Edifícios de Balanço Zero

Net Zero Energy Buildings

NZEB

Helder Gonçalves

26 de Maio de 2011

1. Directivas Europeia – EPBD
2. Conceito de NZEB
3. Como Atingir o NZEB
4. Exemplos

DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 19 May 2010

on the energy performance of buildings

(recast)

Article 9

Nearly zero-energy buildings

1. Member States shall ensure that:

(a) by 31 December 2020, all new buildings are nearly zero-energy buildings; and

(b) after 31 December 2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings.

SHC
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

International Energy Agency
Energy Conservation in Buildings and Community Systems Programme

IEA SHC Task 40/ECBCS Annex 52

Towards Net Zero Energy Buildings

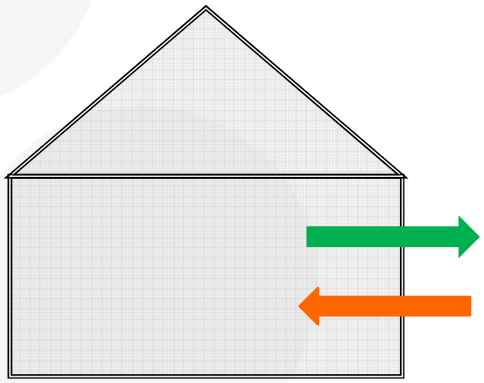
NZEB Definition

Energy Supply

- Electricity
  (PV, wind, geothermal)
- Thermal
  (Solar, Geothermal)

y Kwh

Input = Output



Energy production

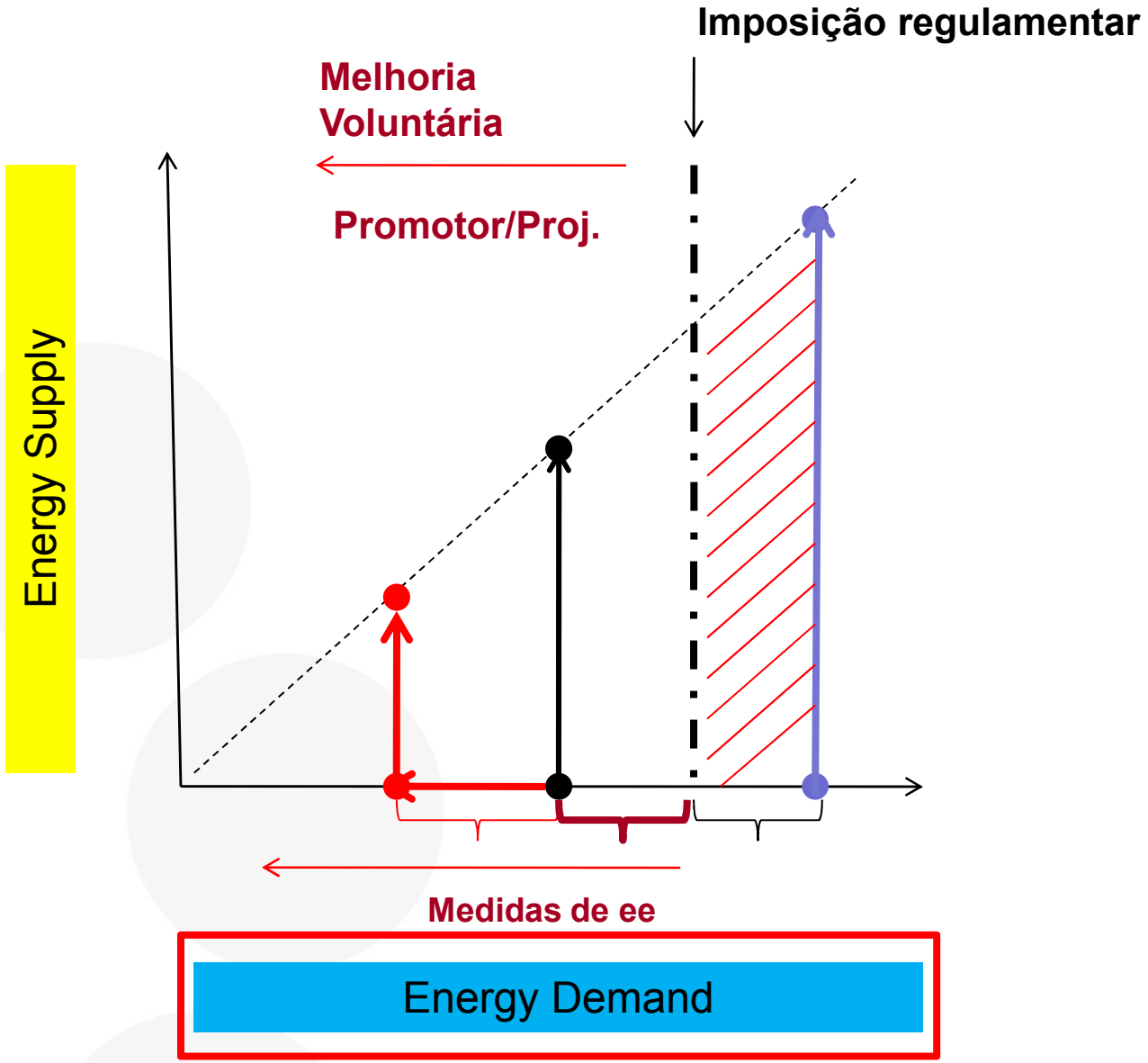
Energy consumption

Energy Demand

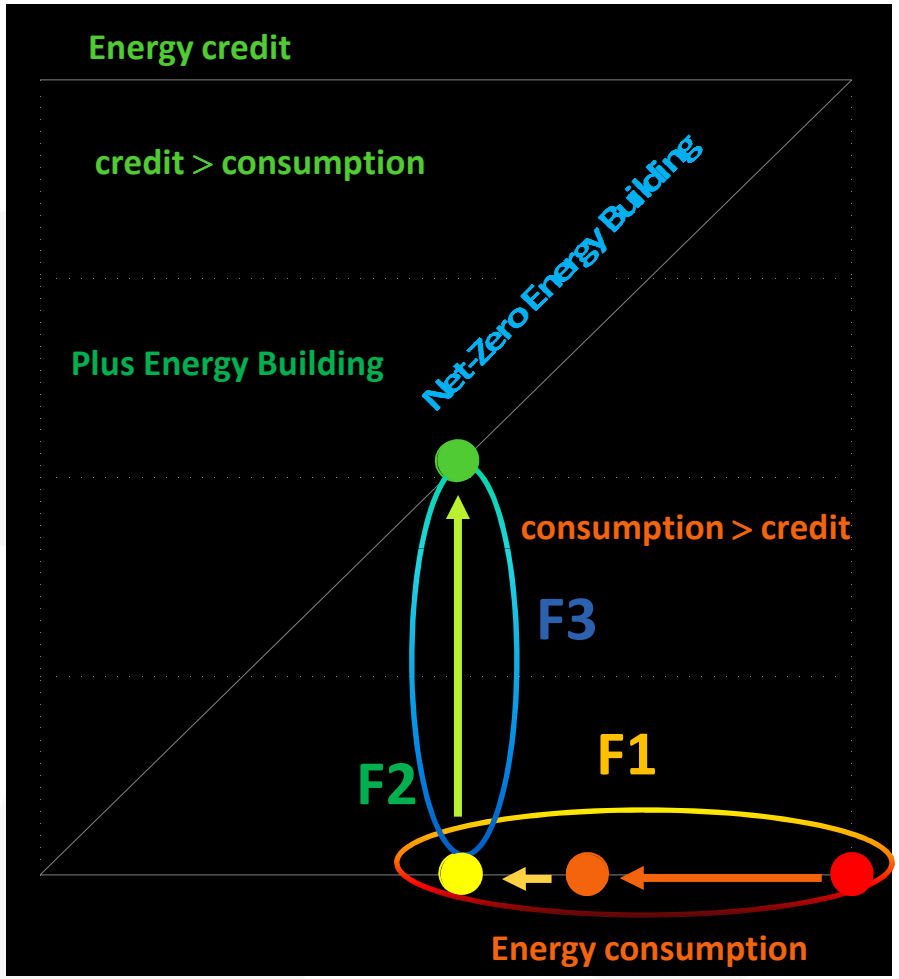
- Heating
- Cooling
- Lighting
- Hot Water
- Appliances

x Kwh

How to achive NZEB ?



How to achive NZEB ?



F1 - Building

- Envelope (Walls, Roof, Windows)
- Airtightness
- Passive systems (trombe walls, earth tube..)

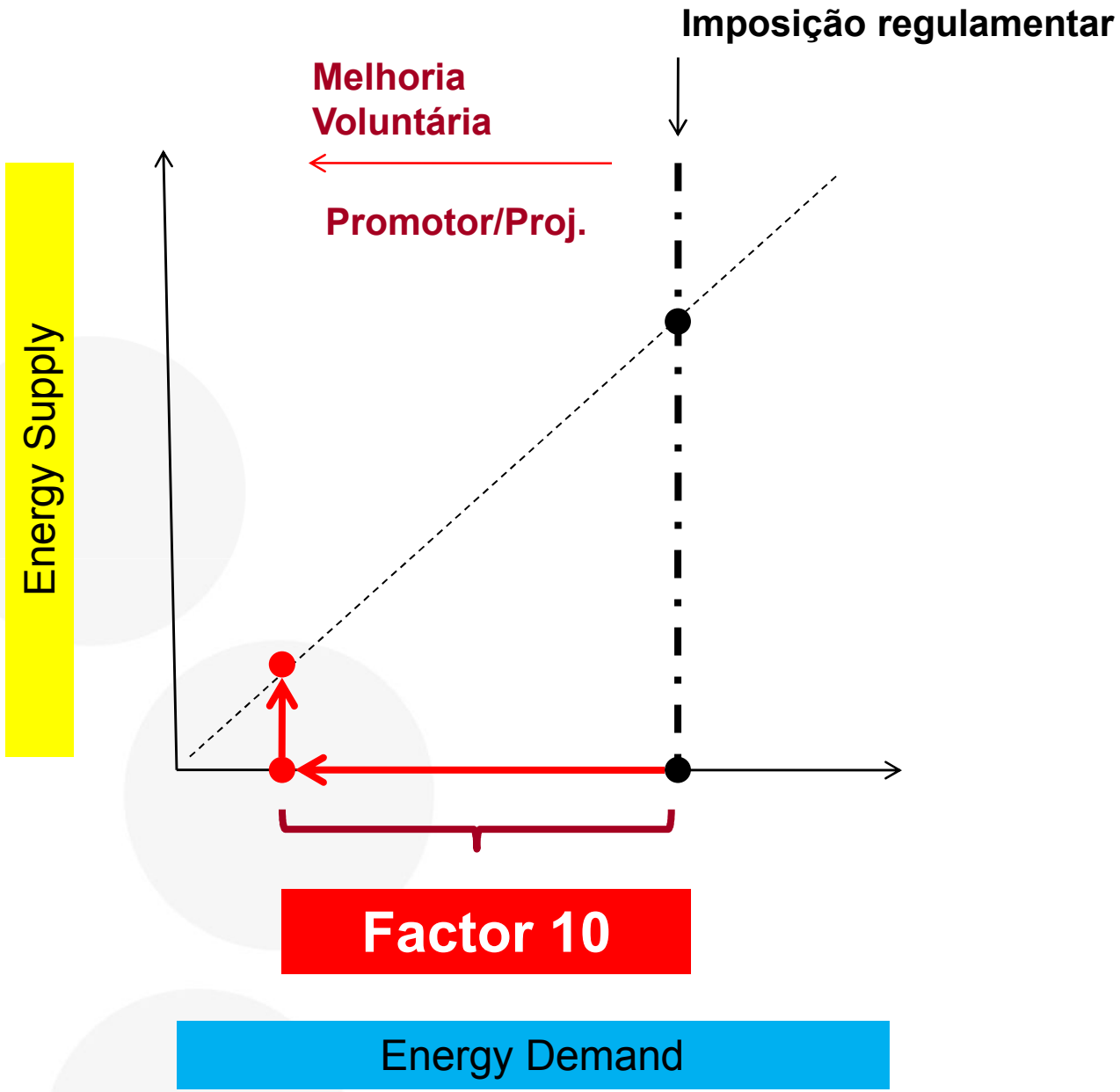
F2 - Energy use

- Heating/Cooling energy use (Space heating /Cooling, DHW)
- Electric use (Cooking, wash machine, lightening, appliance -other equipments)

F3 – RENEWABLE ENERGY

- Solar-thermal
- PV
- Wind
- Biomass
- ...

LNEG

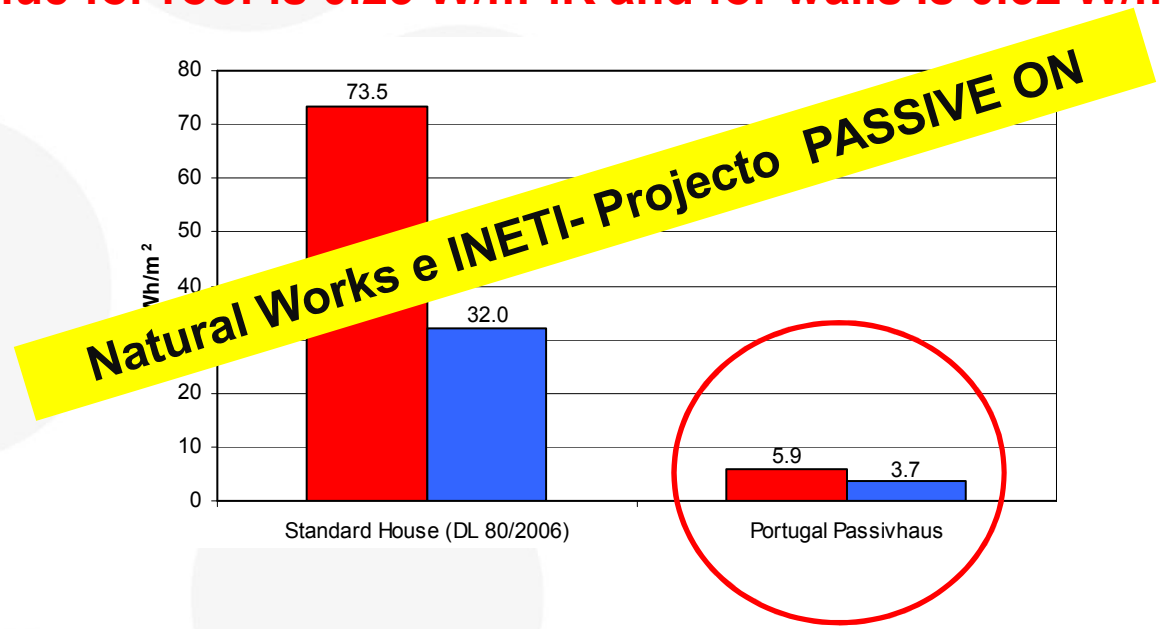

Imposição regulamentar
Melhoria
Voluntária
Promotor/Proj.
Energy Supply
Factor 10
Energy Demand

Passivhaus Portugal – Energy Performance

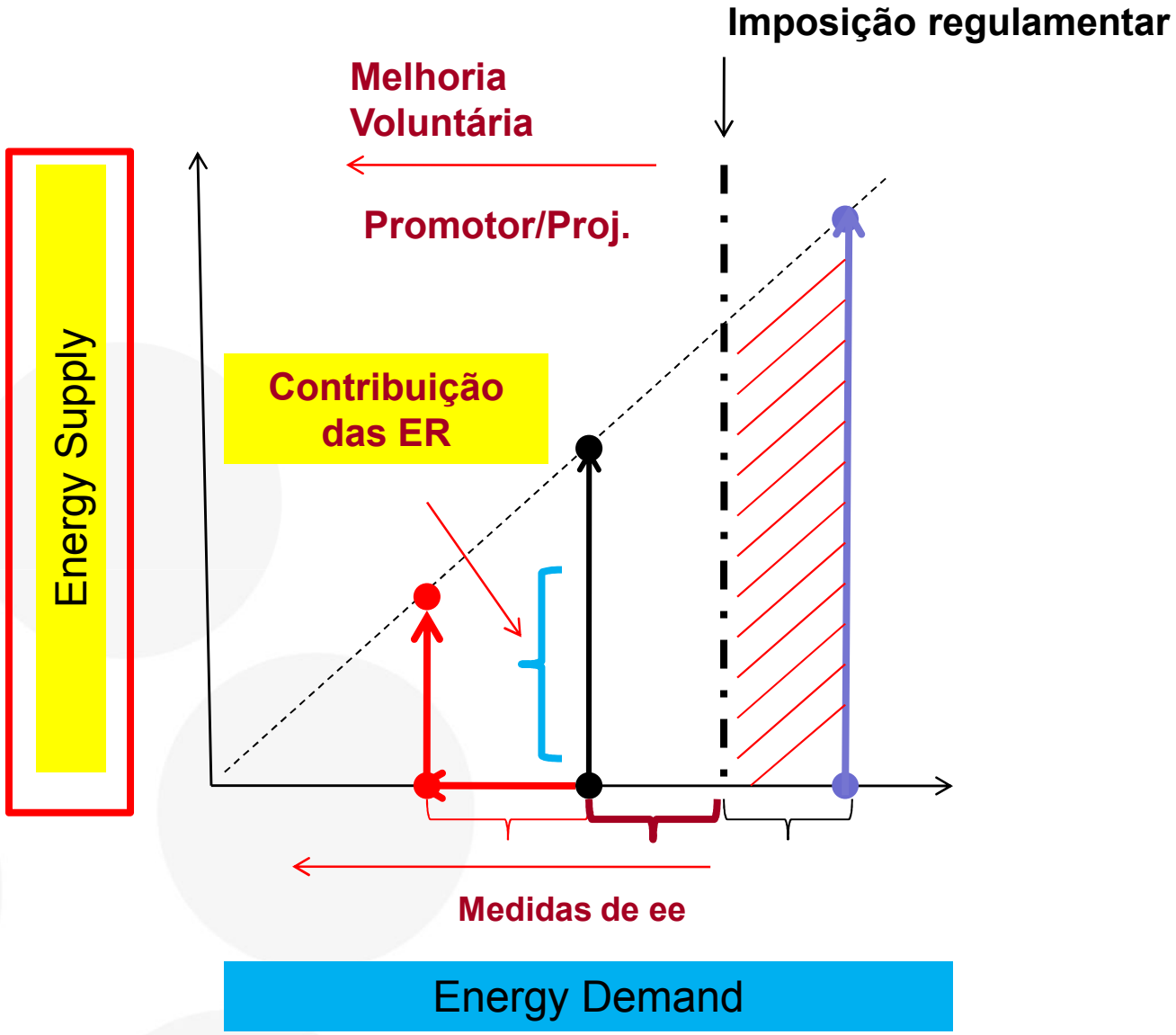
- The annual heating energy demand of the *Passivhaus* proposed for Portugal has been estimated as **16.9 kWh/m^2.year**, of which 11 kWh/m^2.year are supplied by the solar system (in this analysis priority of the solar system is given to heating and the solar fraction for domestic hot water is 48%)
- The annual cooling energy demand is **3.7 kWh/m^2.year**
- The sum of net heating and cooling demand is **9.6 kWh/m^2.year**

Predicted annual heating demand (red) and cooling demand (blue) for Standard House and *Passivhaus* in Lisbon

U-value for roof is 0.23 W/m^2.K and for walls is 0.32 W/m^2.K



Contribuição das Energias Renováveis



How to achive NZEB ?

I) Reducing the building energy demand

1. Building site and urban integration (climatic and microclimate conditions)
2. Thermal optimization of building envelope (reducing heat losses)
3. Optimization of solar gains (winter and summer)
4. Use of passive strategies or systems
5. Use of day lighting strategies
6. Use of natural ventilation strategies
7. Use of efficient systems (domestic appliances and equipment)

II) Produce (Generate) energy on building site (Integration)

1. Thermal Solar (for hot water or air)
2. Photovoltaic
3. Small wind turbines

Towards Net Zero Energy Solar Building

EnOB Forschung für Energieoptimiertes Bauen
Gefördert vom Bundesministerium für Wirtschaft und Technologie aufgrund eines Beschlusses des deutschen Bundestages
SHC SOLAR HEATING & COOLING PROGRAMME INTERNATIONAL ENERGY AGENCY
Energy Conservation in Buildings and Community Systems Programme

NZEB -Project research

	project name and location	picture	NZEB label applied (balance criterion)	included annual energy consumption sectors in the building	building orientation	type of building construction and mass	envelope to volume ratio	net floor area per user or occupant	area of solar thermal collectors per net floor area	area of solar thermal collectors per occupant	area of pv-plant per net floor area	area of pv-plant per occupant
							m²/m³	m²/Pers.	m²/m²	m²/Pers.	m²/m²	m²/Pers.
9	plus energy settlement in Freiburg, Germany		plus energy house (primary energy)	space heating, DHW, ventilation, lighting, appliances, office equipment	site the building for southern exposure, attic north-south facing	wood construction, little heat storage mass	0,55	47,71			0,40	19,08
36	Kleehäuser in Freiburg, Germany		zero-/plus, 2000-Watt Society, passivhaus (primary energy)	space heating, DHW, ventilation, lighting, appliances, office equipment	site the building for southern exposure	composite construction and design (wood, steel, brick, concrete), mass capable of heat storage		34,51	0,02	0,69	0,03	1,04
24	Haus Thening in Thening near Linz, Austria		plus energy house (but no one has defined the standard or label)	space heating, DHW, ventilation, lighting, appliances, office equipment	oriented to the south	prefabricated timber elements, moderately zero-as construction method	0,72	37,50	0,11	4,13	0,57	21,38
54	Lighthouse, in Watford, UK		net zero carbon house (primary energy)	space heating, DHW, HVAC, lighting, appliances	south orientation of the pv-panles	off-site timber floor cassettes on a ring beam; build mass for heat storage with PCM		46,50	0,04	1,86	0,49	22,79
57	Blaue Heimat in Heidelberg, Germany		zero-/plus (primary energy)	space heating, DHW, ventilation, lighting, appliances	east-west	massive construction	0,39	36,67			0,03	1,10
10	row houses settlement Kronsberg in Hannover, Germany		no official label applied (carbon emission)	space heating, DHW, ventilation, lighting, appliances	south orientation	massive concrete construction		24,33	0,03	0,77	0,01	0,29

Towards Net Zero Energy Solar Building

8	SUNDAY'S - Offices and Row-houses in Gleisdorf, Austria		solar low energy house (primary energy)	space heating, ventilation, domestic hot water, appliances, office equipment, lighting	main facade oriented south			0,23		0,01	
20	Sunny woods in Zürich, Switzerland		zero heating energy building (electricity)	space heating, DHW, ventilation	south-nord	heated part is established in timber-frame construction. The rooms made out of concrete	0,49	45,67	0,03	1,33	0,16	7,31
61	Forum Chriesbach, Dübendorf, Switzerland		zero heating energy building, 2000-Watt Society, Minergie-P (primary energy)	space heating, DHW, cooling, ventilation, lighting, services equipment like appliances, and office equipment	south-east to north-west	massive constructional elements, use of concrete and brickworkwall s, inside wood and steel		50,77	0,004	0,20	0,04	2,03
63	Support Office Marché International in Kempttahl, Switzerland		net zero energy office building, Minergie-P Eco (electricity)	space heating, DHW, ventilation, lighting, service equipment, office equipment	south oriented main facade	prefabricated timber frame construction combined with concrete staircases	0,34	25,34			0,36	9,63
74	Solar Info Centre in Freiburg, Germany		zero-emission-building (primary energy)	space heating, hot water, ventilation, lighting, service equipment, office equipment	no special orientation	Concrete steel frame construction	0,29	34,58	0,002	0,09	0,03	0,90
79	Naturalia Bau in Sinigo (Merano), Italy		Zero Emission Commercial Building (emissions)	space heating, DHW, ventilation, lighting, service equipment, office equipment	north	prefabricated timber wood construction	0,43				0,27	

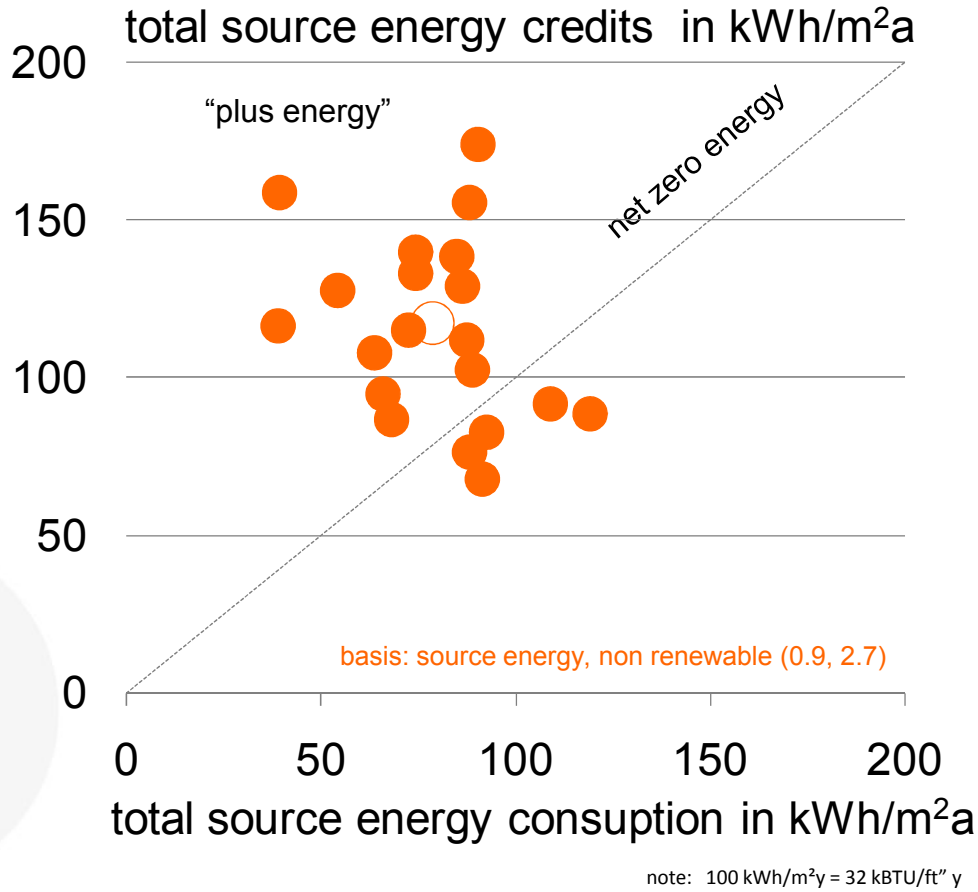
Solar Settlement Freiburg, Germany
Architecture and Concept: Rolf Disch

11,000 m² area with 59 terrace houses,
3,150 m² roof integrated PV,
district heating network

Plus Energy Settlement”

Energy balance of 21 terrace houses in the Freiburg Solar Settlement (56 homes in total) on the basis of monitoring results. The monitoring proofs the design as „plus energy homes”. All sectors of energy use are included.

Solar Settlement, Freiburg
Architecture and concept: Rolf Disch

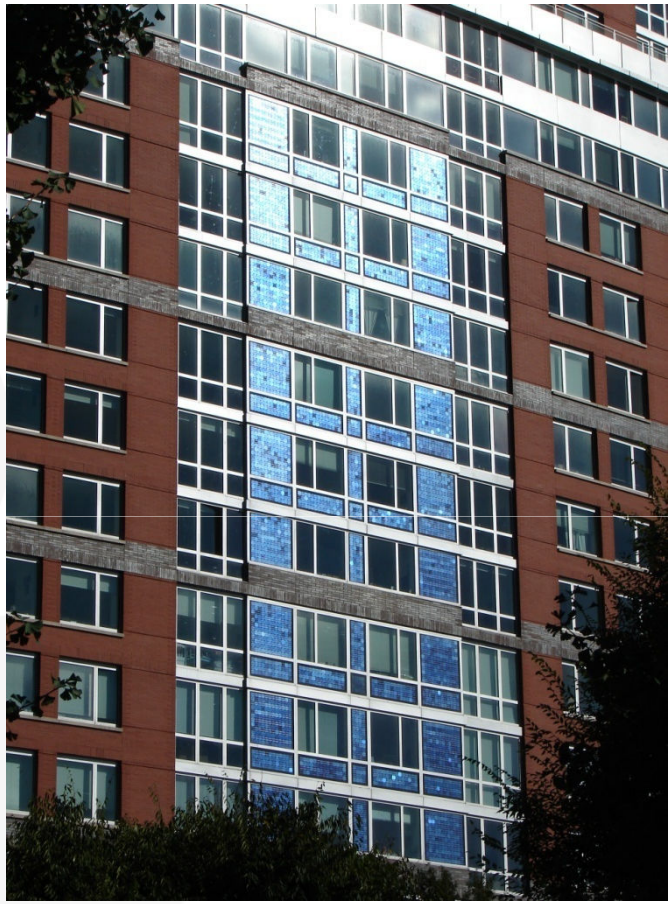


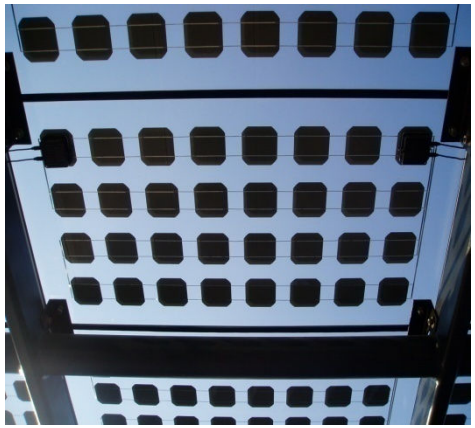
note: 100 kWh/m²y = 32 kBTU/ft” y

Solaire – Battery Park City, NY: 33 kWp

USGBC LEED – Gold

Architect: Cesar Pelli





Cortesy

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RELAB

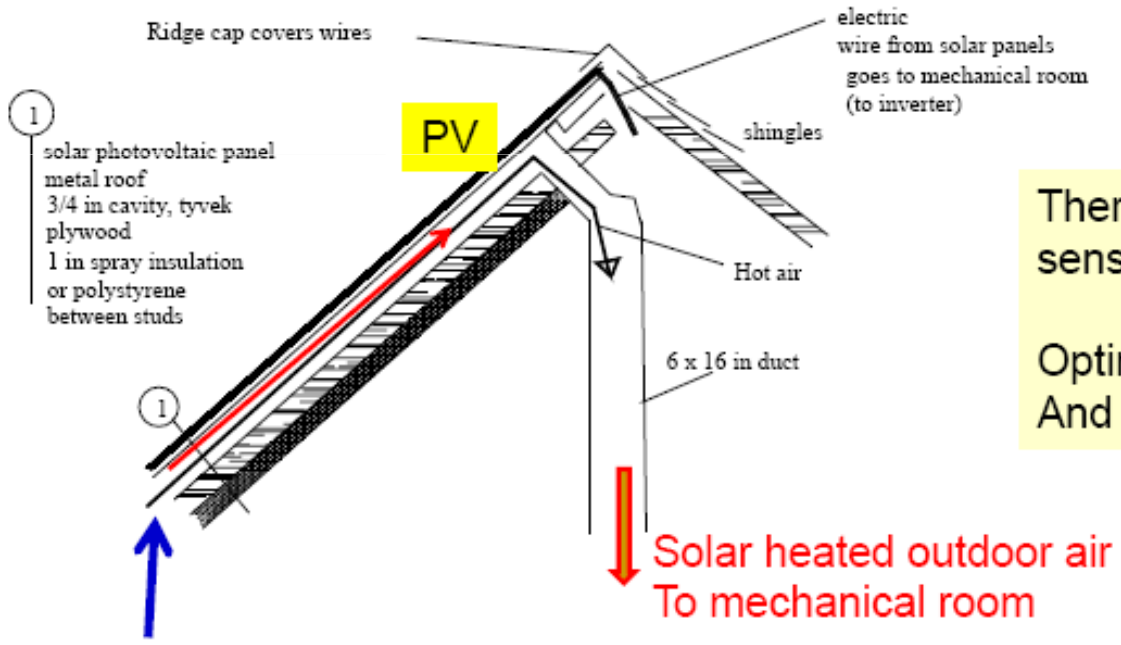
RENEWABLE ENERGY LABORATORY

BIPV – integration

- Building integration: integration with the roof, wall, or fenestration (semitransparent PV) or as shading devices; also with HVAC system.
- BIPV/T – (photovoltaic/thermal systems): heat is also recovered from the PV panels, thus raising their overall solar energy utilization efficiency.
- Heat recovery may be open loop with outdoor air or closed loop with a circulating liquid.
- Open-loop air system BIPV/T implemented.

Building-integrated photovoltaic/thermal system principle and design (Theme 1 of SBRN)

Open loop
Air system



Thermal performance sensitive to slope

Optimal slope for thermal
And to get rid of snow 45deg

Heat recovery from PV roof raises combined solar efficiency by a factor of >= 3

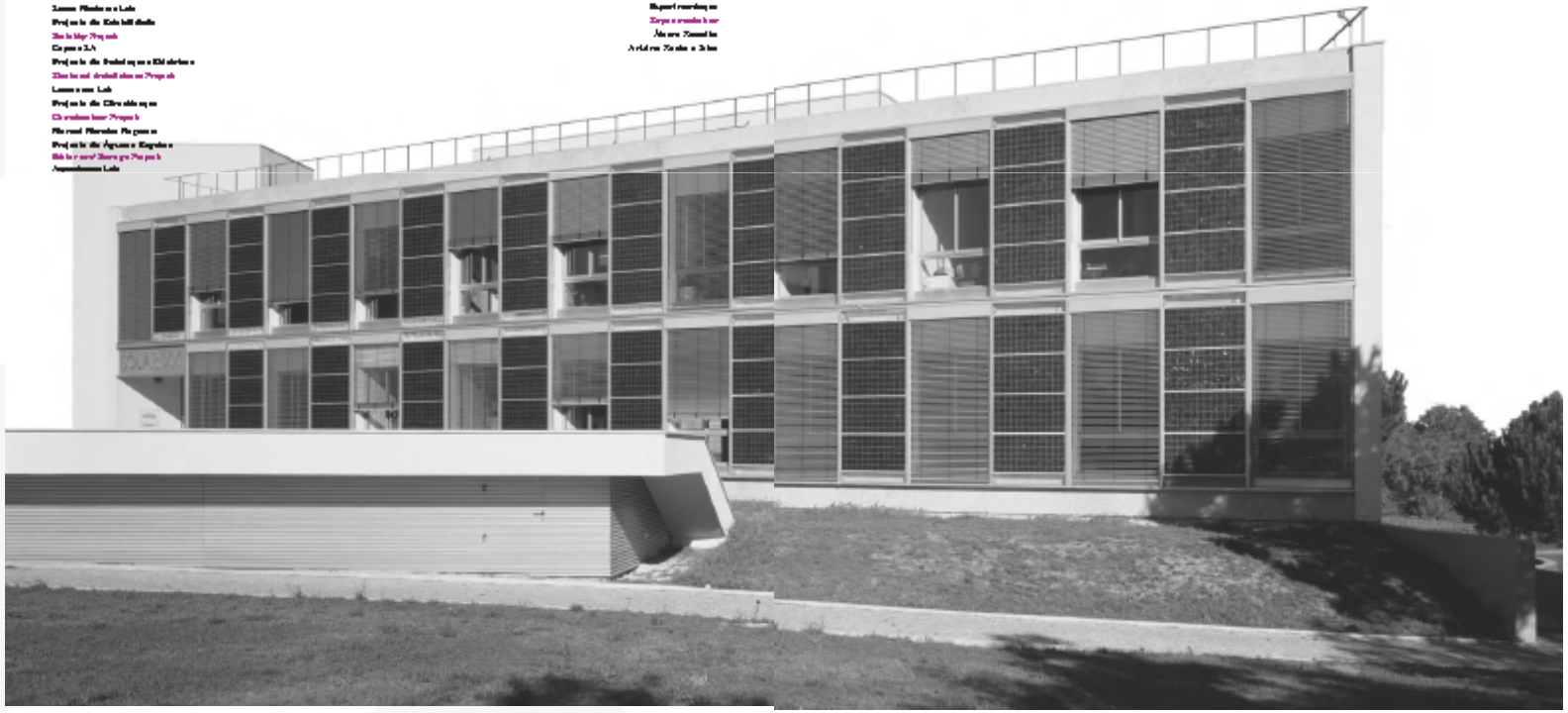
ex. Canada

meid

RE.NEW.ABLE.

SOLAR XXI

Em direcção à energia zero / Towards zero energy



Arq. Pedro Cabrito e Isabel Diniz

Estratégia do Edifício Solar XXI

Projecto; optimização térmica do edifício, redução das cargas de aquecimento, arrefecimento, iluminação

Introdução de medidas “passivas”, para aquecimento e arrefecimento

Integração de energias renováveis no edifício

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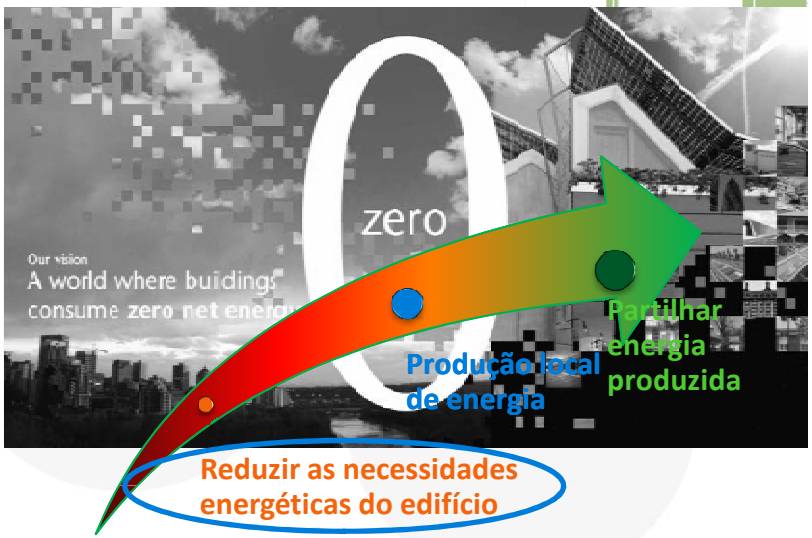
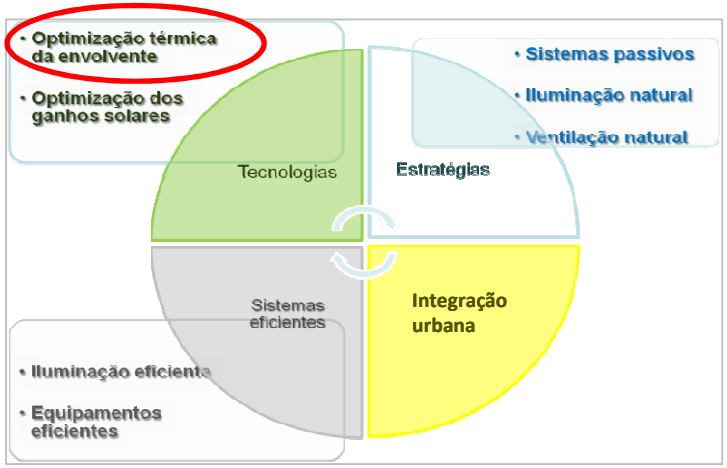
Redução das Necessidades Energéticas dos Edifícios



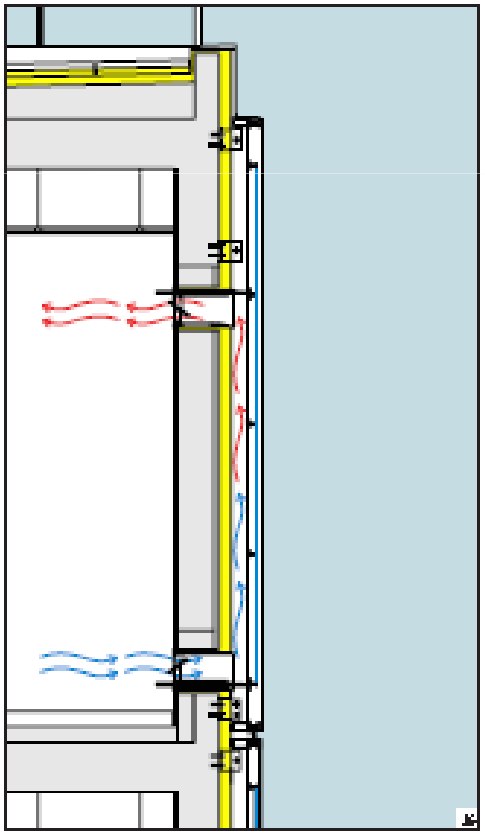


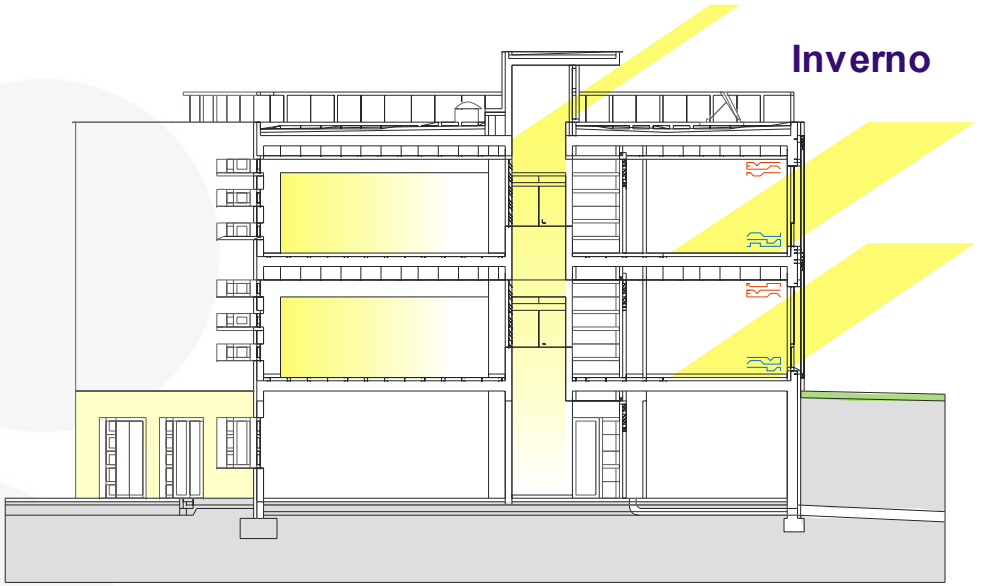
Soluções construtivas

- Cobertura com 10 cm isol. térmico, U= 0.26 W/m^2 ºC
- Paredes simples de alvenaria - tijolo de 22 cm, com 6 cm de isolamento (pelo exterior), U= 0.45 W/m2 ºC
- Pavimento térreo com 10 cm de isol. térmico

Sistemas Passivos

Utilização dos Ganhos Solares para aquecimento ambiente





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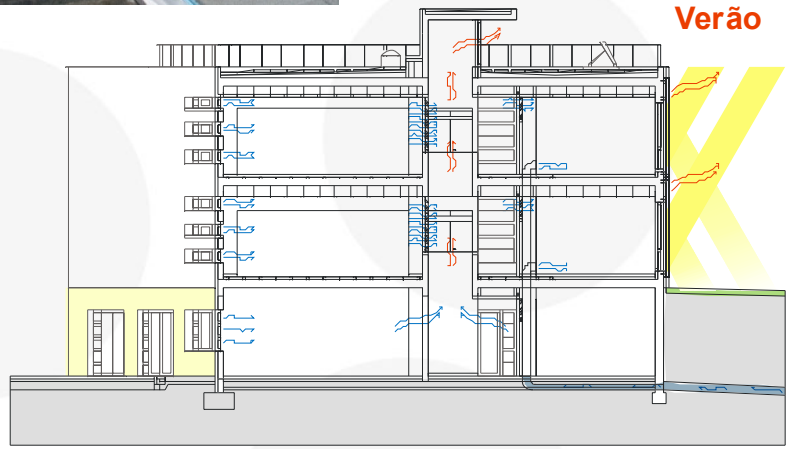
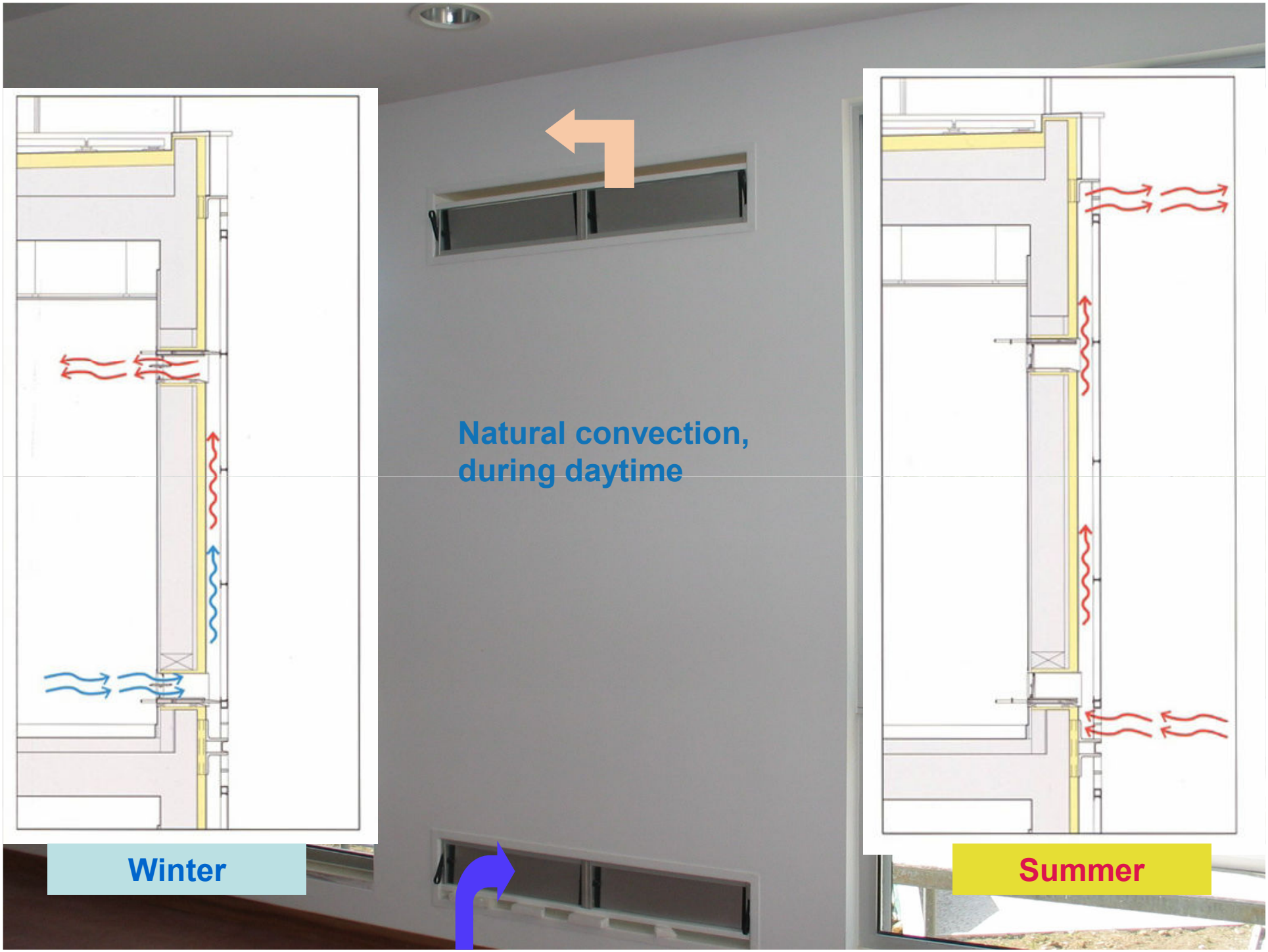
Reduzir as cargas de arrefecimento

CONTROLE SOLAR

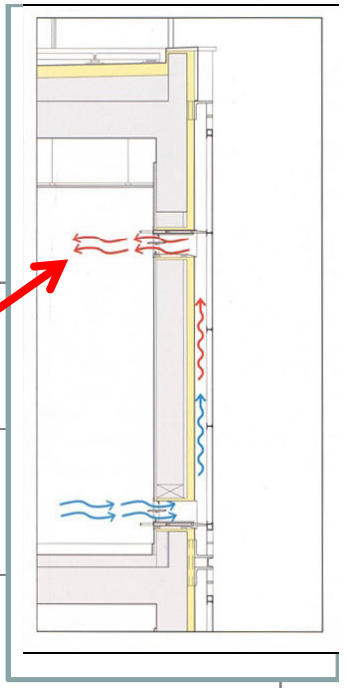
Protecção dos vãos envidraçados (estores exteriores)

Isolamento Exterior (redução das ganhos solares na envolvente)




Natural convection,
during daytime
Winter
Summer

Heat Recovery from the PV system

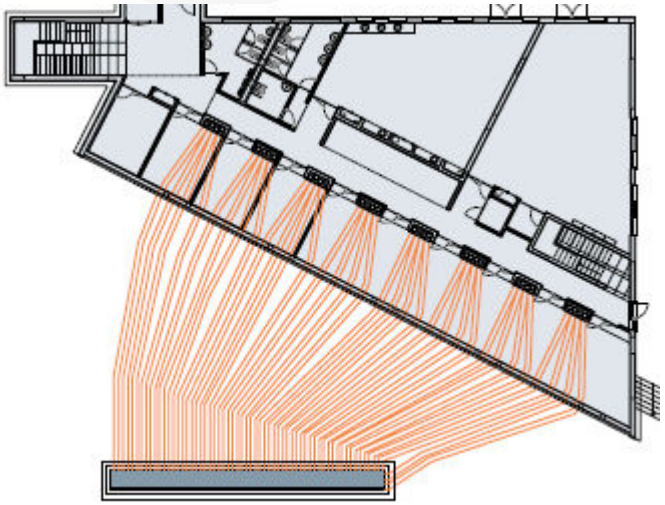


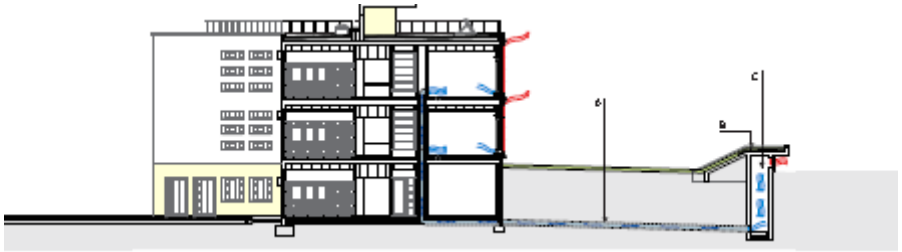


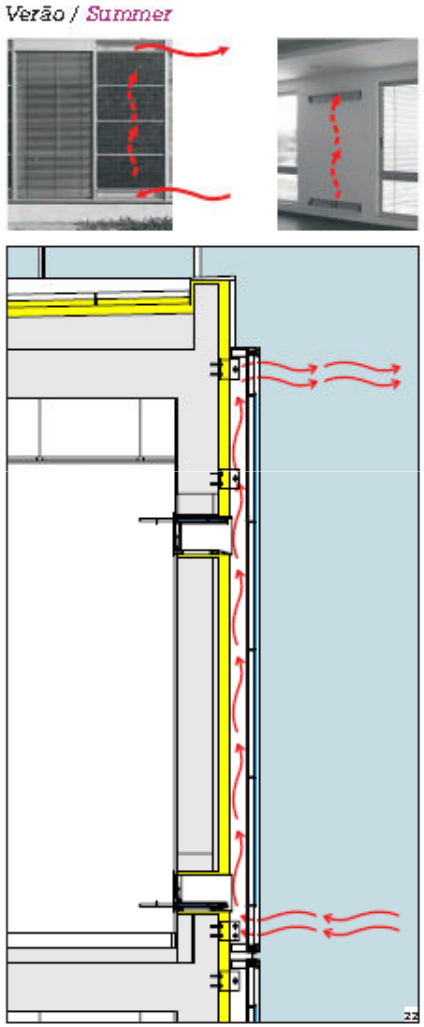


Sistema de ARREFECIMENTO PASSIVO

Sistema de arrefecimento pelo solo, permutador de 32 tubos a ar.

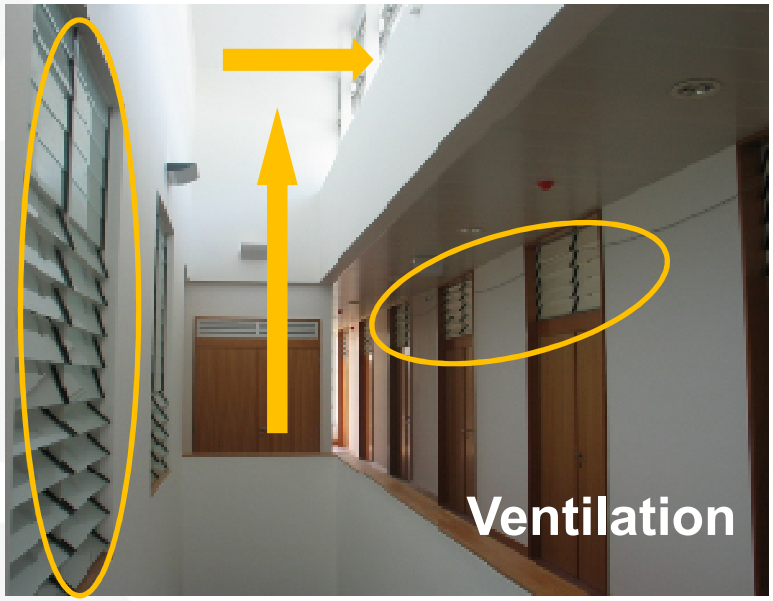




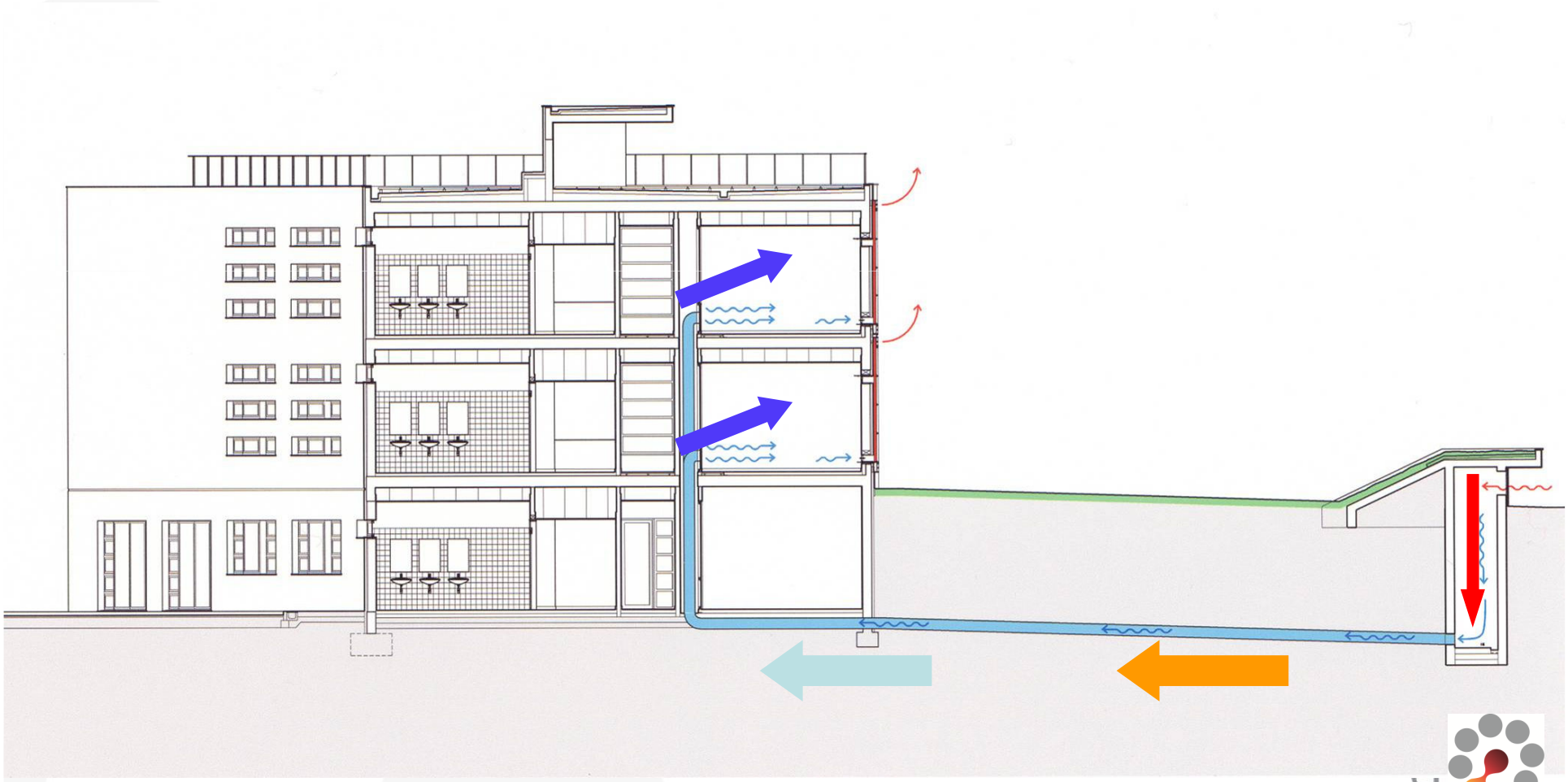


Ventilação Natural

Sistema ventilação natural transversal e por efeito de chaminé pelo hall central.

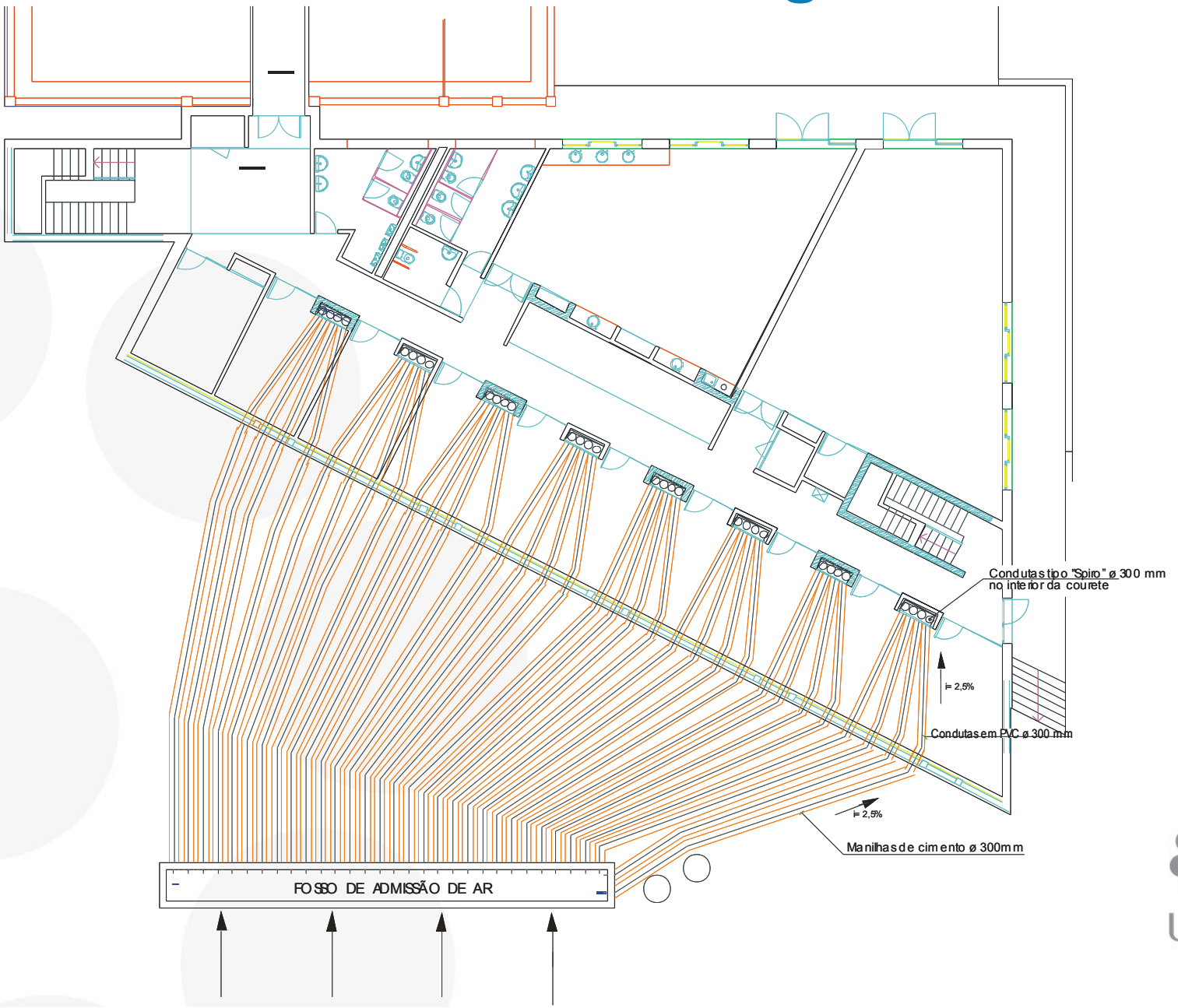


No Air Conditioning



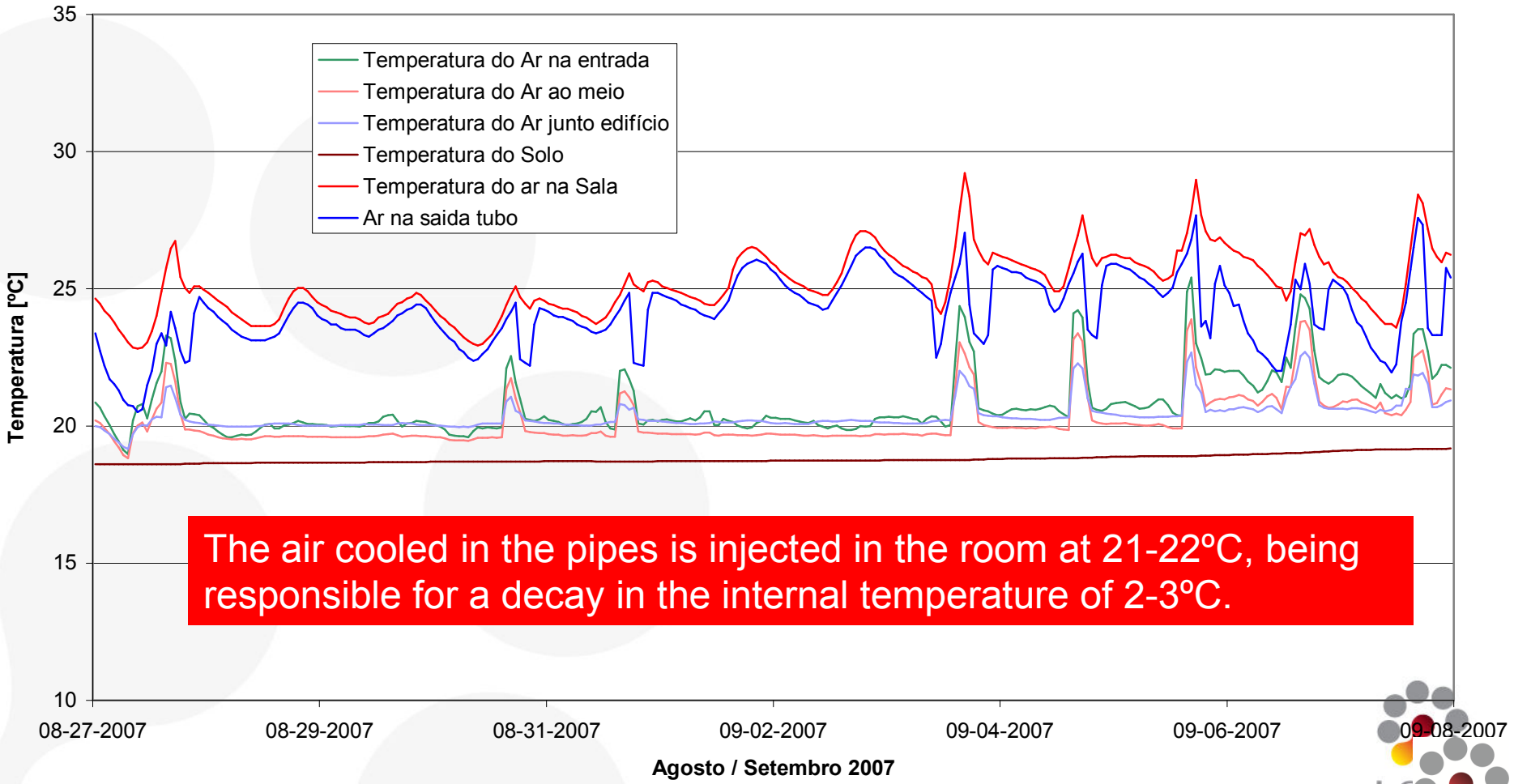
LNEG

Ground Cooling




Inside the building
closed
open

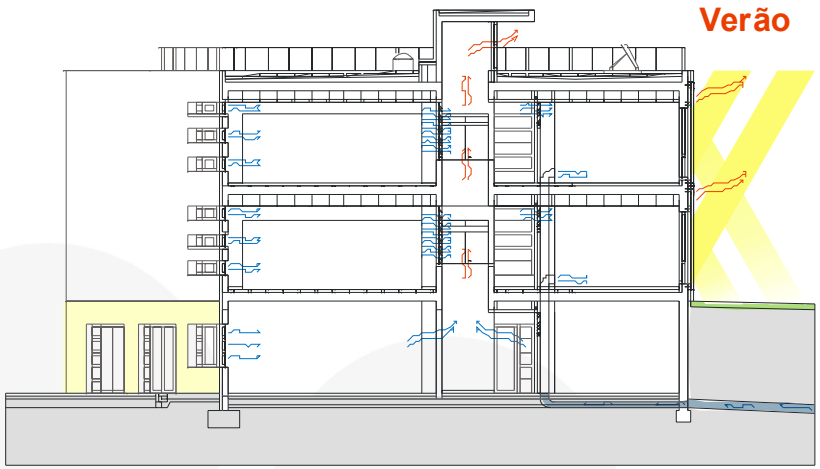
Temperatures in the buried pipes vs air temperature outside



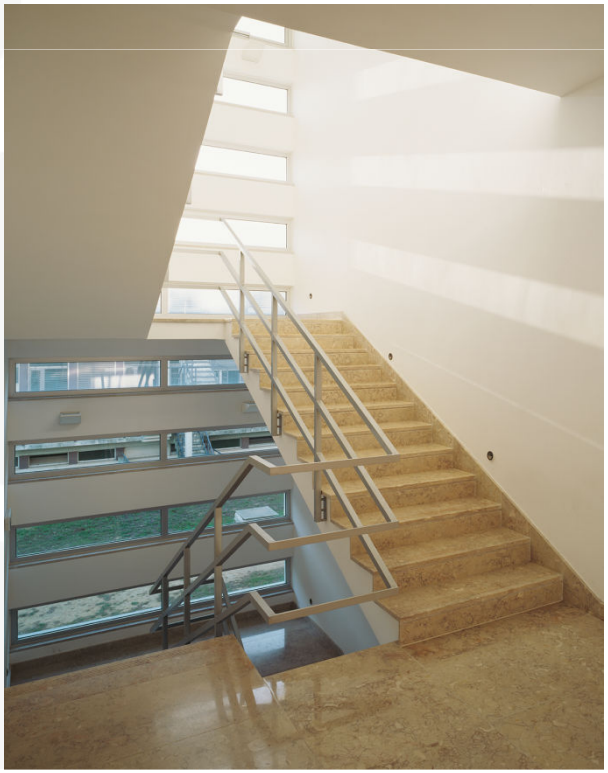
The air cooled in the pipes is injected in the room at 21-22ºC, being responsible for a decay in the internal temperature of 2-3ºC.

LNEG

ILUMINAÇÃO NATURAL
NATURAL LIGHTING



Vãos distribuidos, claraboia central comum aos 3 pisos com ligação às salas a norte e a sul, propiciam iluminação natural, todo o ano.



INTEGRAÇÃO DE ENERGIAS RENOVÁVEIS

Fachada Fotovoltaica no Edifício (96 m2- 12 kWp)

Parque de estacionamento (6kWp)

Colectores Solares para Aquecimento Auxiliar

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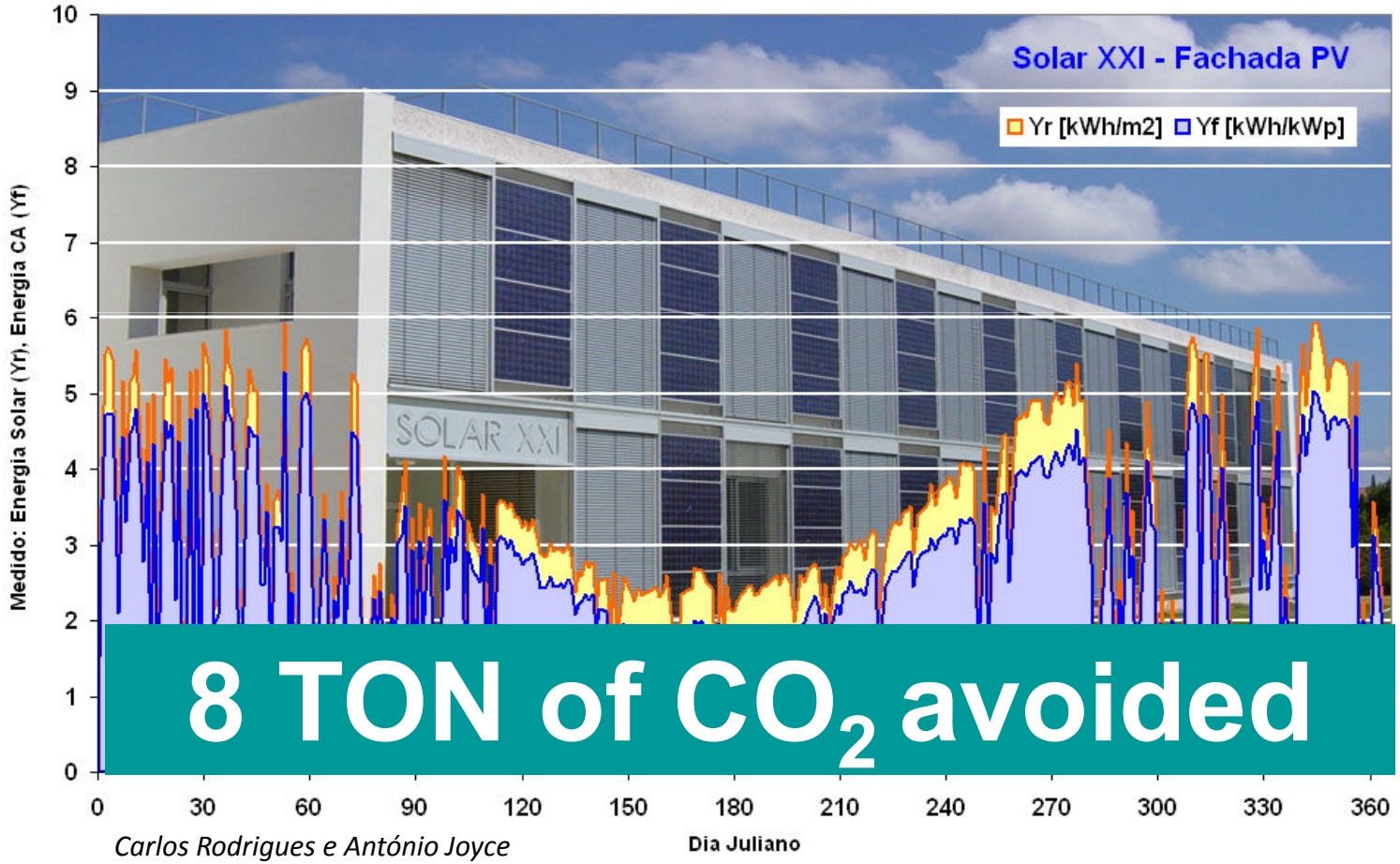
Energy Production in 2007; 12 + 8.4 MWh

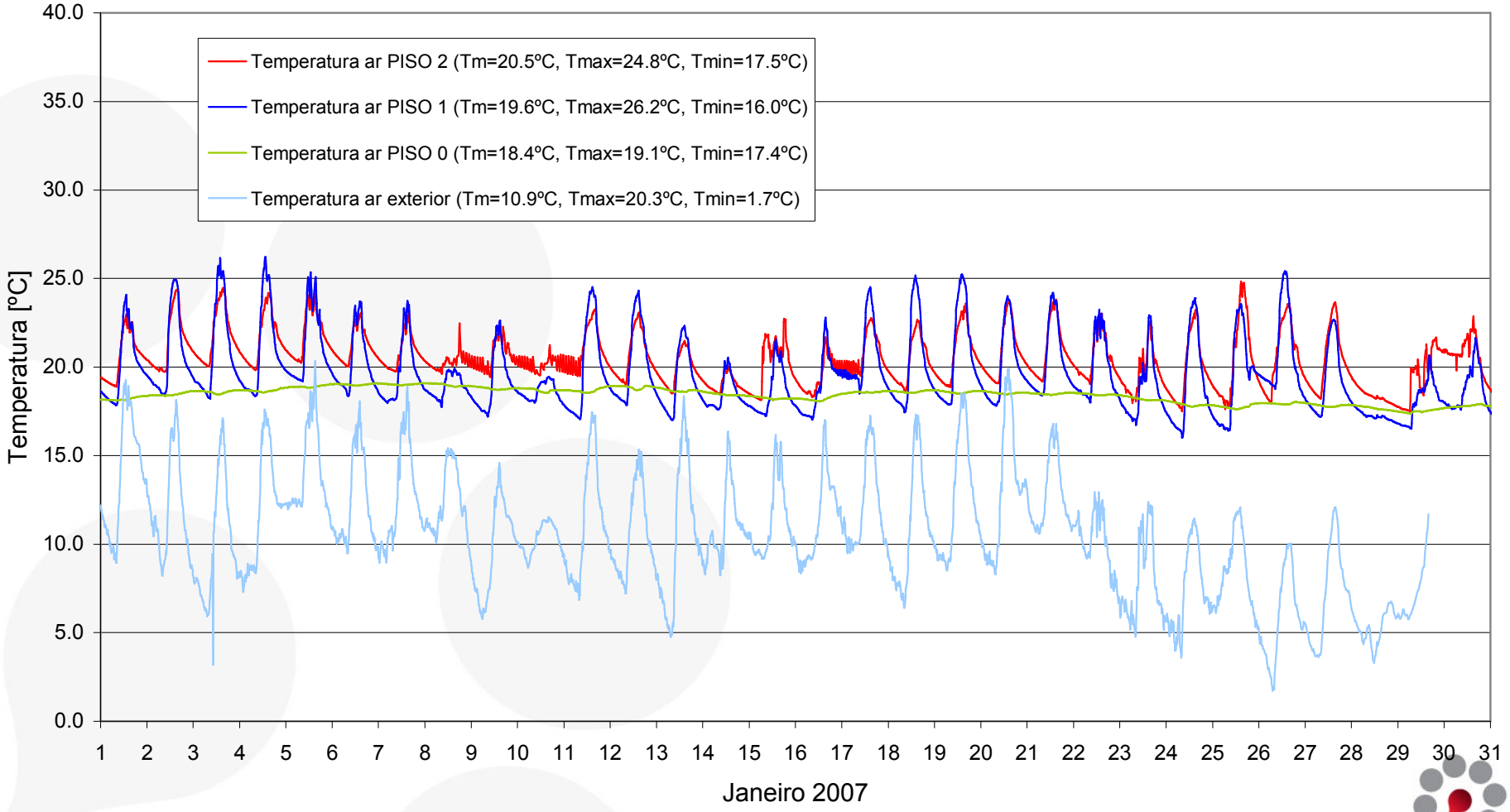
80 % of the electricity consumption produced by the PV system



8 TON of CO_2 avoided

Carlos Rodrigues e António Joyce

Winter - January 2007- Text vs Tint



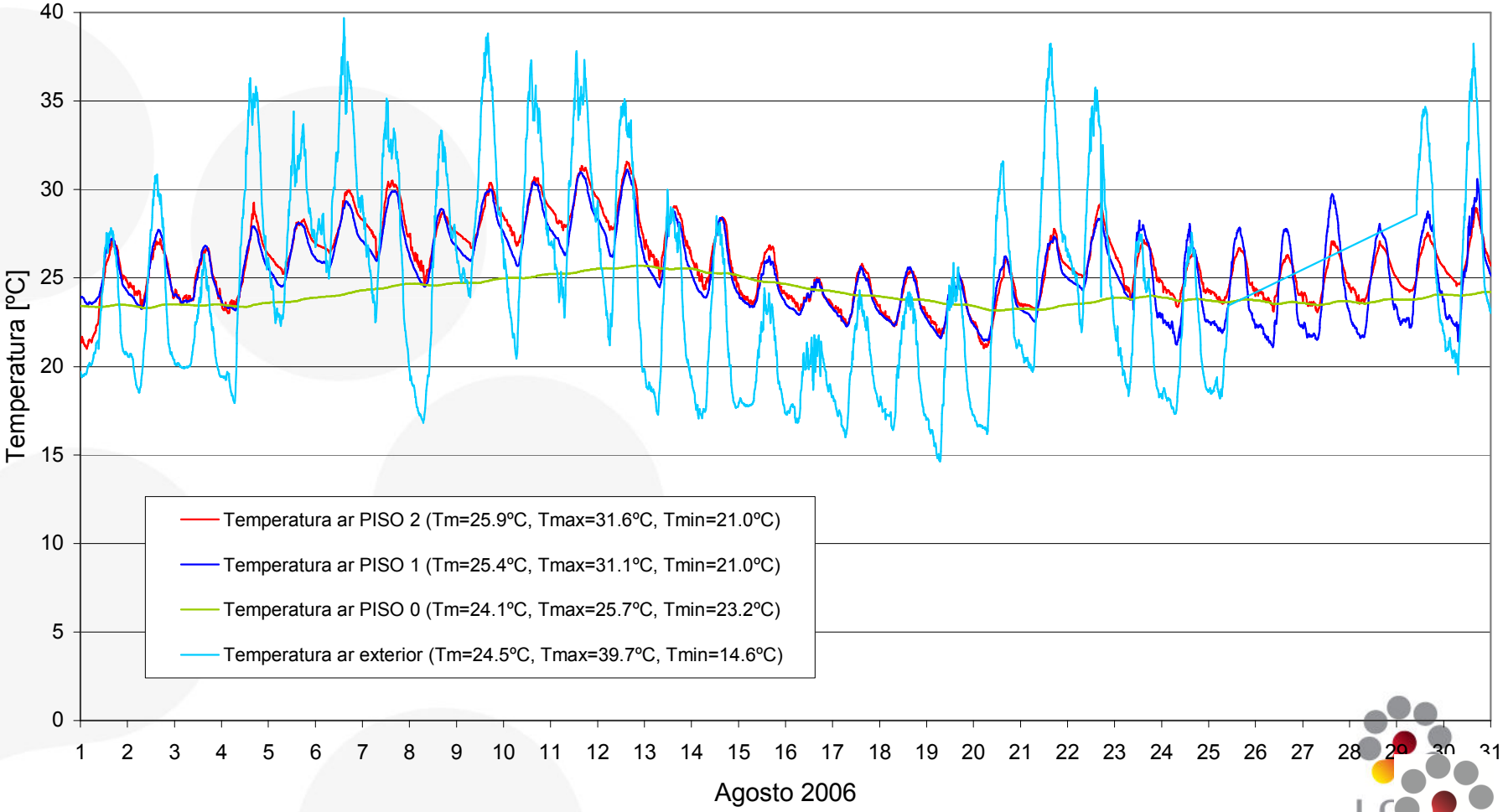
Solar Building XXI

	Fev 06	Nov 06	Dez 06	Jan 07	Fev 07	Nov 07	Dez 07	Jan 08	Fev 08
Text	10.3	16.0	10.8	10.9	12.9	12.8	9.8	11.5	12.2
Tint	21.4	21.5	19.4	19.6	19.7	20.3	18.7	19.9	19.7
Tmax	23.7	24.0	23.0	23.3	22.6	22.9	21.6	22.8	22.6
Tmin	16.0	20.1	17.4	17.6	18.0	18.7	17.1	18.3	18.0
Tdiurno	20.7	22.5	20.8	21.1	20.9	21.6	19.9	21.2	20.9

Temperaturas (ºC) - Winter

LNEG

Summer - August 2006- Text vs Tint



Solar Building XXI

Temperature (ºC) - SUMMER

	Jul 06	Ago 06	Set 06	Jul 07	Ago 07	Set 07
Text	23.7	24.5	22.3	21.8	21.5	21.2
Tint	25.1	25.4	24.2	24.1	24.7	24.2
Tmax	27.3	28.1	27.1	26.4	26.7	26.7
Tmin	23.3	23.3	21.5	22.3	23.2	21.5
Tdiurno	26.3	26.8	25.5	25.3	25.6	25.4

external, internal mean, internal mean maximum, internal mean minimum and internal mean daily

LNEG

Energy performance for office/service buildings: IEE (Energy Eficiency Indicator)

IEE SOLAR XXI (real)

2.8

kgep/(m2.year)

IEE SOLAR XXI (typical user related loads)

16

kgep/(m2.year)

IEE

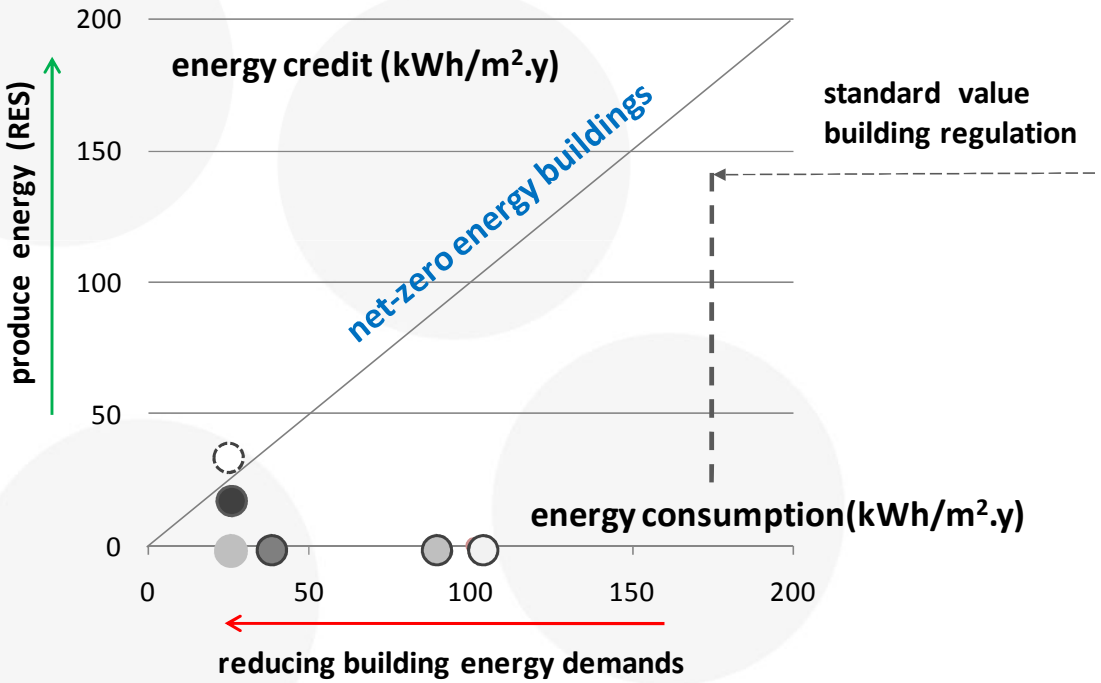
Standard value office building

30

kgep/(m2.year)

NZEB Energy performance

Reaching "zero energy"



- Building in accordance with actual building code+typical building related loads
- Improved standard + Typical building related loads
- Use of efficiency measures (passive techniques and strategies)
- Use of renewable energies
- Feed-in credit
- Feed-in credit (estimated in 2011)


zero
Our vision
A world where buildings
consume zero net energy

É POSSíVEL

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MINISTÉRIO DA ECONOMIA E DA INOVAÇÃO

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