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

SOLAR XXI

Um Marco Tecnologico em Direcção à “Energia Zer0”

Laura Aelenei

26 de Outobro de 2012

GOVERNO DE PORTUGAL | MINISTÉRIO DA ECONOMIA E DO EMPREGO

Tópicos a abordar

contexto

exemplo initiativa/projeto international

exemplo nacional edifício NZEB: SOLARXXI

contexto

NZEB - definições

zero site energy

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).

zero source energy

Net-Zero Source Energy - produção de energia em quantidade suficiente para compensar as necessidades anuais (contagem efectuada na fonte). "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!)

zero energy emissions

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.

zero energy costs

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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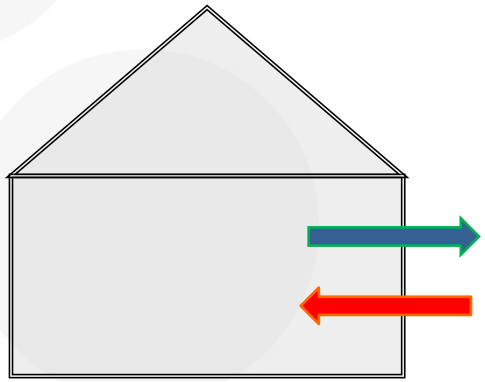
NZEB - conceito

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

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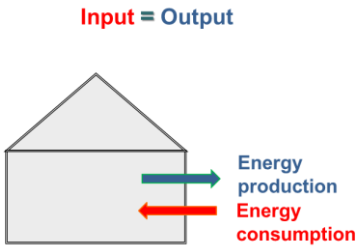
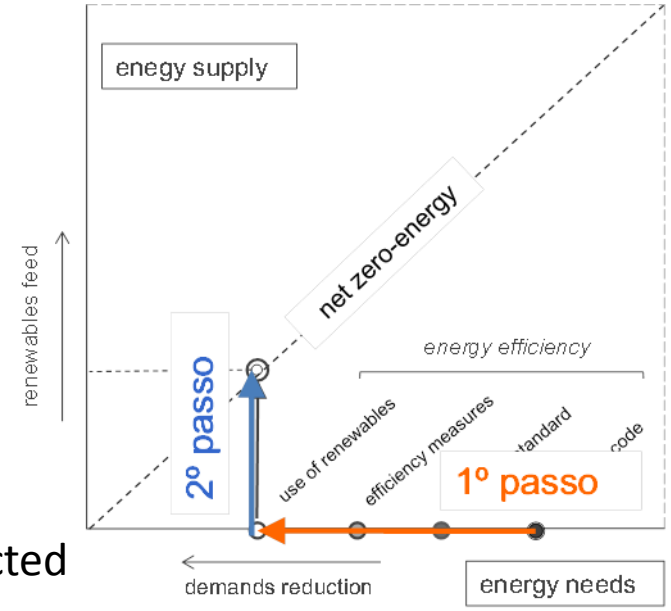
Methodology

Efficiency versus Supply





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Balance boundary:

- on site - non grid connected
- off site - grid connected
- green energy
- single building
- building cluster

Metric

- Site energy: *delivered*
- Source energy*: primary*
- Energy costs
- Energy emissions

Energy use

- heating
- cooling
- lighting
- DHW
- …

NZEB - International Initiatives

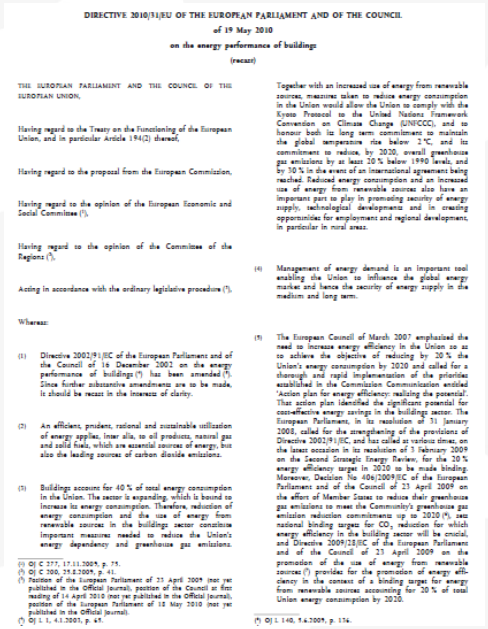
- *IEA Joint Project Solar Heating & Cooling Programme*: Towards Net Zero Energy Solar Buildings (Task 40)
- *World Business Council for Sustainable Development's Energy Efficiency in Buildings* (EEB) project - leading industry-only group
- *World Green Building Council* (WorldGBC) - union on national 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 - 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

EPBD Recast



DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 19 May 2010
on the energy performance of buildings
(recast)

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty on the Functioning of the European Union, and in particular Article 194(2) thereof,

Having regard to the proposal from the European Commission,

Having regard to the opinion of the European Economic and Social Committee (1),

Having regard to the opinion of the Committee of the Regions (2),

Acting in accordance with the ordinary legislative procedure (3),

Whereas:

(1) Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings (4) has been amended (5). Since further substantive amendments are to be made, it should be recast in the interests of clarity.

(2) An efficient, prudent, rational and sustainable utilisation of energy applies, inter alia, to oil products, natural gas and solid fuels, which are essential sources of energy, but also the leading sources of carbon dioxide emissions.

(3) Buildings account for 40 % of total energy consumption in the Union. The sector is expanding, which is bound to increase its energy consumption. Therefore, reduction of energy consumption and the use of energy from renewable sources in the buildings sector constitute important measures needed to reduce the Union's energy dependency and greenhouse gas emissions.

Together with an increased use of energy from renewable sources, measures taken to reduce energy consumption in the Union would allow the Union to comply with the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), and to honour both its long term commitment to maintain the global temperature rise below 2 °C, and its commitment to reduce, by 2020, overall greenhouse gas emissions by at least 20 % below 1990 levels, and by 30 % in the event of an international agreement being reached. Reduced energy consumption and an increased use of energy from renewable sources also have an important part to play in promoting security of energy supply, technological developments and in creating opportunities for employment and regional development, in particular in rural areas.

(4) Management of energy demand is an important tool enabling the Union to influence the global energy market and hence the security of energy supply in the medium and long term.

(5) The European Council of March 2007 emphasised the need to increase energy efficiency in the Union so as to achieve the objective of reducing by 20 % the Union's energy consumption by 2020 and called for a thorough and rapid implementation of the priorities established in the Commission Communication entitled 'Action plan for energy efficiency: realising the potential'. That action plan identified the significant potential for cost-effective energy savings in the buildings sector. The European Parliament, in its resolution of 31 January 2008, called for the strengthening of the provisions of Directive 2002/91/EC, and has called at various times, on the latest occasion in its resolution of 3 February 2009 on the Second Strategic Energy Review, for the 20 % energy efficiency target in 2020 to be made binding. Moreover, Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020 (6), sets national binding targets for CO_2 reduction for which energy efficiency in the building sector will be crucial, and Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources (7) provides for the promotion of energy efficiency in the context of a binding target for energy from renewable sources accounting for 20 % of total Union energy consumption by 2020.

(1) OJ C 277, 17.11.2005, p. 75.
(2) OJ C 200, 25.8.2005, p. 41.
(3) Position of the European Parliament of 23 April 2009 (not yet published in the Official Journal), position of the Council at first reading of 14 April 2010 (not yet published in the Official Journal), position of the European Parliament of 18 May 2010 (not yet published in the Official Journal).
(4) OJ L 1, 4.1.2003, p. 65.
(5) OJ L 140, 5.6.2009, p. 136.

"nearly zero energy building"[…] has **a very high performance** The nearly zero or **very low amount of energy required** should be covered to a very significant extent by energy from renewable sources, including on-site or nearby [EPBD]

Article 9
Nearly zero-energy buildings

- by 31 December 2020, all new buildings are nearly zero-energy buildings;
- after 31 December 2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings.
- draw up national plans for nZEB public sector leading example
  - Interim target by 2015
  - National definition for nZEB/NZEB (including building retrofit towards NZEB levels

initiativa internacional

IEA Task40

IEA Joint Project: Solar Heating & Cooling Programme

Task 40 Annex 52
Towards Net Zero-Energy Solar Buildings

(October 2008 - September 2013)

International Energy Agency
Energy Conservation in Buildings and Community Systems Programme

SHC
SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

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

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Task 40 ECBCS Annex 52

DEFINITIONS

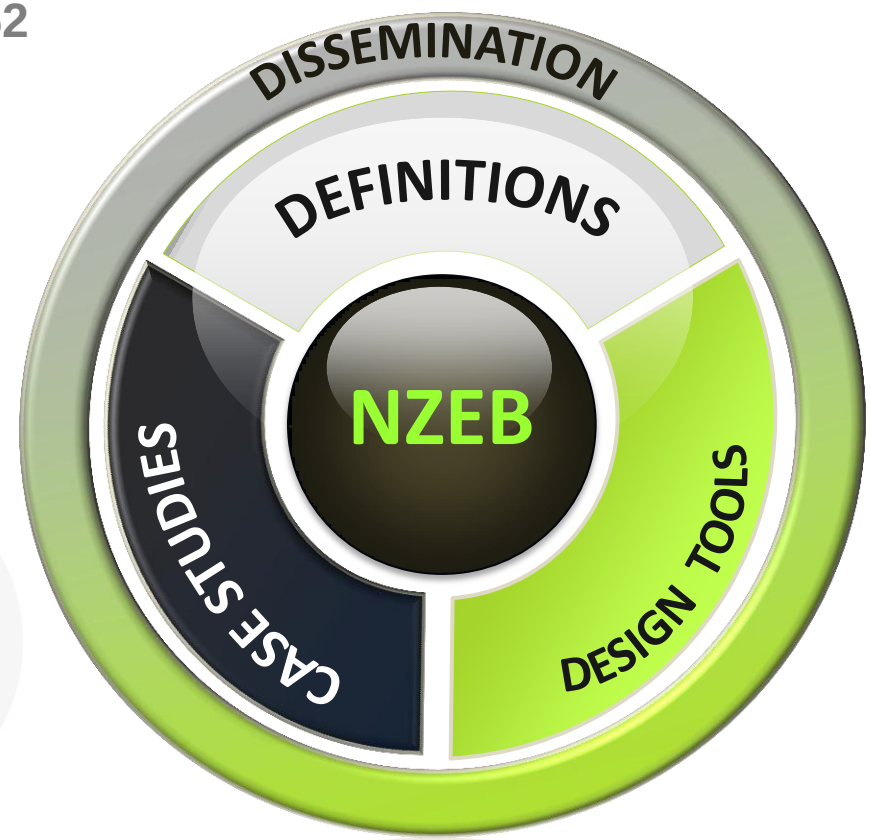
development of a harmonized international definition framework

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

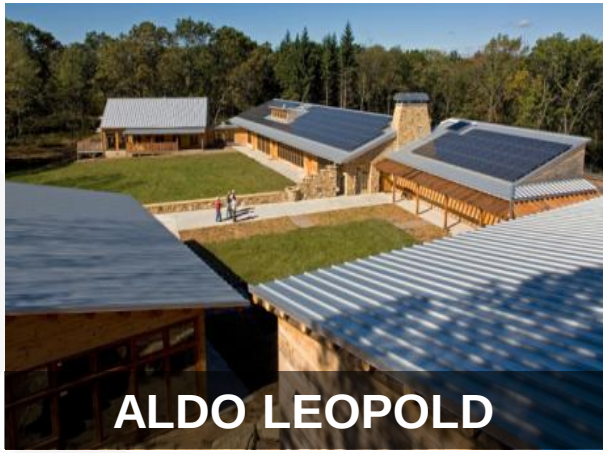
http://www.enob.info/en/site-info/




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

Architectural integration



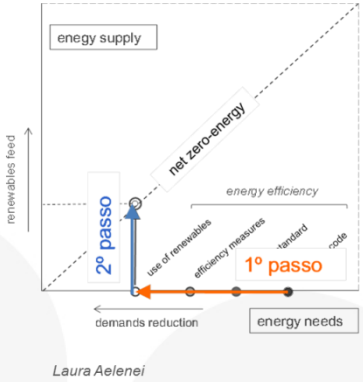
Architectural integration

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



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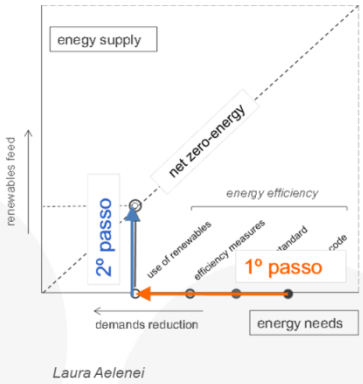
Prioridade: Eficiência energética

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



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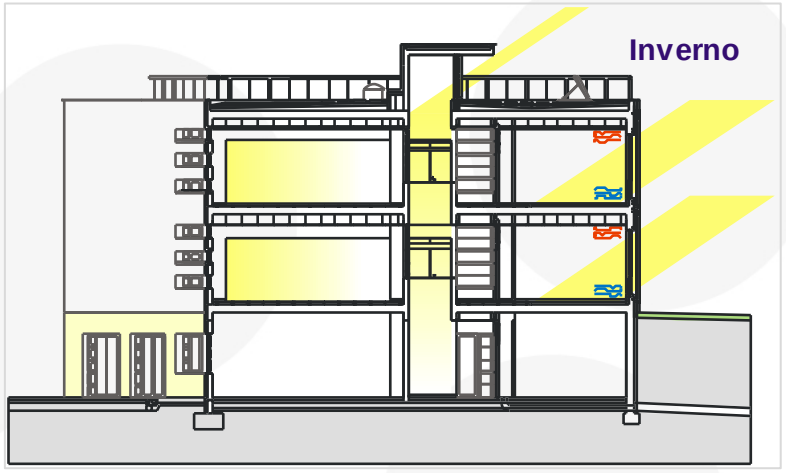
Prioridade: Eficiência energética

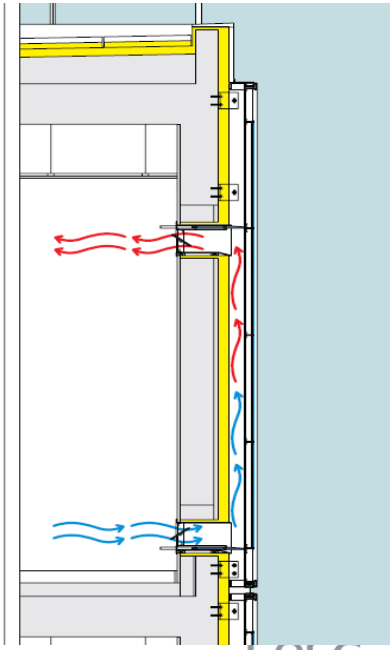
diminuir as neccesidades energéticas

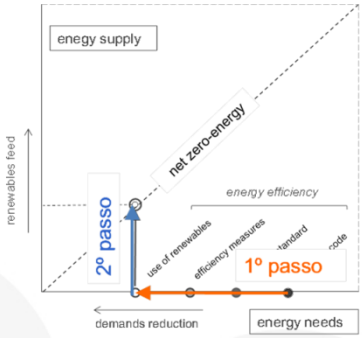
2. Optimização dos ganhos solares

sistema de recuperação de calor

ganhos diretos







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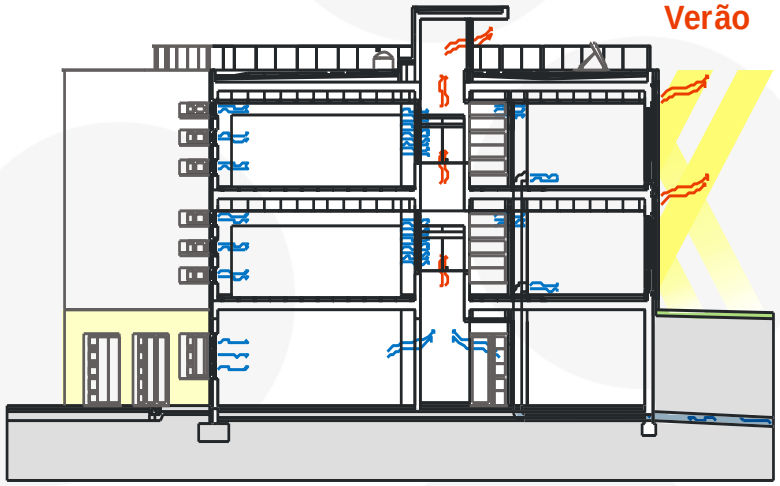
Prioridade: Eficiência energética

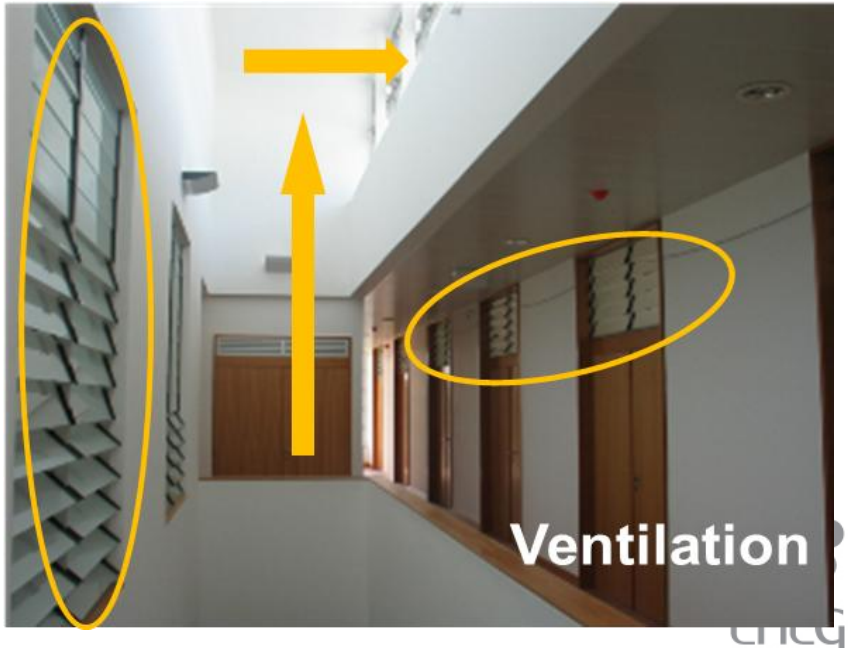
diminuir as neccesidades energéticas

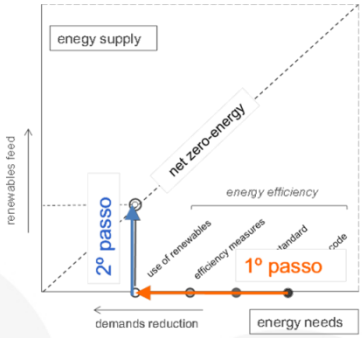
3. Reduzir as necessidades da arrefecimento

protecção dos
vãos envidraçados (estores exteriores)



ventilação natural





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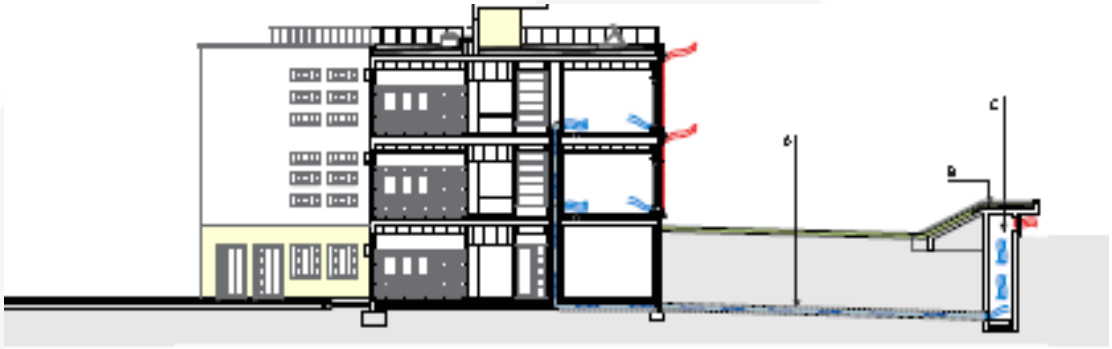
Prioridade: Eficiência energética

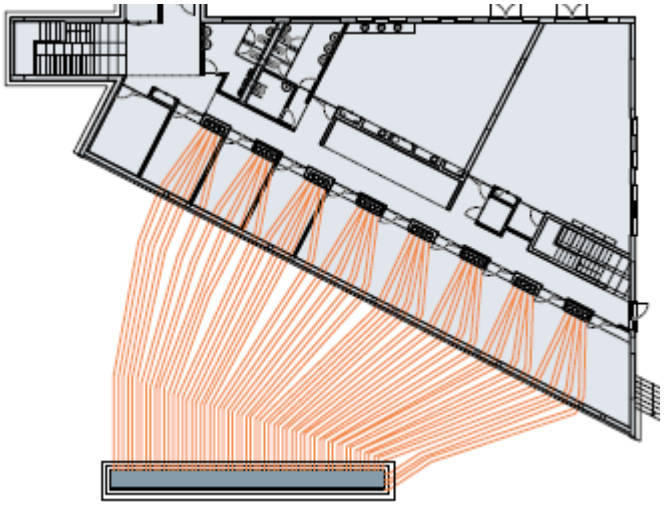
diminuir as neccesidades energéticas

4. Reduzir as necessidades da arrefecimento




sistema de tubos enterrados





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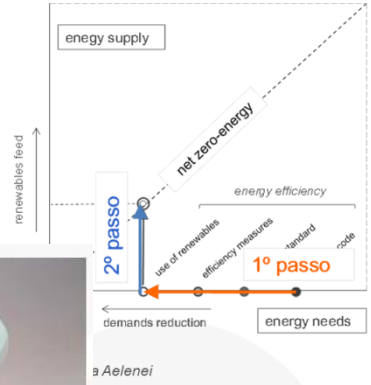
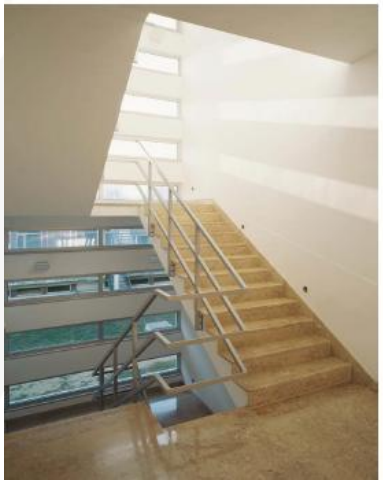


Prioridade: Eficiência energética

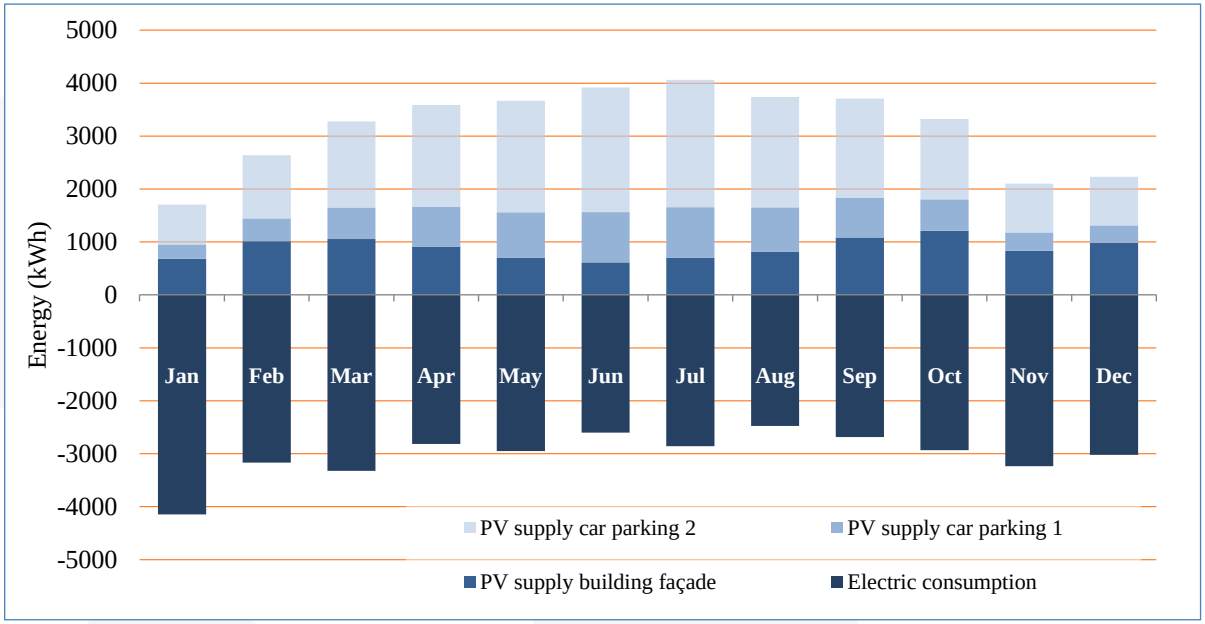
diminuir as neccesidades energéticas

5. Reduzir o consumo de iluminação electrica



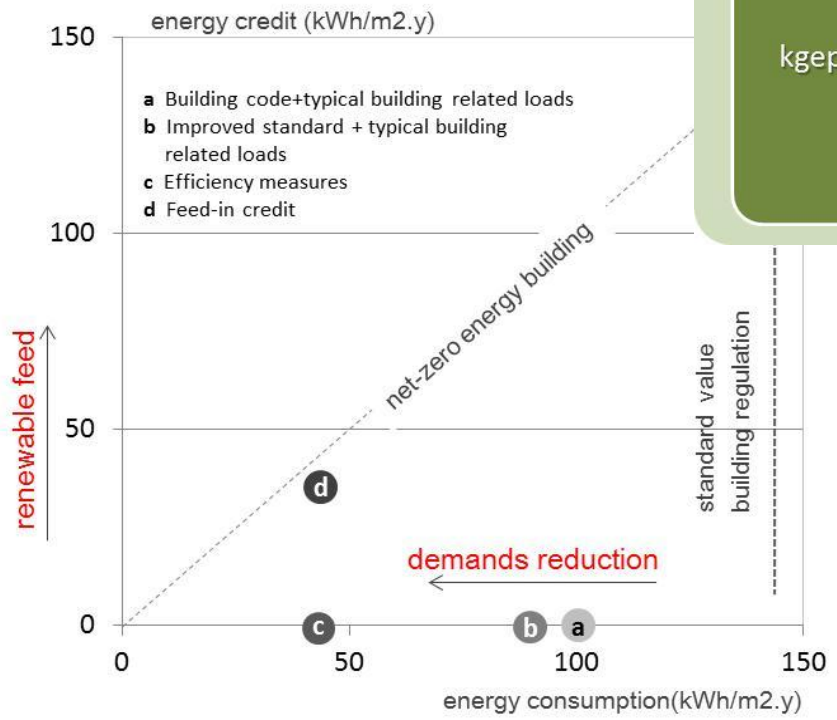
Vãos distribuidos, claraboia central comum aos 3 pisos com ligação às salas a norte e a sul propiciam iluminação natural, todo o ano.

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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