Edifícios de Balanço Energético Nulo: implicações, soluções de design e exemplos

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LNEG
Laboratório Nacional de Energia e Geologia, I. P.

GOVERNO DE PORTUGAL
MINISTÉRIO DA ECONOMIA E DO EMPREGO

contexto

iniciativa AIE SHC Task 40

soluções de design

exemplo national

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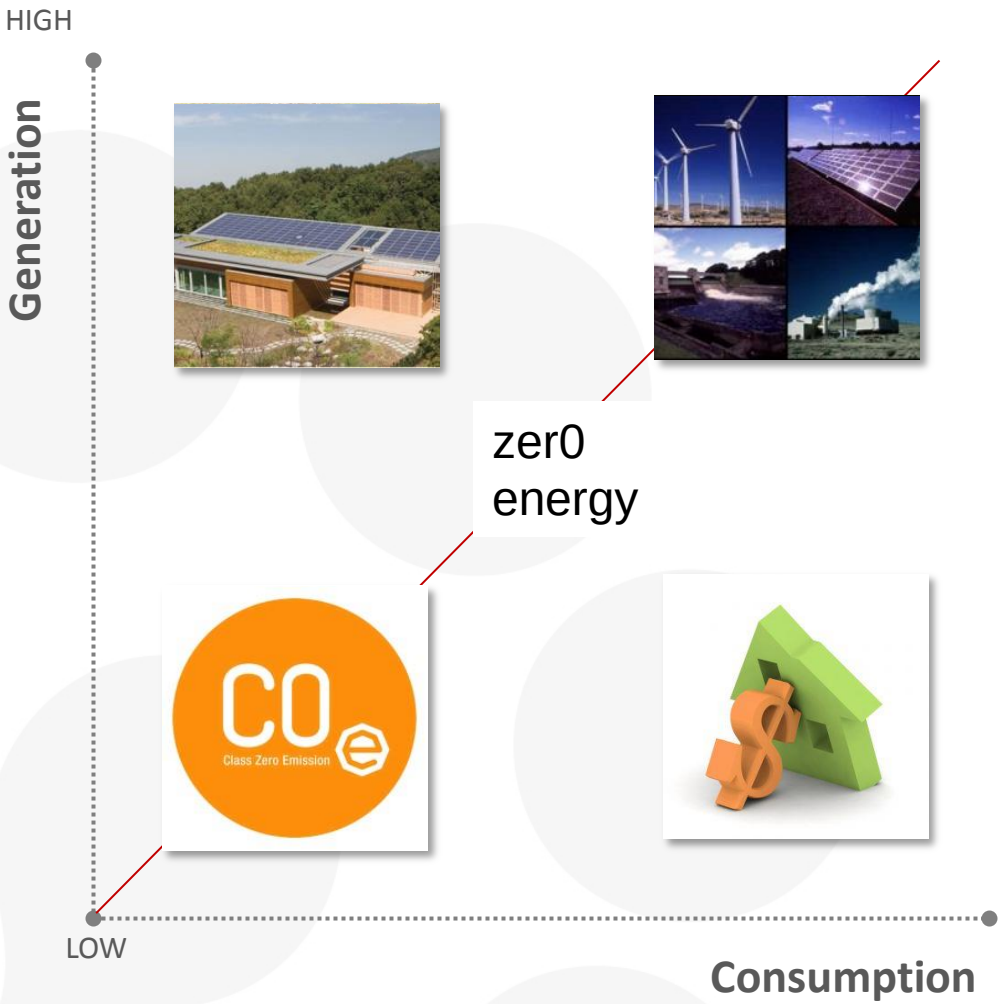
contexto

NZEB - International Initiatives

- *IEA Joint Project Solar Heating & Cooling Programme*: Towards Net Zero Energy Solar Buildings (Task 40)
- *World Business Council for Sustainable Development's Energy Efficiency in Buildings* (EEB) project - leading industry-only group
- *World Green Building Council* (WorldGBC) - union on national Green Building Councils
- *Net-Zero Energy Home* (NZEH) Coalition
- *The Zero Energy Commercial Buildings Database*
- *Massachusetts Zero Net Energy Buildings Task Force*
- *Zero Energy Building Research Alliance* (ZEBRAlliance)
- *ASHRAE: Guidance for Net-Zero Energy Design*
- *California's Long Term Energy Efficiency Strategic Plan* includes two "Big Bold Strategies" on zero energy buildings

NZEB - definições



Net-Zero Site Energy
produção de energia a partir de fontes renováveis (fotovoltaica, eólica, etc.) em quantidade suficiente para compensar as necessidades anuais (contagem efectuada no local).

Net-Zero Source Energy
"Source energy" pretende referir a energia primária requerida para produção de energia útil utilizada no local (a contabilização das necessidades deve entrar em conta com os coeficientes de conversão!)

Net-Zero Energy Emissions
produção de energia "limpa" em quantidade suficiente para compensar a energia adquirida produzida a partir de fontes convencionais (associados a produção de CO2), calculada numa base anual

Net-Zero Energy Costs
produção (e venda) de energia em quantidade suficiente para compensar os custos associados a aquisição de energia necessária para funcionamento/utilização do edifício, calculada numa base anual

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NZEB - EU Initiatives

- ***DIRECTIVE 2010/31/EU: Recast of Directive on Energy Performance of Buildings 2010***
- *Buildings Performance Institute Europe (BPIE)*
- *Concerted Action (CA) EPBD*
- *BUILD UP* - The web portal was established by the European Commission in 2009
- *Intelligent Energy Europe (IEE)* - a number of ongoing research projects

DIRECTIVE 2010/31/EU
Recast of Directive on Energy Performance of Buildings 2010

Article 2

Definitions

For the purpose of this Directive, the following definitions shall apply:

1. 'building' means a roofed construction having walls, for which energy is used to condition the indoor climate;

2. 'nearly zero-energy building' means a building that has a very high energy performance, as determined in accordance with Annex I. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby;

Article 9

Nearly zero-energy buildings

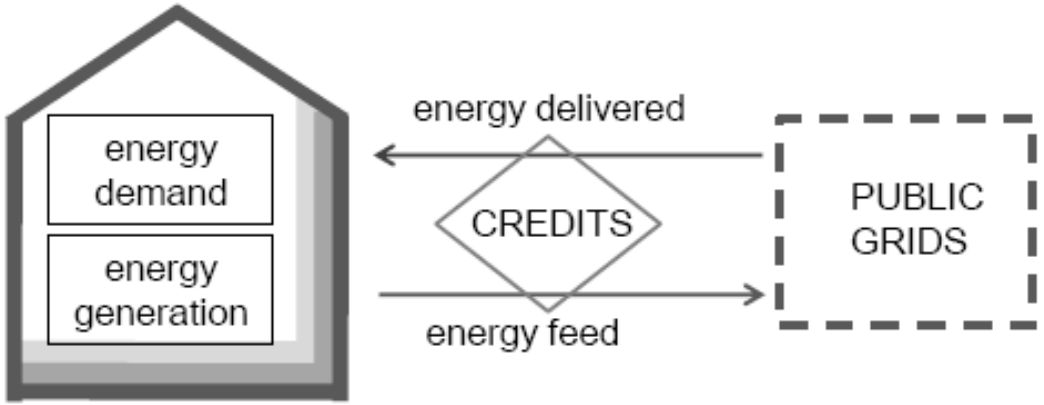
Member States shall ensure that:

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

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

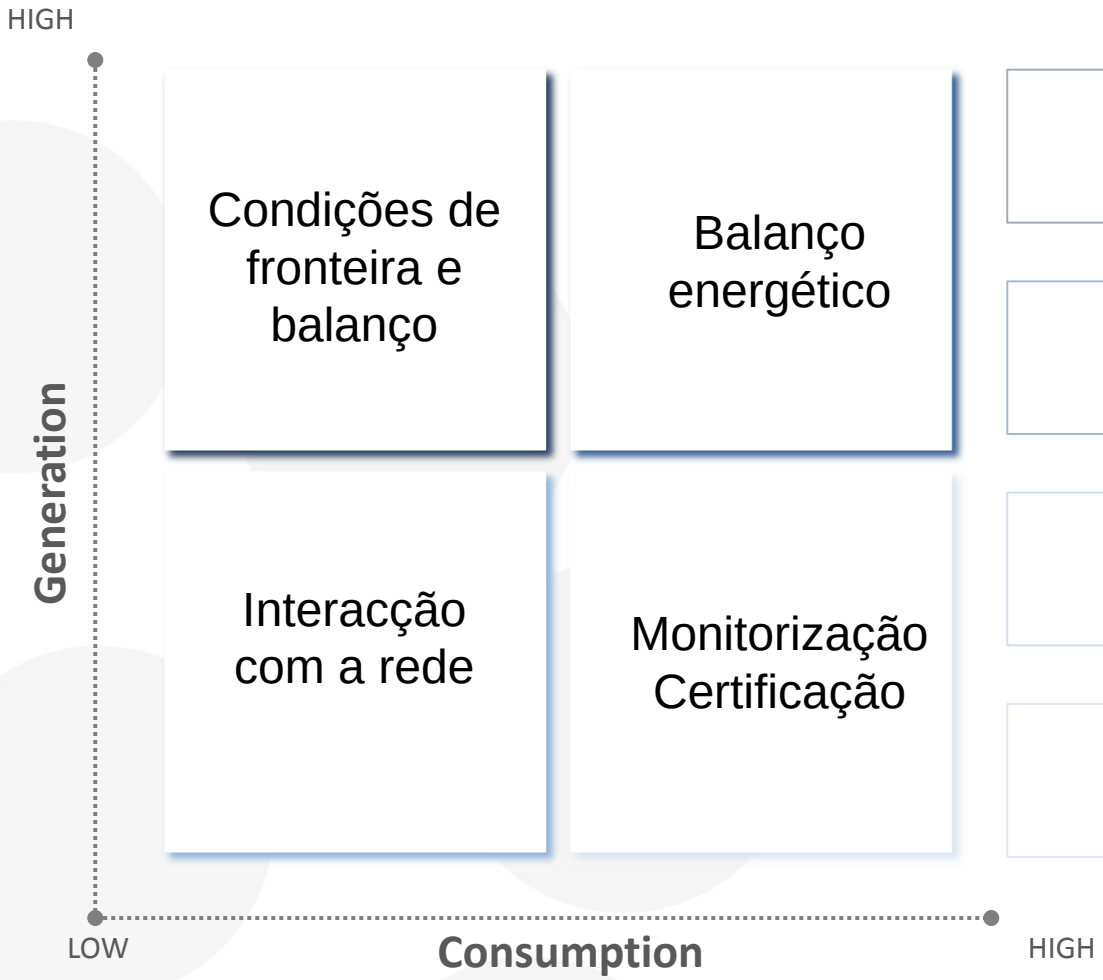
EPBD Recast

- Quadro harmonizado de definições



$$energy\ balance = energy\ \ feed \times credits - energy\ delivered \times credits$$

O balanço energético é contabilizado na fonte (em termos de energia primária).
A energia (consumida e produzida) é multiplicada por factores de conversão.



Fronteira fisica
Factores de conversão
Clima e conforto

Itens considerados
Período
Prioridades
Supply options.

Load match
Grids interaction

Monitorização
Certificação

DESAFIOS

CLIMA - DESIGN DO EDIFÍCIO - AQUECIMENTO/ARREFECIMENTO/POTENCIAL DOS RES

UTILIZAÇÃO DO EDIFÍCIO

iniciativa internacional

IEA Task40

Task 40 ECBCS Annex 52
Towards Net Zero-Energy Solar Buildings

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Task 40 ECBCS Annex 52

DEFINITIONS

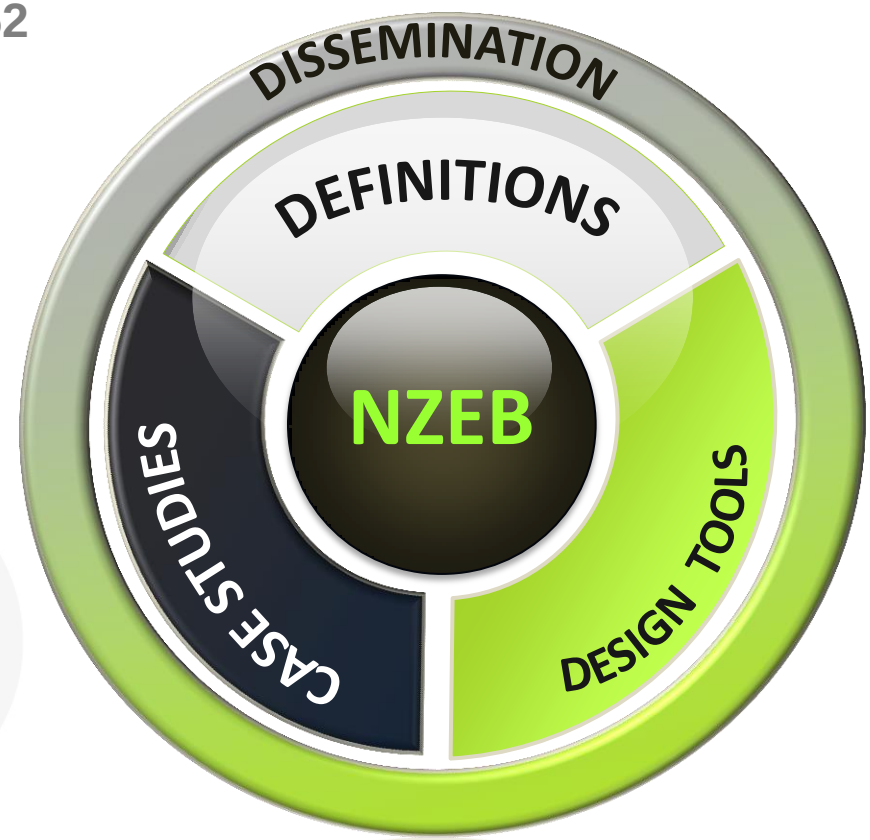
development of a harmonized international definition framework

DESIGN TOOLS

processes and tools currently being used to design NZEBs

CASE STUDIES

investigating advanced integrated design concepts, solution sets of NZEBs



case studies - the proof of NZEB design

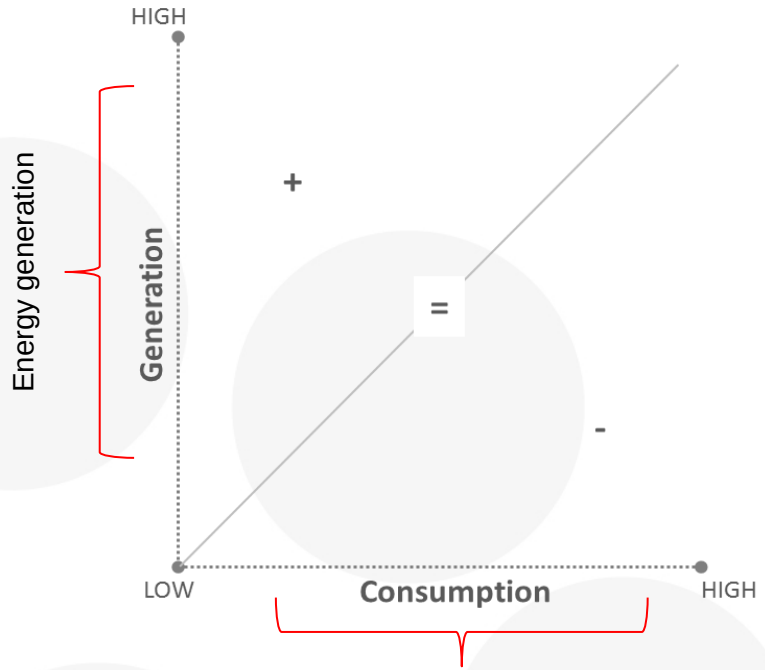
http://www.enob.info/en/site-info/



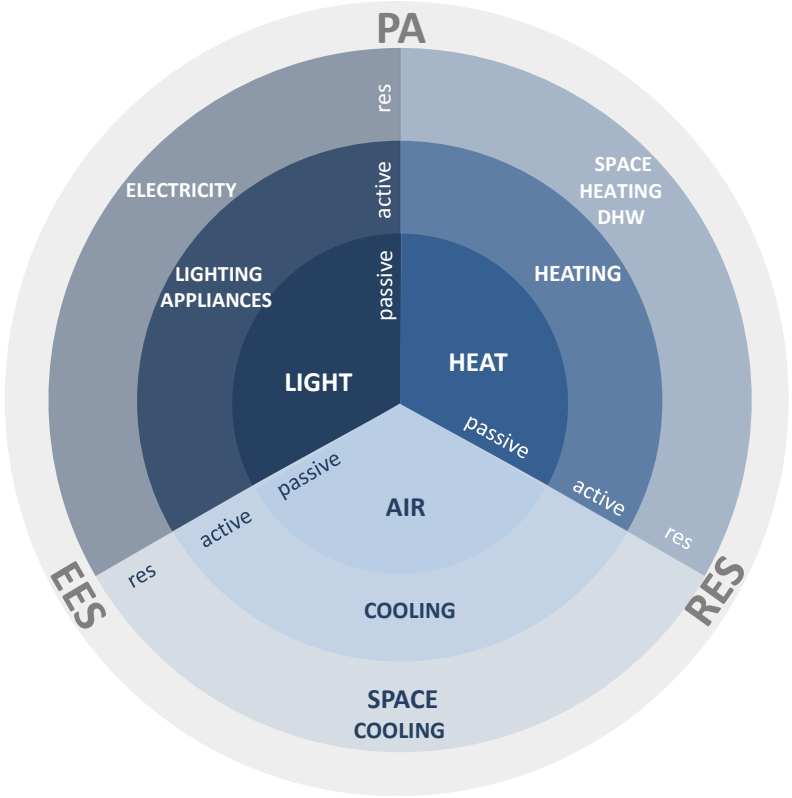

All these case studies:

- Represent nearly zero, zero or plus-energy buildings
- Energy performance > 50% better than benchmark
- Well documented physical characteristics
- Monitored and simulated energy performance
- Important *lessons learned* from designing, operating, POE

soluções de design



Energy efficiency:
passive solar design + energy efficient systems



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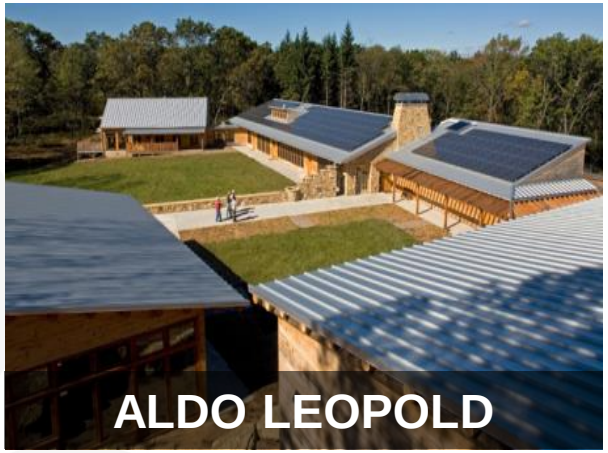
DESAFIOS

CLIMA - DESIGN DO EDIFÍCIO - AQUECIMENTO/ARREFECIMENTO/POTENCIAL DOS RES

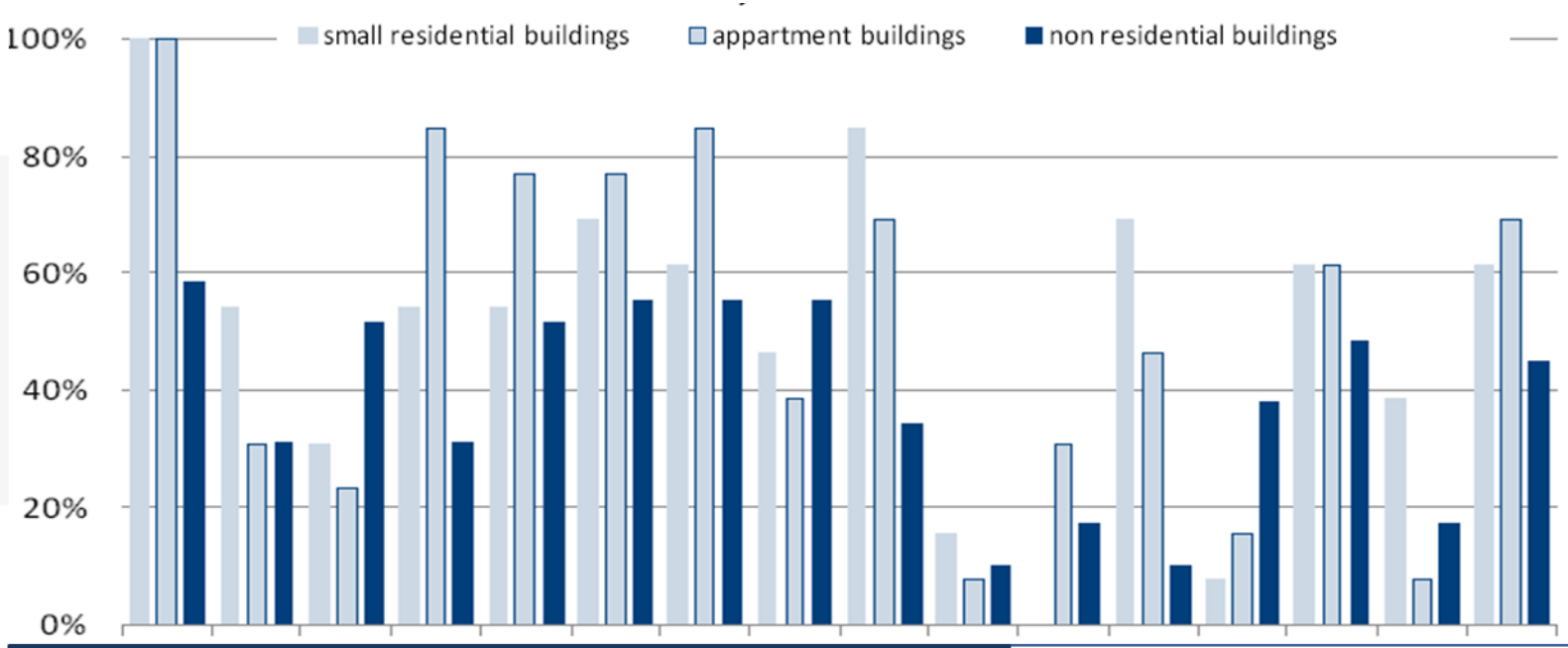
UTILIZAÇÃO DO EDIFÍCIO

Architectural integration



Architectural integration

soluções de design



Passive approaches

- ✓ Improved insulation
- ✓ High thermal mass
- ✓ Compactness
- ✓ Passive solar gain
- ✓ Sunshading
- ✓ Heat recovery
- ✓ Energy storage
- ✓ Mechanical ventilation
- ✓ Natural ventilation
- ✓ Cross ventilation
- ✓ Night cooling
- ✓ Green roof/façade
- ✓ Earth tube exchanger

Energy Efficient Systems

- ✓ Efficient appliances
- ✓ Efficient office equipment
- ✓ Efficient HVAC
- ✓ LED lighting

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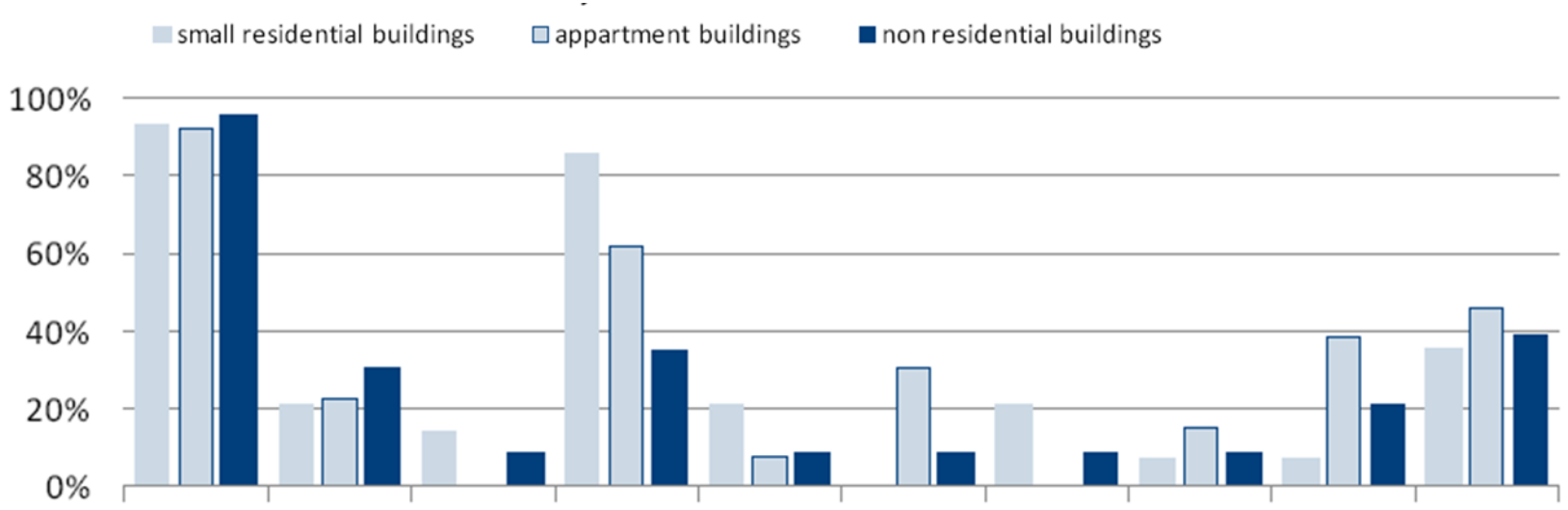
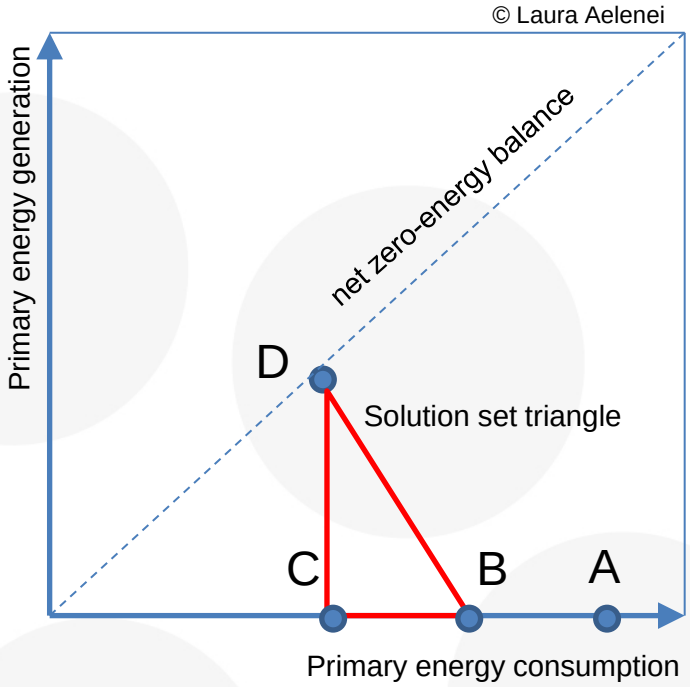
soluções de design



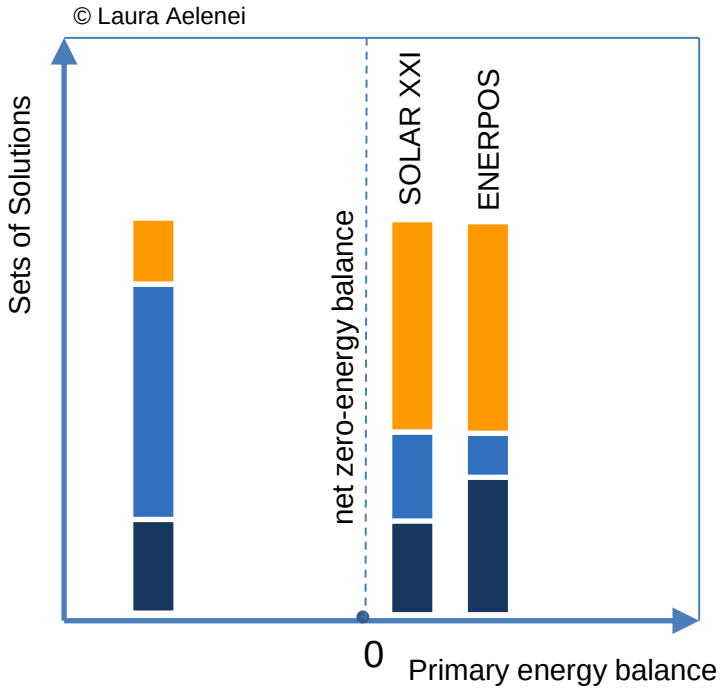
Renewable Energy Systems

- ✓ PV: roof top, façade, on site
- ✓ Solar Thermal DHW
- ✓ Solar Thermal Heating
- ✓ Wind power off-site
- ✓ Biomass Boiler
- ✓ CHP (Fossil/Biomass)
- ✓ Geothermal Heat Pump

soluções de design

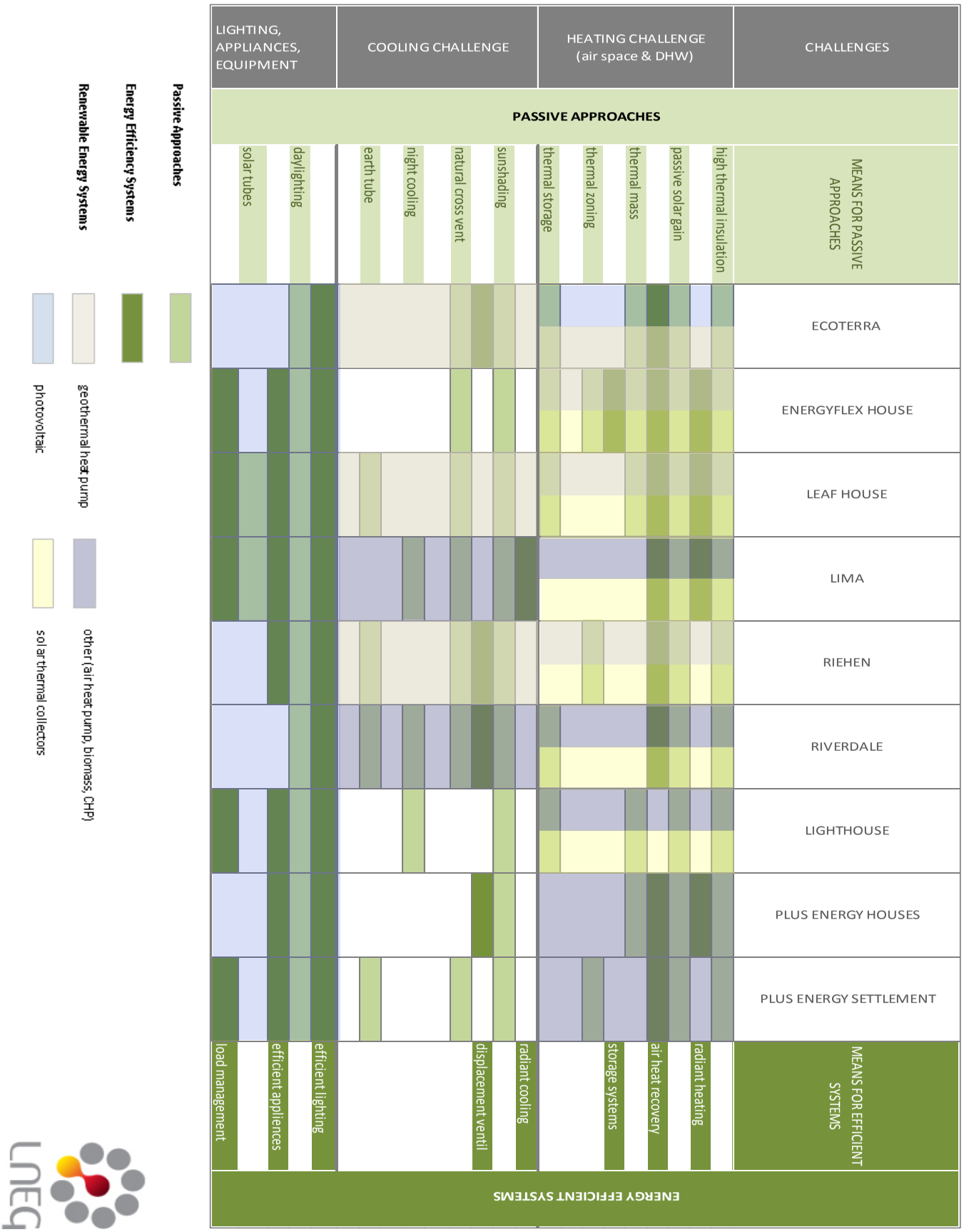


A - Building code
B - Passive measures
C - Energy Efficient Systems
D - Energy generation



Energy generation
Energy Efficient Systems
Passive measures

NZEB design - Matrix of design solutions

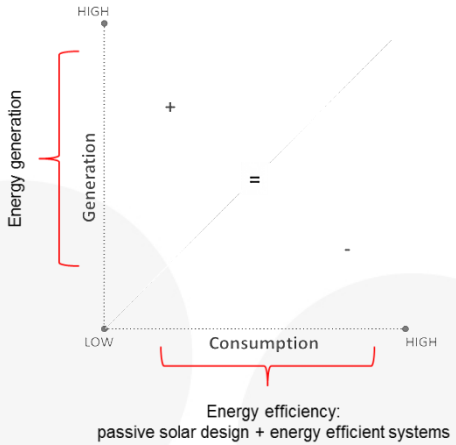


SOLAR XXI

SOLAR XXI

General characteristics	
Location	Lisbon Latitude 38°46'20.27" north Longitude 9°10'39.83" west
Owner	National Energy and Geology Laboratory (LNEG)
Project co-ordinator	Helder Gonçalves helder.goncalves@lneg.pt
Architect	Pedro Cabrita, Isabel Diniz
Building costs (tax included)	800 €/m²
Typology	Office building
Climate data	Temperate Heating period 5.3 month Heating Degree Days 1190ºC (Tb 20ºC)
Main stimulation of the project	Test, experimental, research
Site context	Urban
Building construction	High
Number of occupants	20 pc
Number of stories	3 pc
Number of buildings	1pc
Heated net floor area	1200 m²
Gross floor area	1500 m²
Total envelope area	1436 m²
Envelope to volume ratio	0.4 m^{-1}

SOLAR XXI - dados gerais

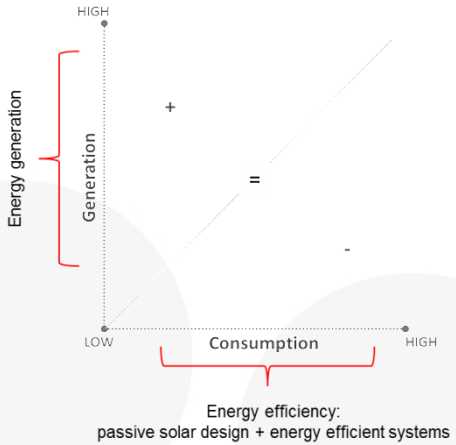


Prioridade: Eficiência energética

diminuir as neccesidades energéticas

1. Optimização térmica da envolvente

Building elements	Material	U value (W/m^2K)
External walls	Brick wall + ETICS (6 cm)	0.45
Roof	Concrete with external insulation (10 cm)	0.26
Thermal bridges	Concrete with external insulation (6 cm)	0.55
Windows	Transparent double glazing	3.50
Envelope (average)		0.88



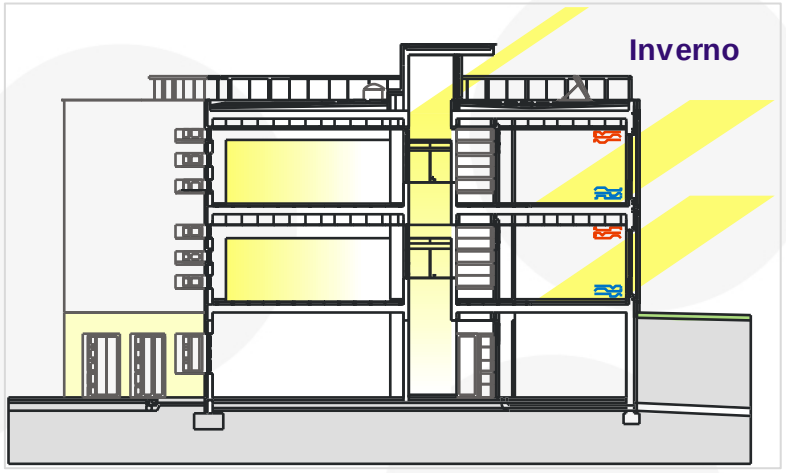
Prioridade: Eficiência energética

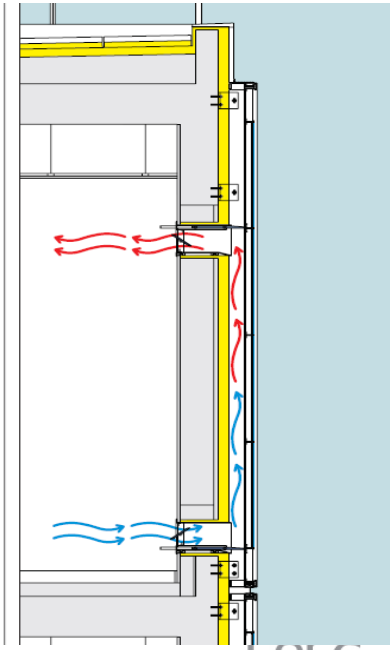
diminuir as neccesidades energéticas

2. Optimização dos ganhos solares

sistema de recuperação de calor

ganhos diretos





Estrategias/sistemas adoptadas - Verão

Prioridade: Eficiência energética
diminuir as neccesidades energéticas

3. Reduzir as necessidades da arrefecimento

Sombreamento dos vãos

Dispositivos de sombreamento-estores de laminas exteriores, regulavéis e orientvéis, adequar a entrada de radiação solar e luz.

Prioridade: Eficiência energética
diminuir as neccesidades energéticas

3. Reduzir as necessidades da arrefecimento

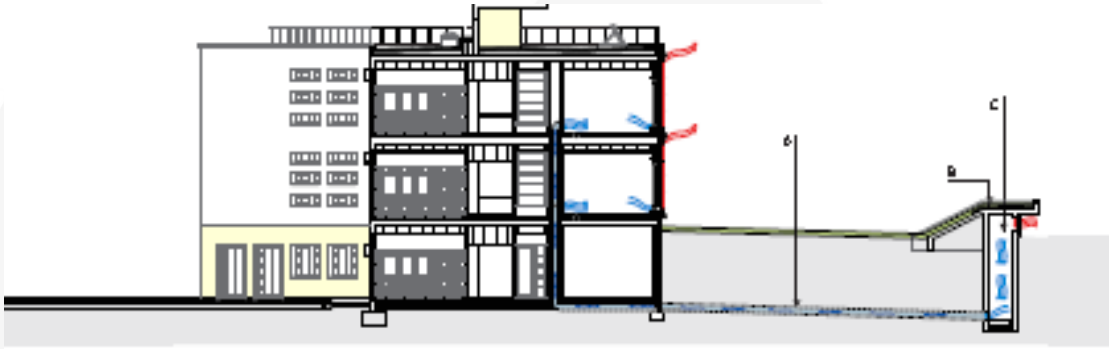
Ventilação natural

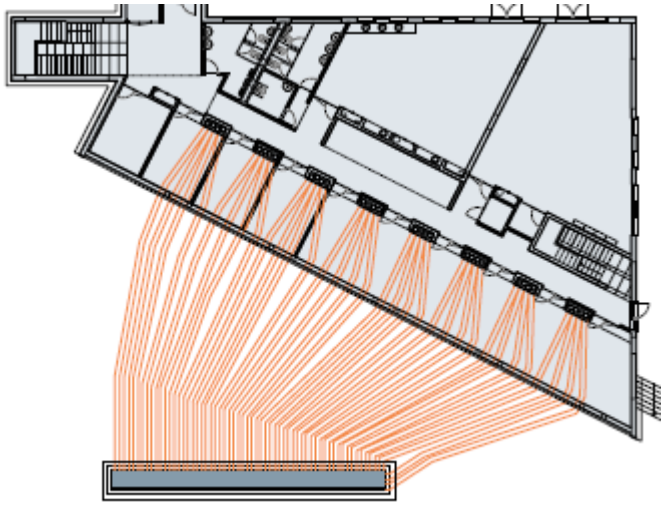
- através de aberturas nas diferentes fachadas de forma a permitir uma ventilação transversal
- existência de registos reguláveis em bandeiras existentes sobre todas as portas, que ligam as salas ao corredor e ao poço central, que por sua vez permite uma ventilação ascendente por efeito de chaminé

Prioridade: Eficiência energética
diminuir as neccesidades energéticas

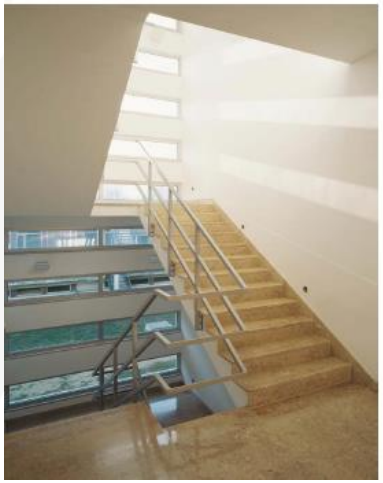
3. Reduzir as necessidades da arrefecimento

sistema de tubos enterrados





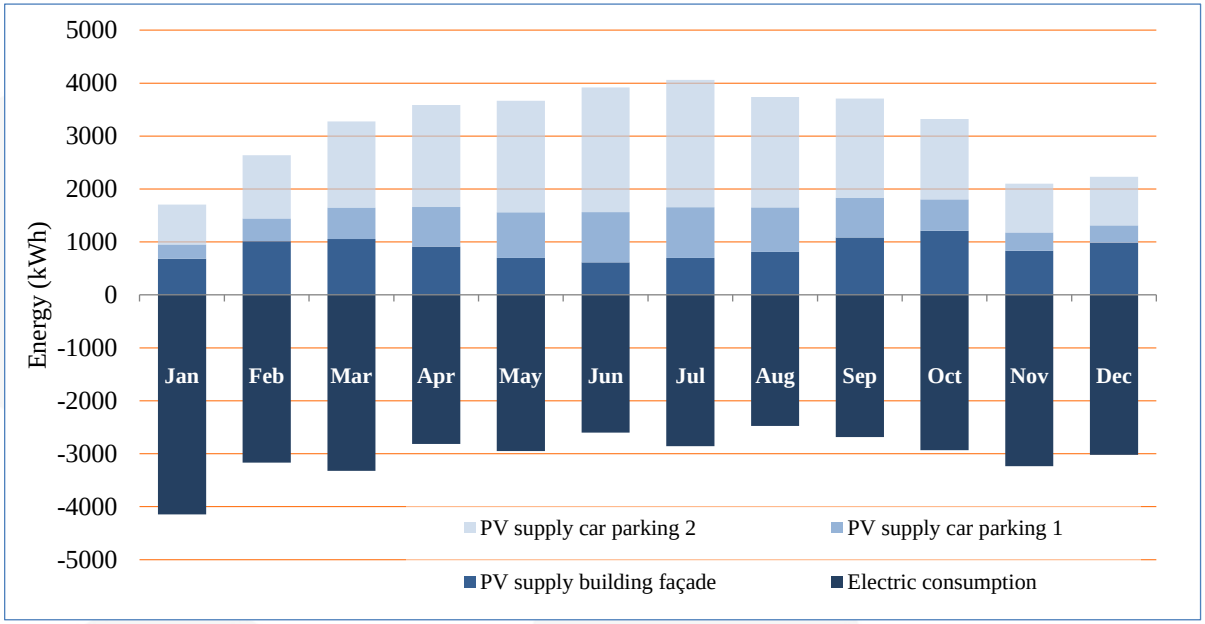
Prioridade: Eficiência energética
diminuir as neccesidades energéticas



4. Reduzir o consumo de iluminação electrica

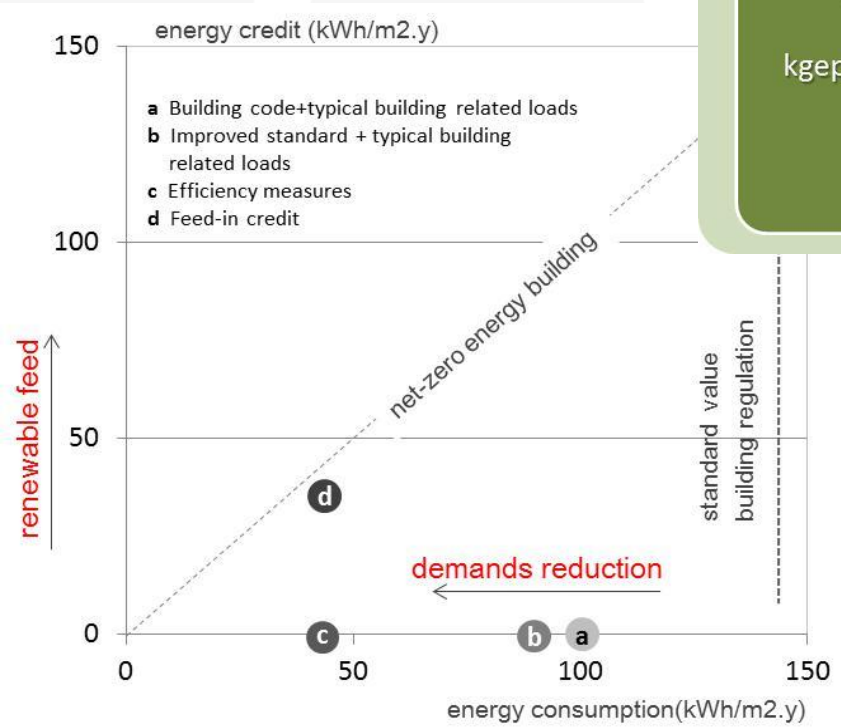
Vãos distribuidos, claraboia central comum aos 3 pisos com ligação às salas a norte e a sul propiciam iluminação natural, todo o ano.

Segundo passo: produção de energia



RES	Integration	Area (m^2)	Installed Peak power (kW)	Productivity (kWh/kW)
76 PV multicristalline silicon modules	Building façade	96	12	1004
100 PV amorphous silicon	Car parking 1	95	6	1401
150 PV CIS thin-film modules	Car parking 2	110	12	1401
CPC Thermal Solar Collectors	Building roof	16	11 MWh, from which 5MWh being used	

NZEB performance



IEE SOLAR XXI (real)	IEE SOLAR XXI (typical user related loads)	IEE Standard value office building
2.8 kgep/(m2.year)	16 kgep/(m2.year)	30 kgep/(m2.year)

Energy performance for office buildings IEE (Energy Eficiency Indicator)

obrigada

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