0	
February	1,614.6	530.4	0	
March	56.2	1.4	0	
April	6.6	0	0	
May	0	0	0	
June	0	0	1,132.0	
July	0	0	3,386.5	
August	0	0	1,778.9	
September	0	0	1,469.2	
October	0	0	85.2	
November	95,1	0	0	
December	1,644.9	628.1	0	
YEAR	5,636.4	1937.5	7,851.7	kWh/a
	6.57	2.26	9.16	kWh/m²a net floor
PHPP		6,50	4,00	kWh/m ² a

LIMA, reduction of energy consumption and CO₂ eq. emissions

Energy:

-89 % embodied energy
renewable and recycled materials

-90 % energy consumption
insulation ($U < 0,27 \text{ W/m}^2\text{K}$
opaque and $U < 1,1 \text{ W/m}^2\text{K}$
window glazing), thermal inertia,
solar protection, mechanical
ventilation with heat recovery,
highly efficient heating and
cooling generation and
distribution, solar thermal and
PV, intelligent control, efficient
lighting and low consumption
equipment.

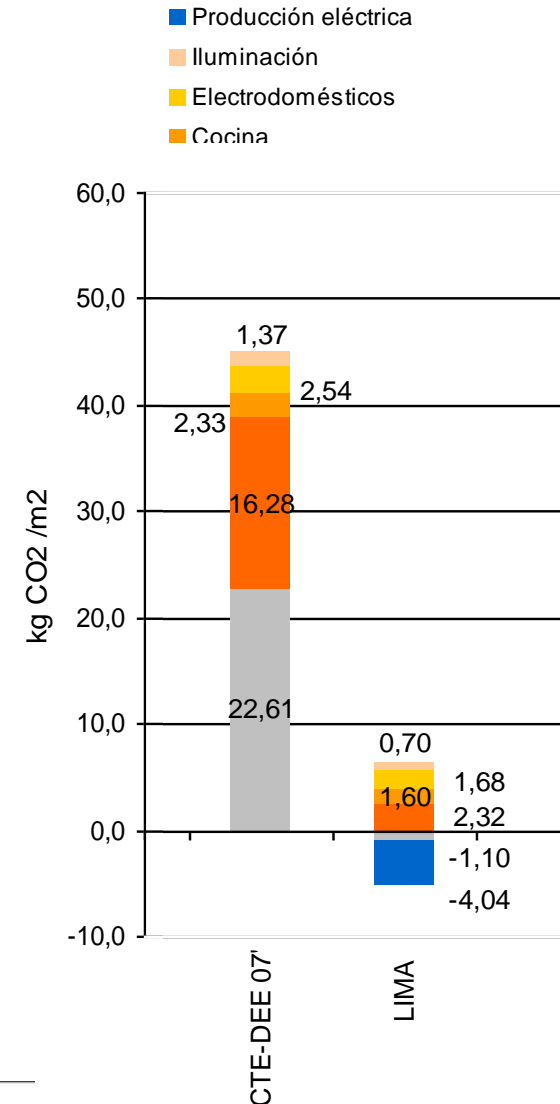
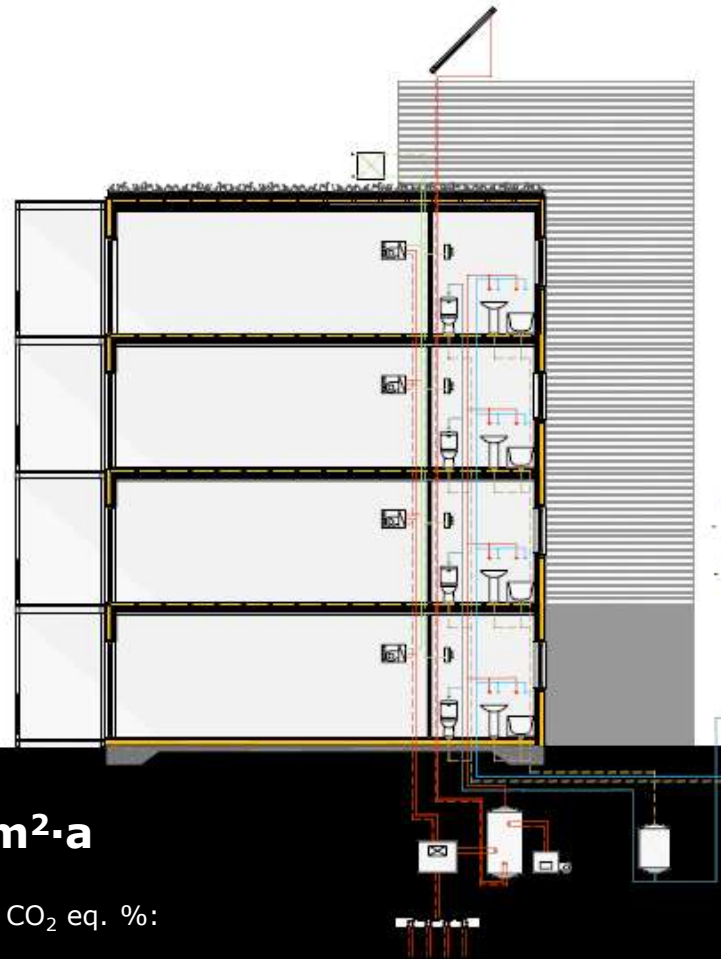


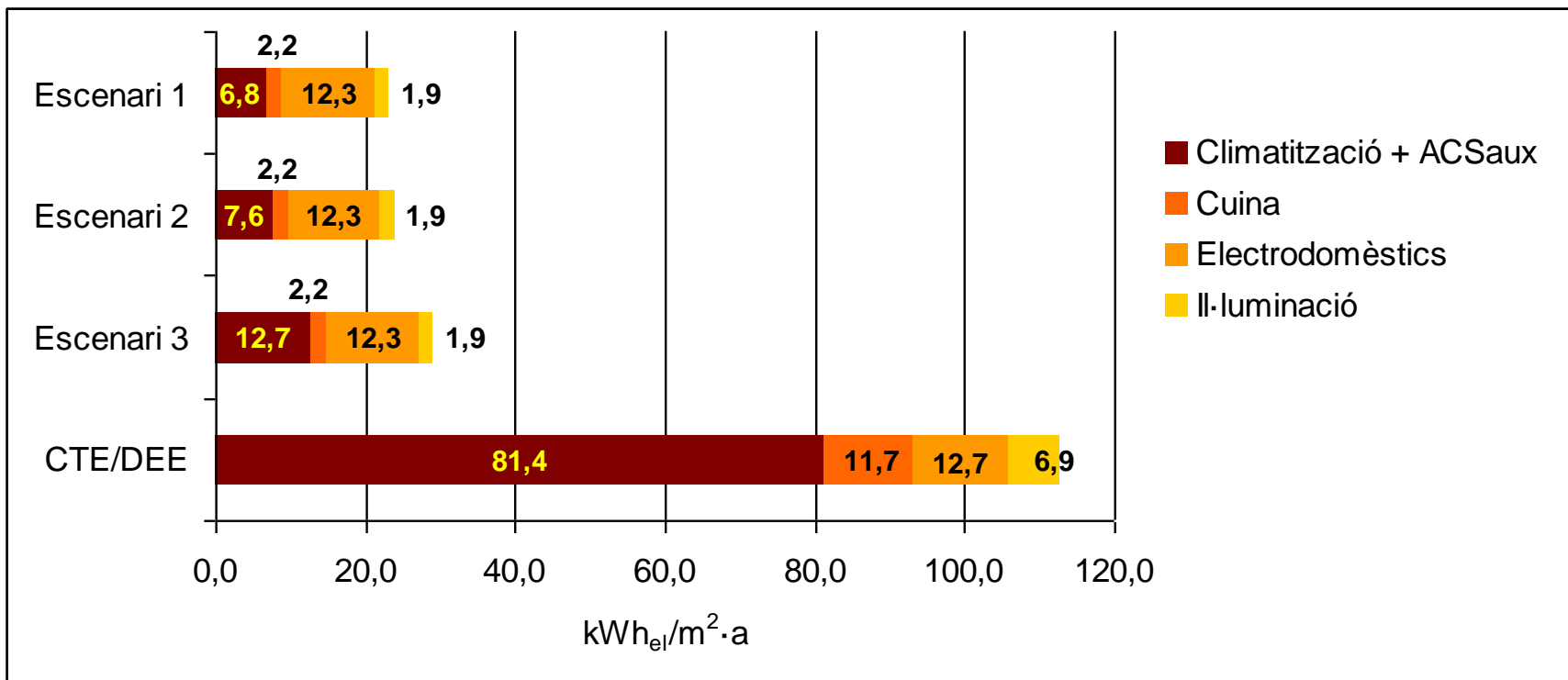
Emisiones de CO₂ eq:

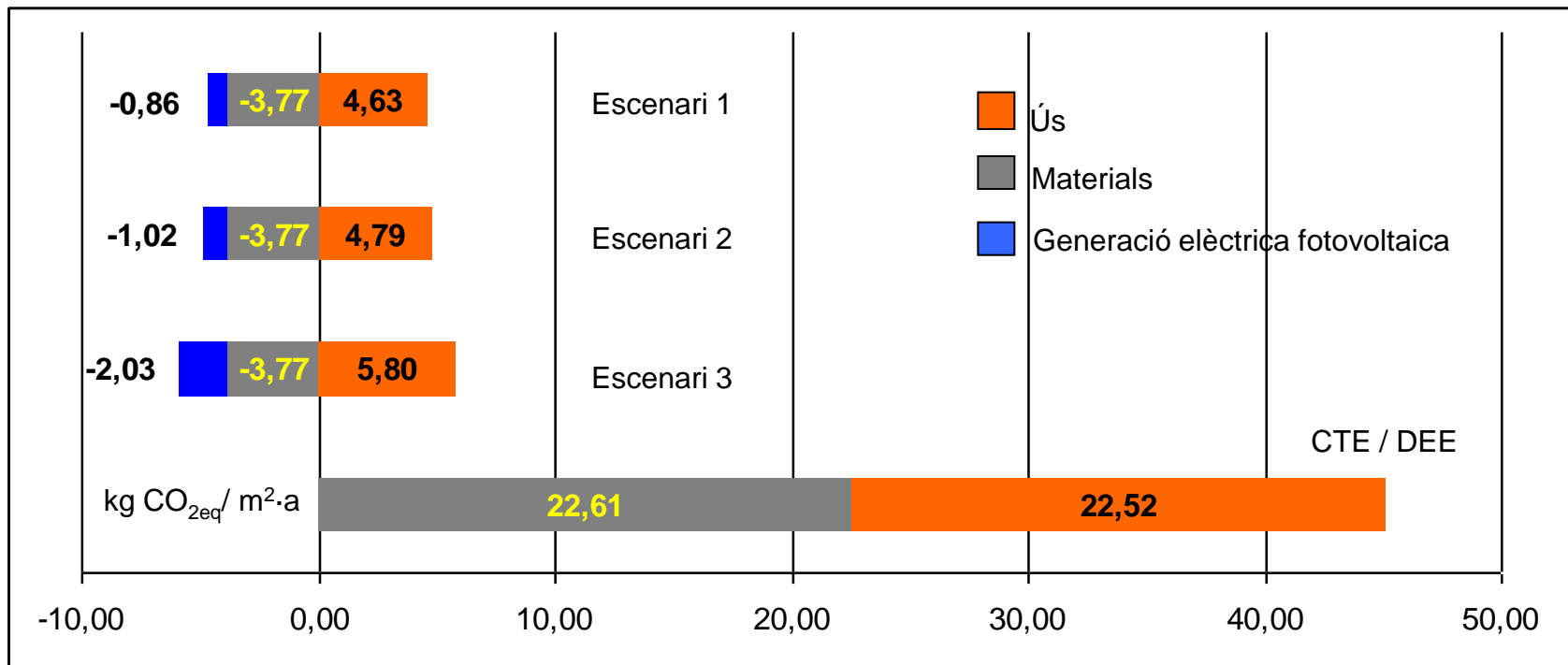
1,31kg CO₂/ m²·a

Reducción emisiones de CO₂ eq. %:

97,5 %







Per compensar les emissions restants, a una producció elèctrica anual de 1250 kWh/kW (òptima inclinació i orientació), es precisa 14,5 i 17,6 kW potència fotovoltaica instal·lada, equivalent a una superfície horitzontal de 180 – 200 m², de coberta sobre la coberta de l'edifici de referència.

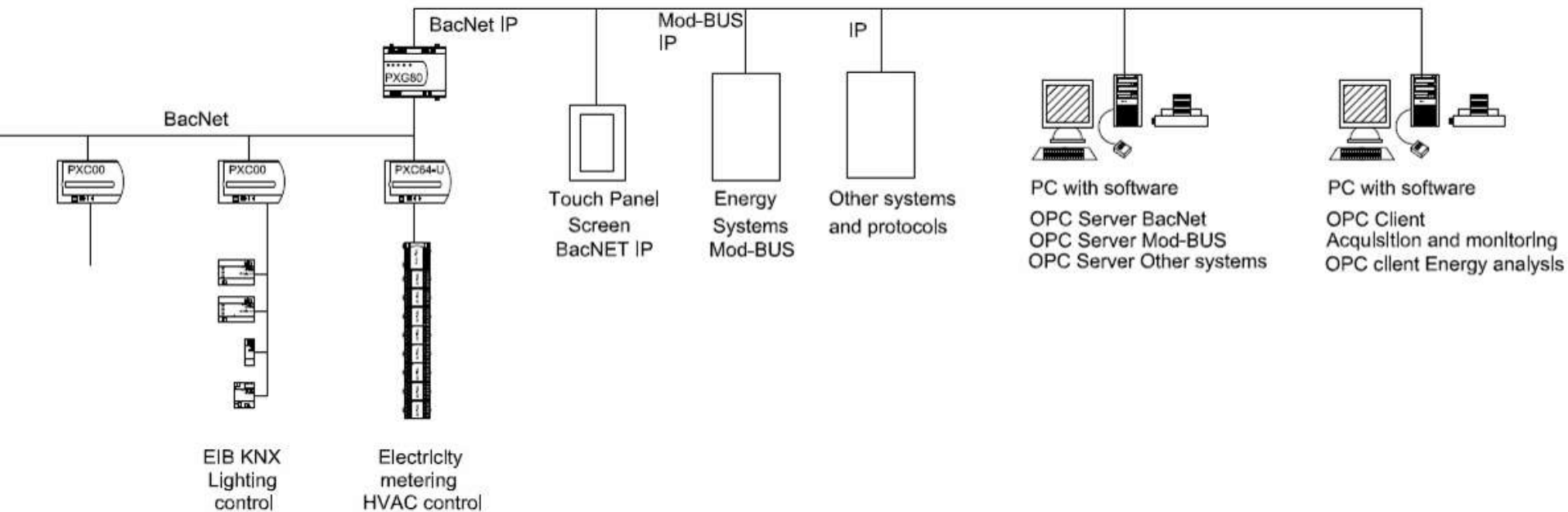
LIMA research: one year monitoring under standard conditions

Evaluation of thermal performance under standard conditions:

Fixed internal loads:	user's sensible heat:	small radiator
	user's latent heat:	humidifier
	electric equipment	scheduled operation
	lighting	scheduled operation

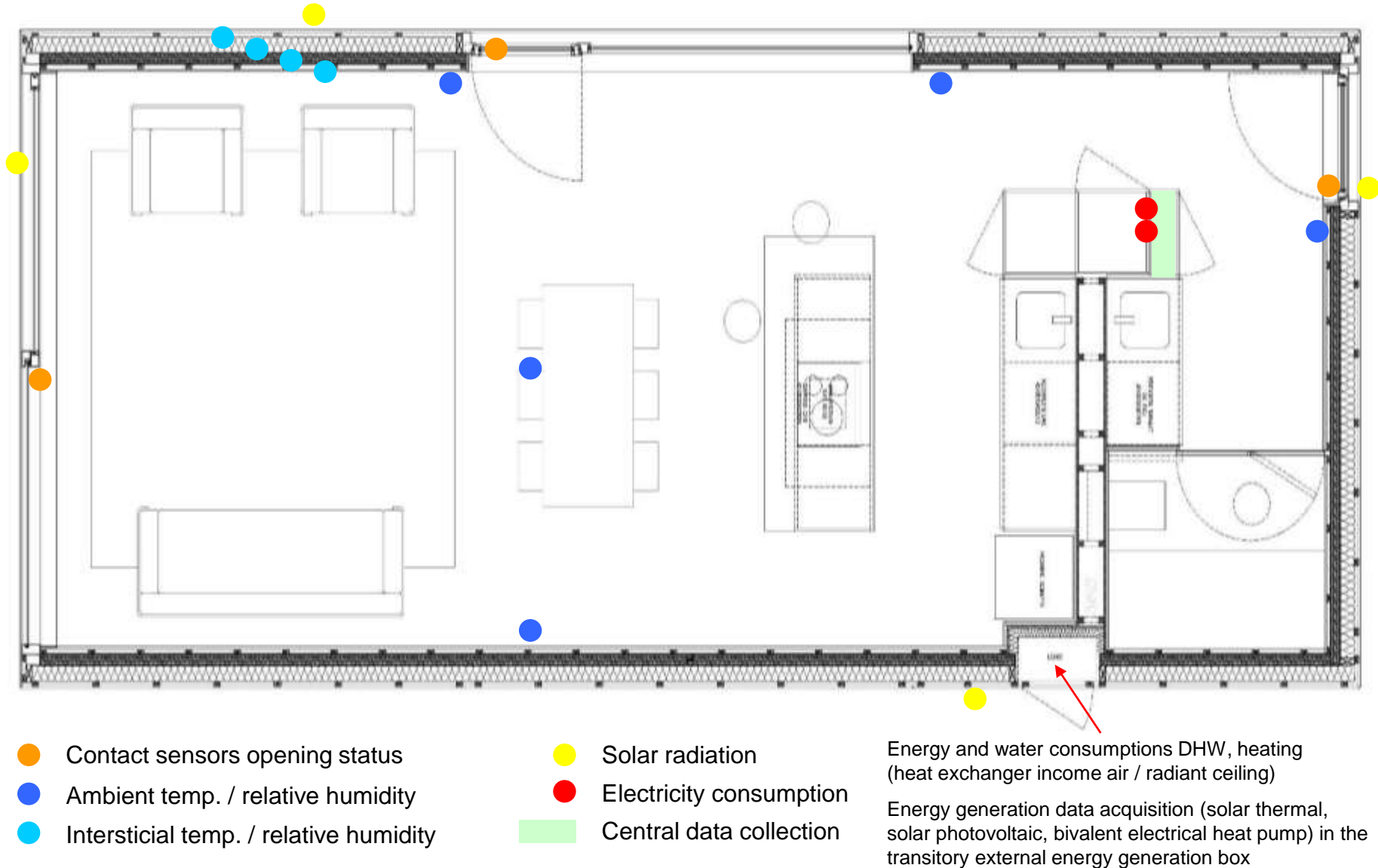
Equal internal loads as in simulation

**Special interest: ventilation strategies (free-cooling, night ventilation)
heat recovery performance**

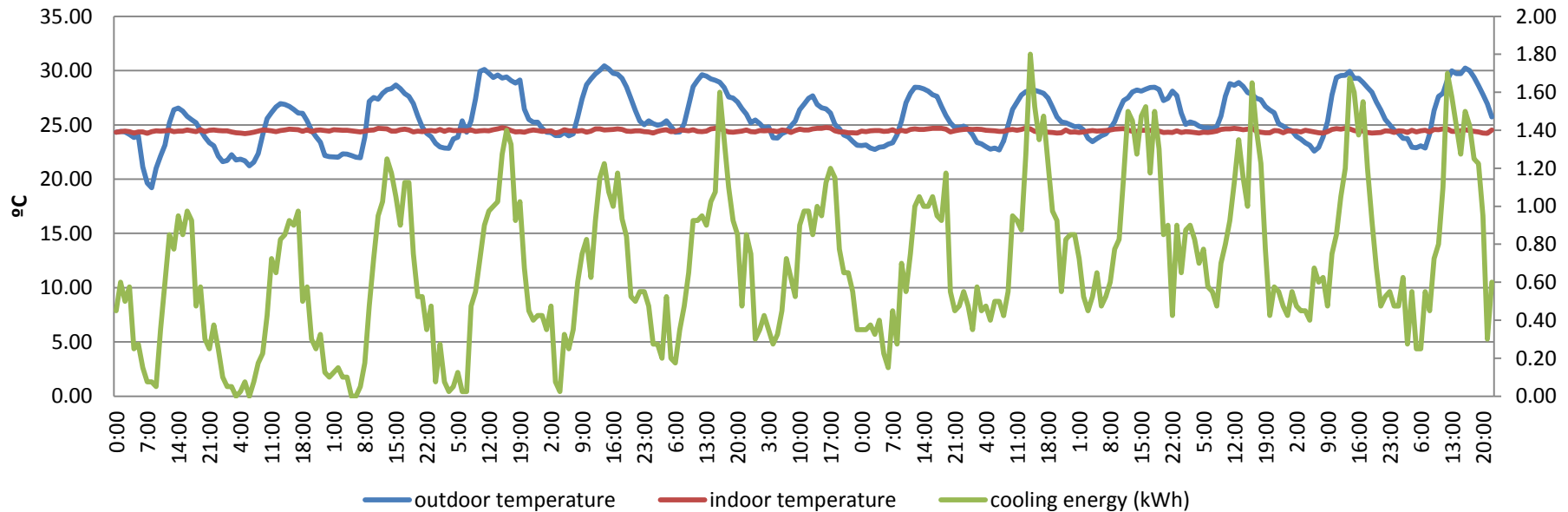




Data available since end of November 2010, but not under standard conditions



Cooling energy, indoor and outdoor temperatures - August 06-18, 2012

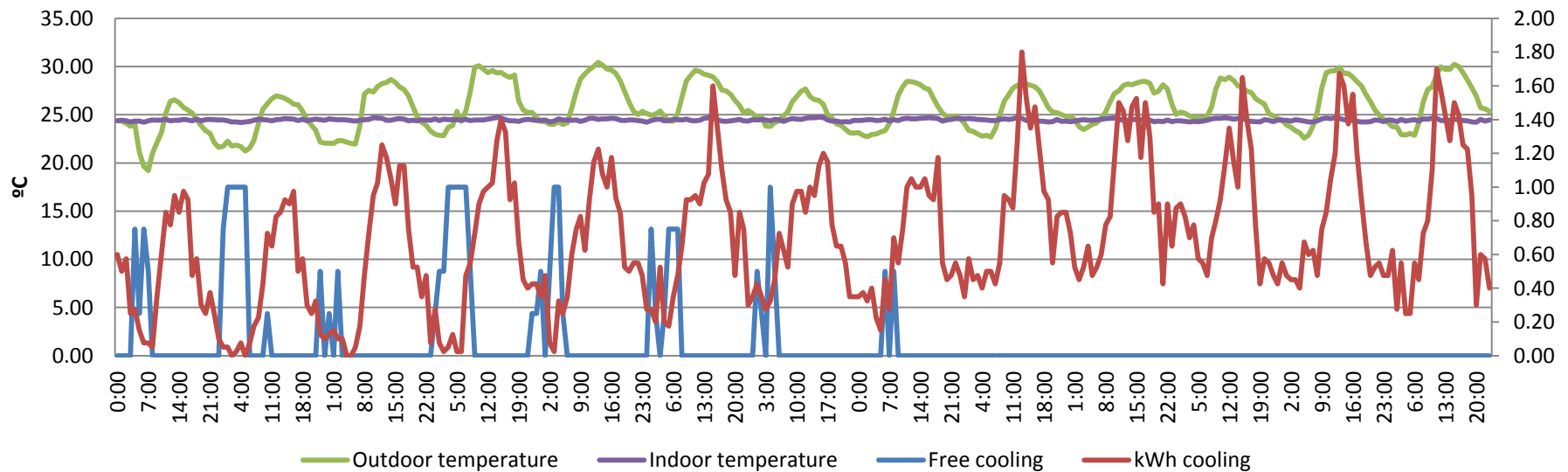


Setpoint temperature test phase (during occupation: 24°C / during no occupation: 26°C)

Setpoint temperature simulation (during occupation: 26°C / during no occupation: 32°C)

Real setpoint: continuously 24.5 °C .

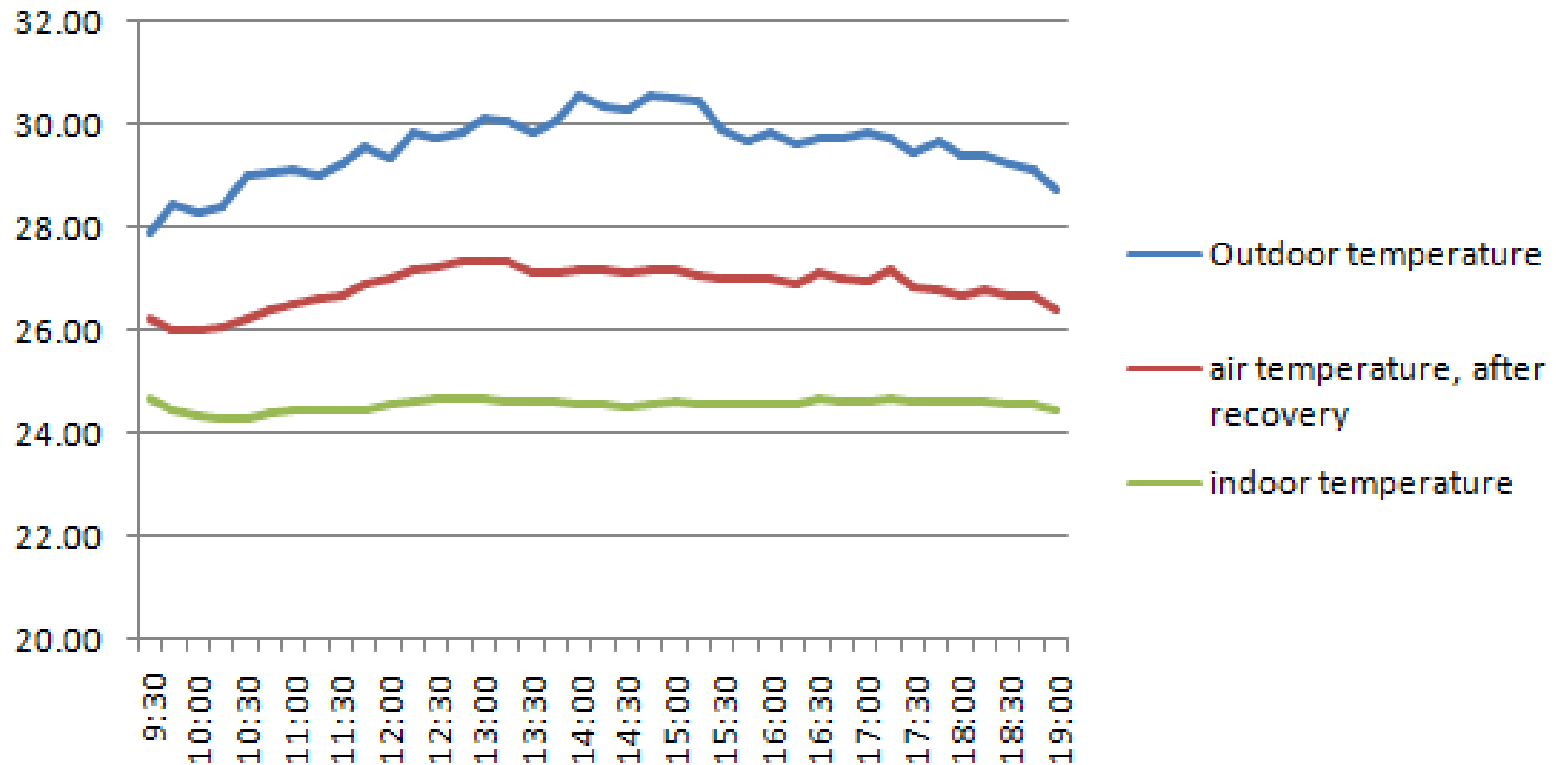
**Free cooling, cooling energy demand, indoor and outdoor temperatures.
August 06.-18. 2012**



**30% energy reduction by night ventilation (6.-12.8.)
compared to periods without night ventilation (12.-18.8.)**

Continuous ventilation rate of 3.5/h instead of the scheduled 0.52/h !!

Efficiency of cold recovery during daytime

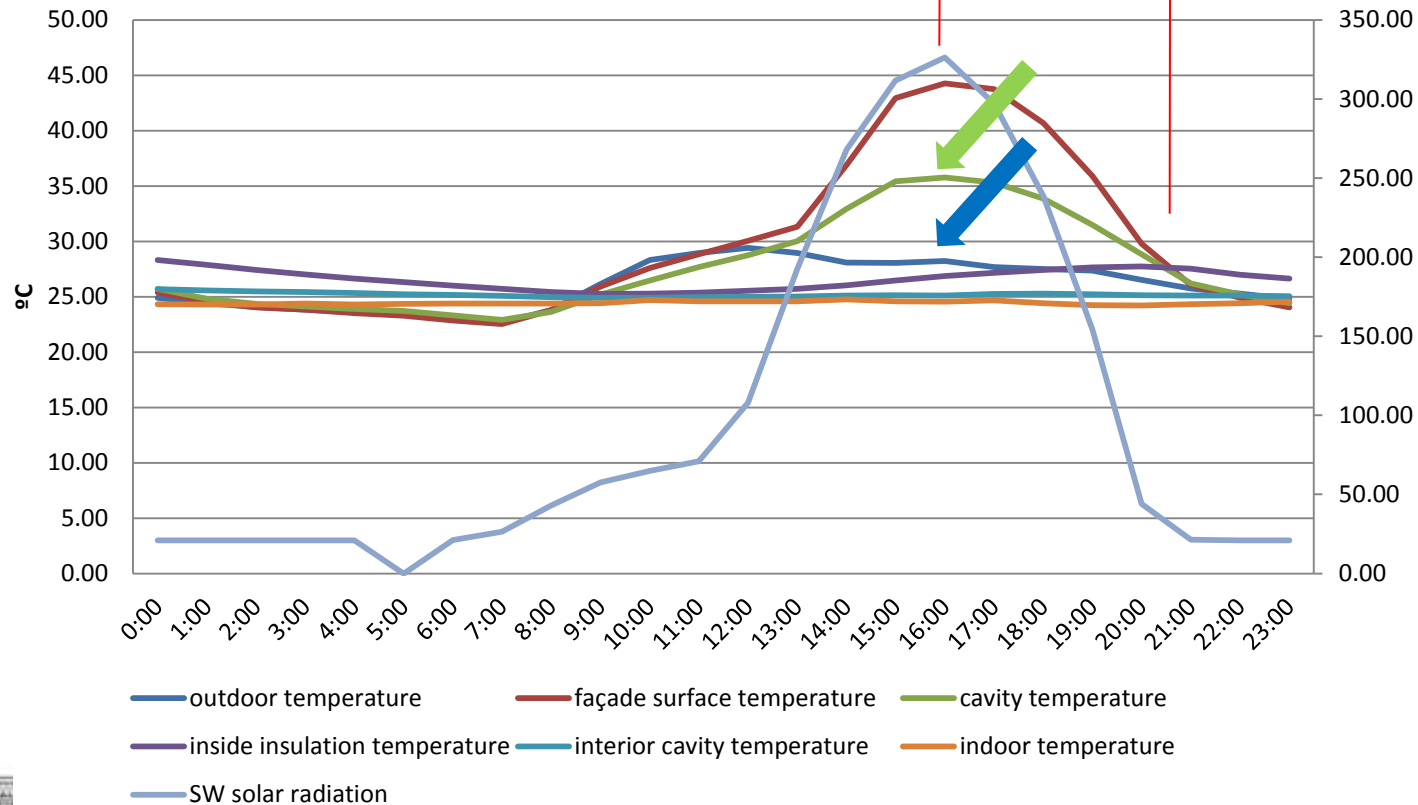


Approximately 50% efficiency in cold recovery from indoor exhaust air to income air

Blower door test shows infiltrations much higher than in simulation (0.2/h) > 2.5/h

LIMA, preliminary monitoring results

Façade section temperatures. August 2nd, 2012



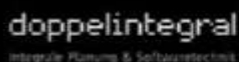
Important time lack in maximum temperature on air gap to inside layer of insulation

Air gap and thermal stack effect don't achieve the expected temperature reduction !

Research team

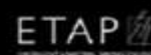
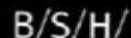


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Cluster of enterprises

Clúster d'empreses / Clúster de empresas / Companies cluster



Collaborating enterprises

Empreses col·laboradores / Empresas colaboradoras / Collaborating companies



SaAS

Sabaté associats
Arquitectura i Sostenibilitat

LIMA, <i>low impact mediterranean architecture</i>	SaAS, Doopelintegral, La Salle, SO, HS, JG
directors	Joan Sabaté, Christoph Peters, Horacio Espeche
project coordination	Aina Ferrer
energy demand and consumption	Ursula Eicker (Doppelintegral)
domotic and control	Sergi Cantos (La Salle)
embodied energy and LCA	Albert Sagrera (SO)
biohabitability	Elisabet Silvestre, Mariano Bueno (HS)

SaAS
Balma 439, 1r 1a
E 08022 Barcelona
T +34 932 531 269
F +34 932 531 646
www.saas.cat

For more information cpeters@saas.cat
www.lima.cat

Co-financing

