DESIGN ISSUES FOR NET ZERO-ENERGY BUILDINGS

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ZEMCH 2012

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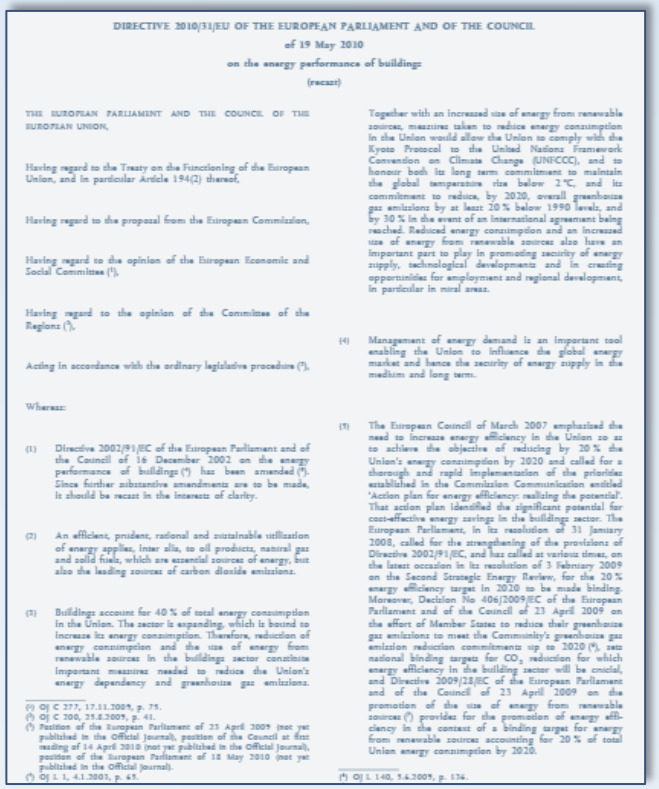
SUMMARY

INTRODUCTION



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 development 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 (4), 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 (5) 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.

DIRECTIVE 2010/31/EU

Recast of Directive on Energy Performance of Buildings 2010

"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]

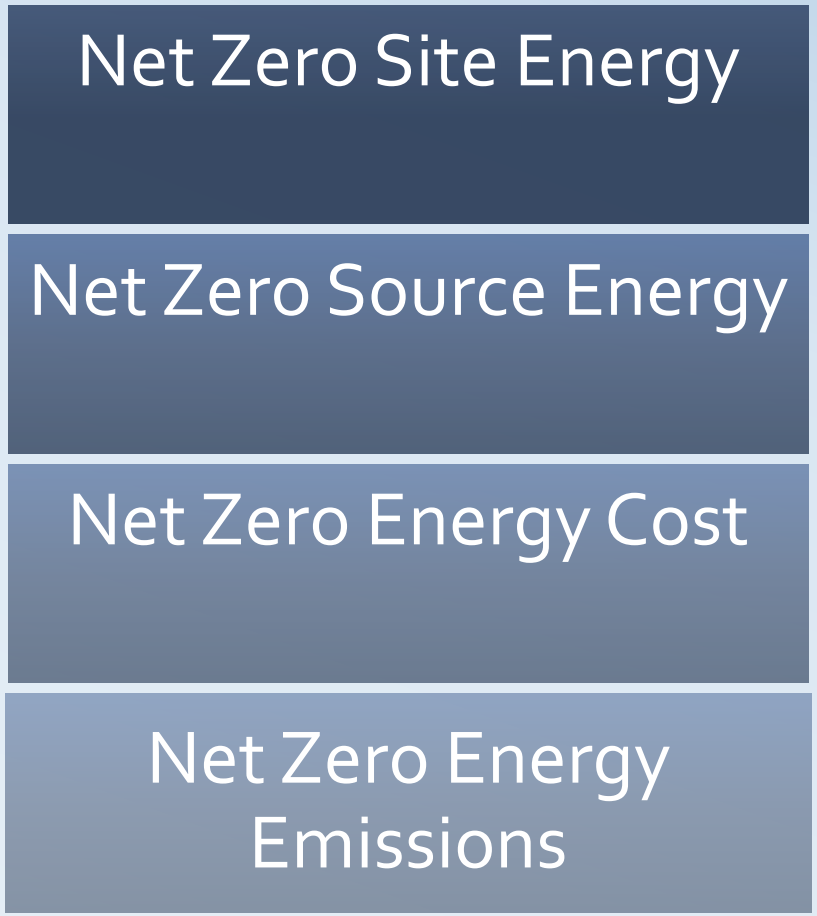
Article 9 Nearly zero-energy buildings

- 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

NET ZERO-ENERGY BUILDINGS



- annual balance is based on the grid interaction at the boundary of the building
- the energy (delivered from and feed into the grid) has to take into account primary energy conversion factors
- energy bills of a building are equivalent the amount of money the utility pays the owner for renewable energy the building feeds to the grid
- buildings produce and export at least as much emissions-free renewable energy as they import and use from emission-producing sources on an annual basis

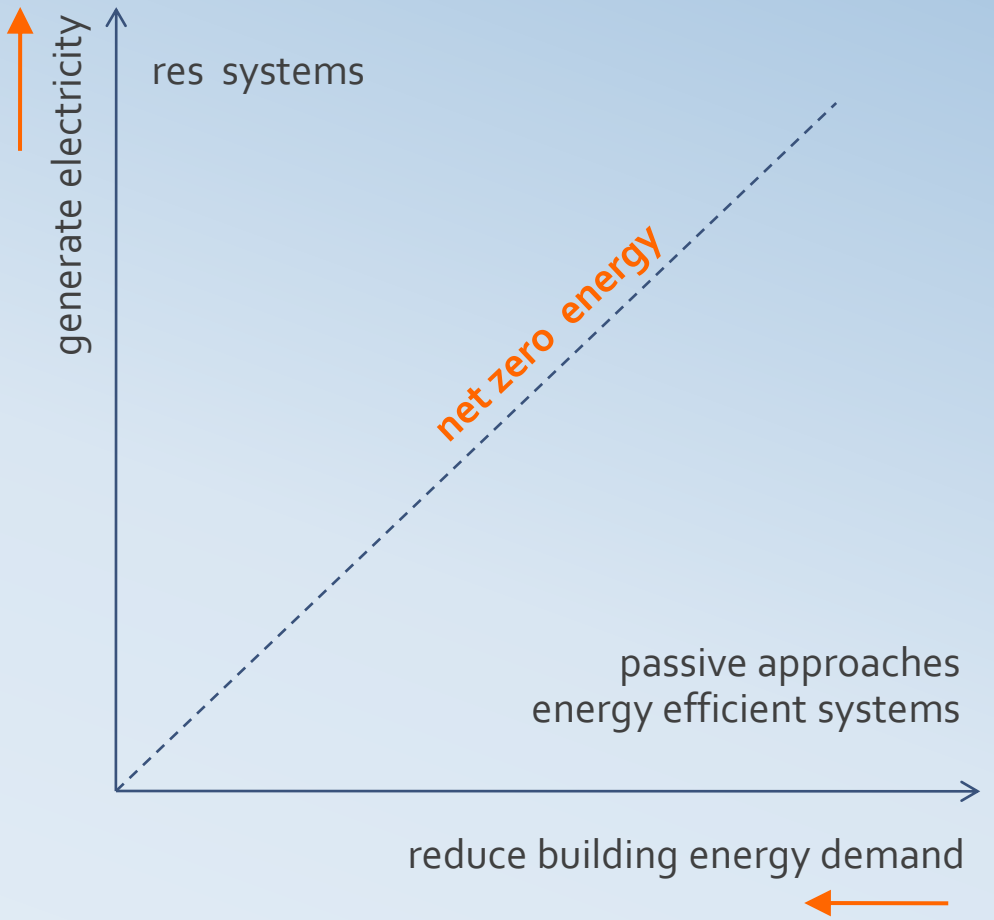
HOLISTIC NZEB METHODOLOGY APPROACH

- Two fundamental steps:

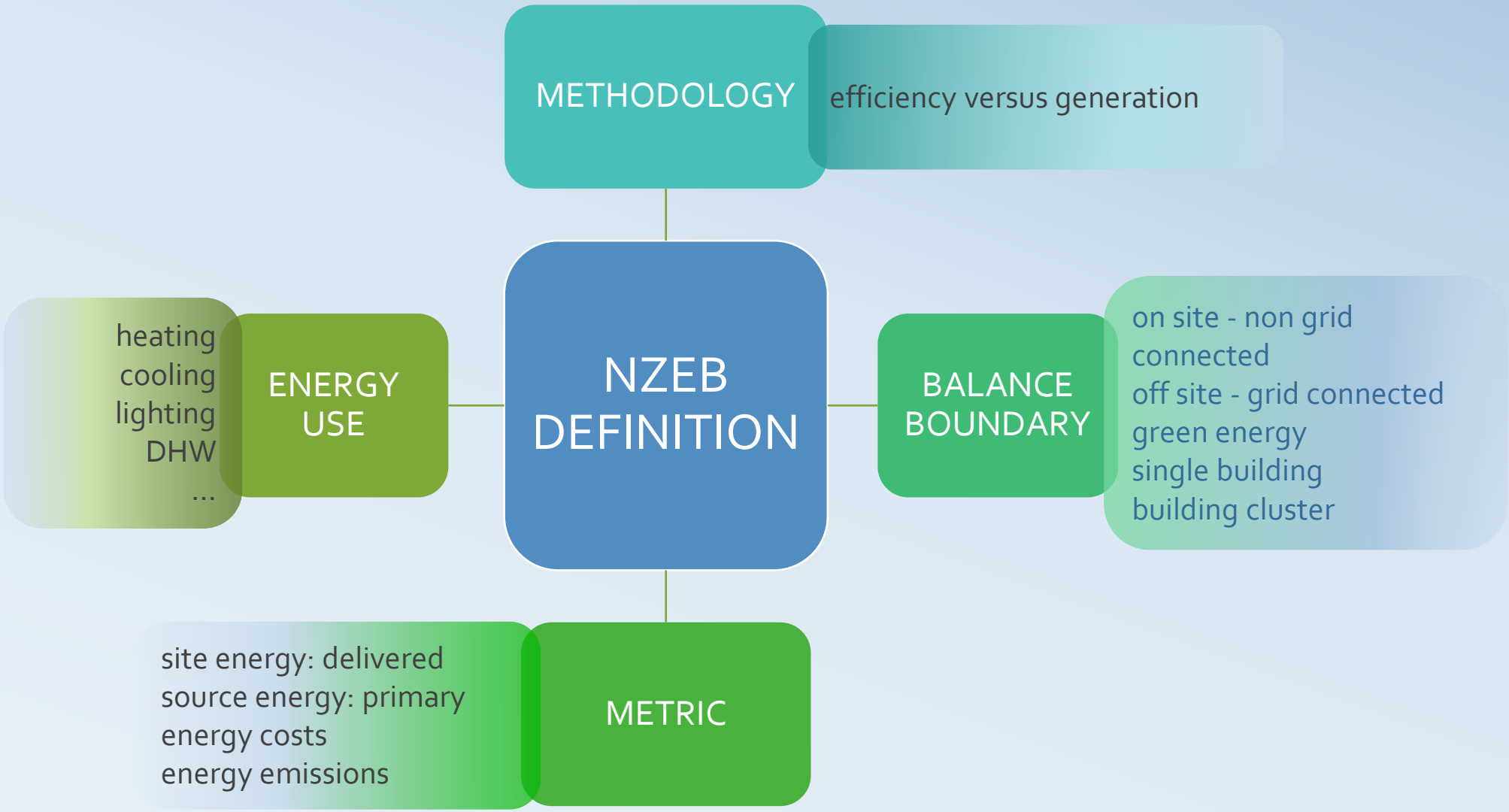
  (a) reduce building energy demand

  (b) generate electricity or other energy carriers to get enough credits to achieve the desired energy balance

- Passive approaches play a crucial role in addressing NZEB design as they directly affect the heating, cooling, ventilation and lighting loads put on the buildings mechanical and electrical systems, and indirectly, the strive for renewable energy generation.



NZEB performance



NZEB performance

IEA Joint Project:

Solar Heating & Cooling Programme

IEA TASK 40 ANNEX 52

(October 2008 – September 2013)

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

DISSEMINATION

TOWARDS NET ZERO-ENERGY SOLAR BUILDINGS

LNEG

SOLAR XXI Portugal

ENERGYFLEX Denmark

ECOTERRA Canada

PLUS ENERGY Germany

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

Case Studies
IEA Task 40 data base

ENERGY FLEXHOUSE

- 90.3 kWh/m2.y
+ 108.3 Wh/m2.y

ÉCOTERRA

- 50.80 kWh/m2.y
+ 16.35KWh/m2.y

LEAF HOUSE

- 151.24 kWh/m2.y
+ 108.3kWh/m2.y

LIMA

- 79.08 kWh/m2.y
+ 61.56 kWh/m2.y

RIEHEN

- 62.86 kWh/m2.y
+ 85.08 kWh/m2.y

RIVERDALE

- 38.50 kWh/m2.y
+ 42.40 kWh/m2.y

LIGHTHOUSE

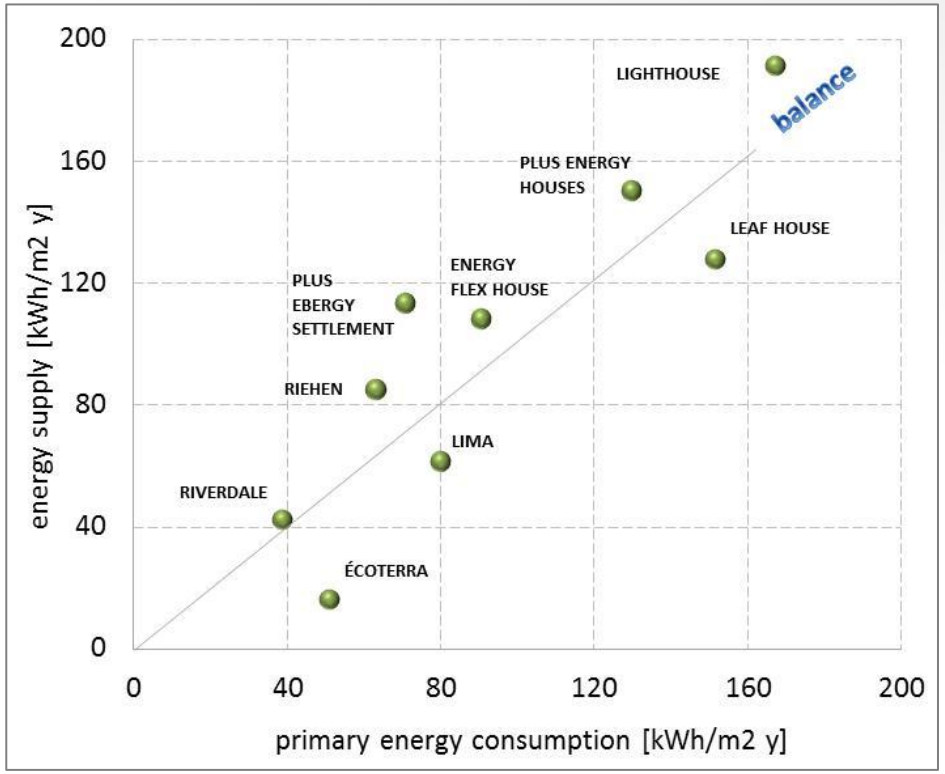
- 166.92 kWh/m2.y
+ 191.54 kWh/m2.y

PLUS ENERGY HOUSES

- 129.50 kWh/m2.y
+ 150.4 kWh/m2.y

PLUS ENERGY

- 70.65 kWh/m2.y
+ 113.95 kWh/m2.y



Case Studies

CLIMATE

- [ ] Heating dominated
- [ ] Cooling dominated
- [ ] Heating and cooling dominated

TYPOLOGY

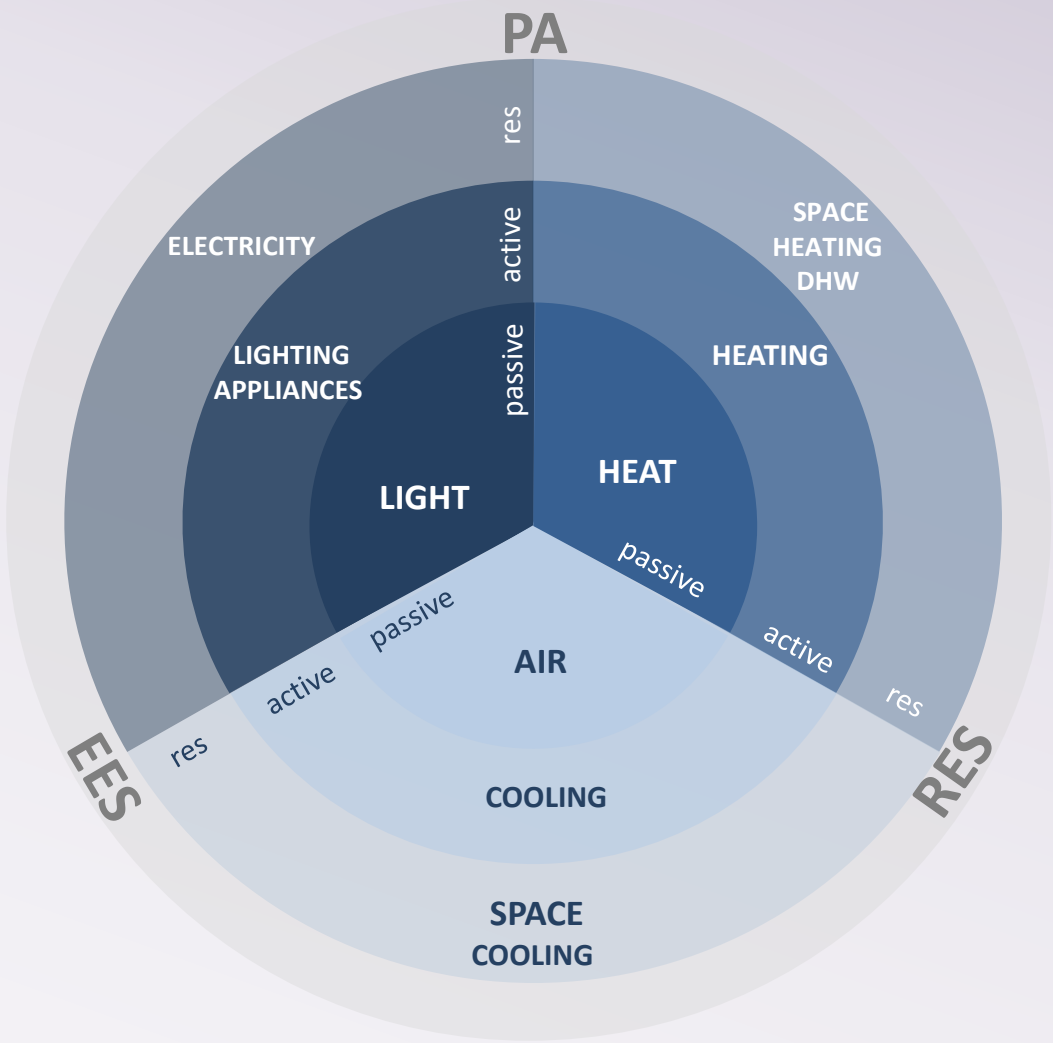
- [ ] Residential
  (small, multifamily…)
- [ ] Non-residential
  (office, schools…)

NZEB METHODOLOGY

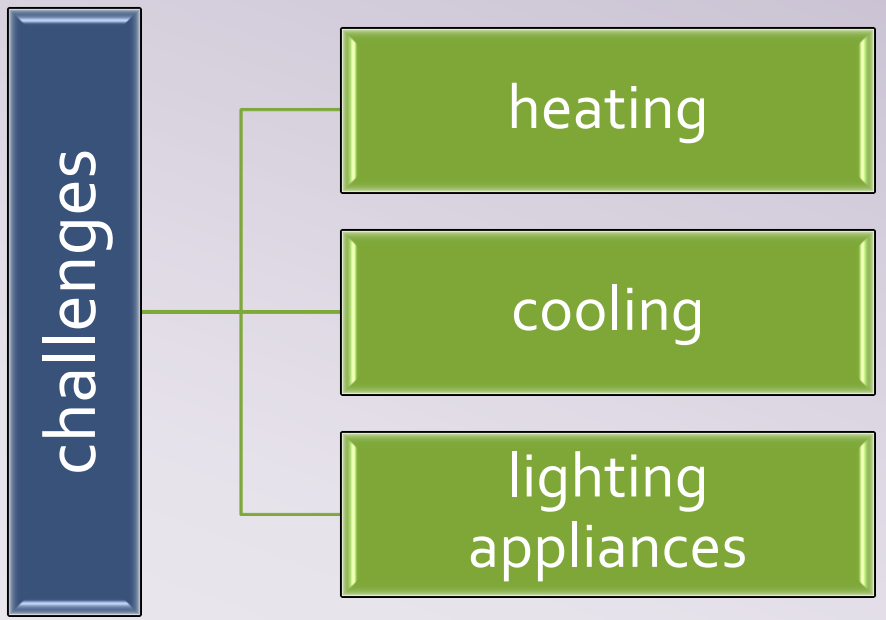
- [ ] Efficiency:
  passive approaches and energy efficient systems
- [ ] Generation :
  renewable energy systems

NZEB Design

LNEG



PASSIVE SOLAR ENERGY DESIGN



relative strategies used

prevention – modulation – control – rejection

NZEB Design

passive approaches

sunshading
prevention

natural/cross ventilation
rejection

night cooling
rejection

stack effect
rejection

Envelope physical characteristics
prevention of heat loss

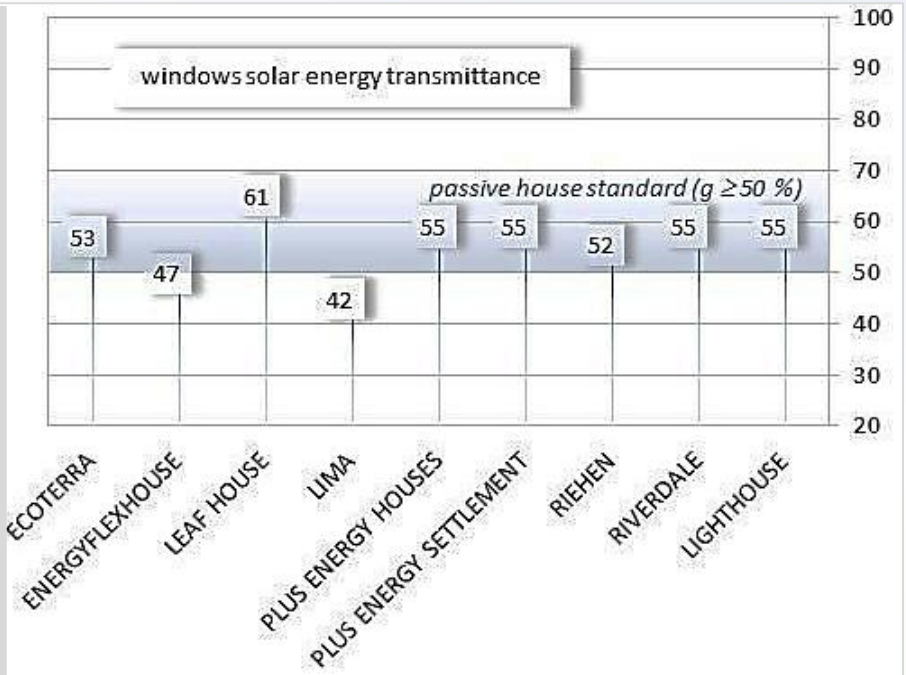
Project	U value wall [W/m2.K]	U value roof [W/m².K]	U value ground [W/m².K]	Solar energy transmittance (g)	Compactness
Écoterra	0.16	0.16	0.16	0.53	0.16
EnergyFlex House	0.08	0.09	0.08	0.47	0.41
Leaf House	0.15	0.25	0.15	0.61	0.52
LIMA	0.15	0.25	0.19	0.42	1.07
Plus energy Houses Weiz	0.09	0.11	0.09	0.55	0.47
Plus Energy Settlement	0.12	0.12	0.16	0.55	0.56
Riehen	0.13	0.11	0.13	0.52	0.59
Riverdale	0.10	0.06	0.10	0.55	0.74
Lighthouse	0.11	0.11	0.12	0.55	0.87

NZEB design - PASSIVE APPROACHES

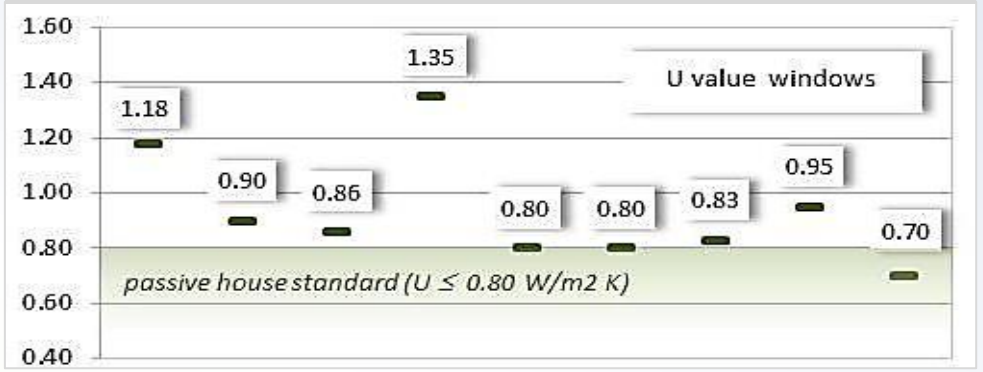
LNEG

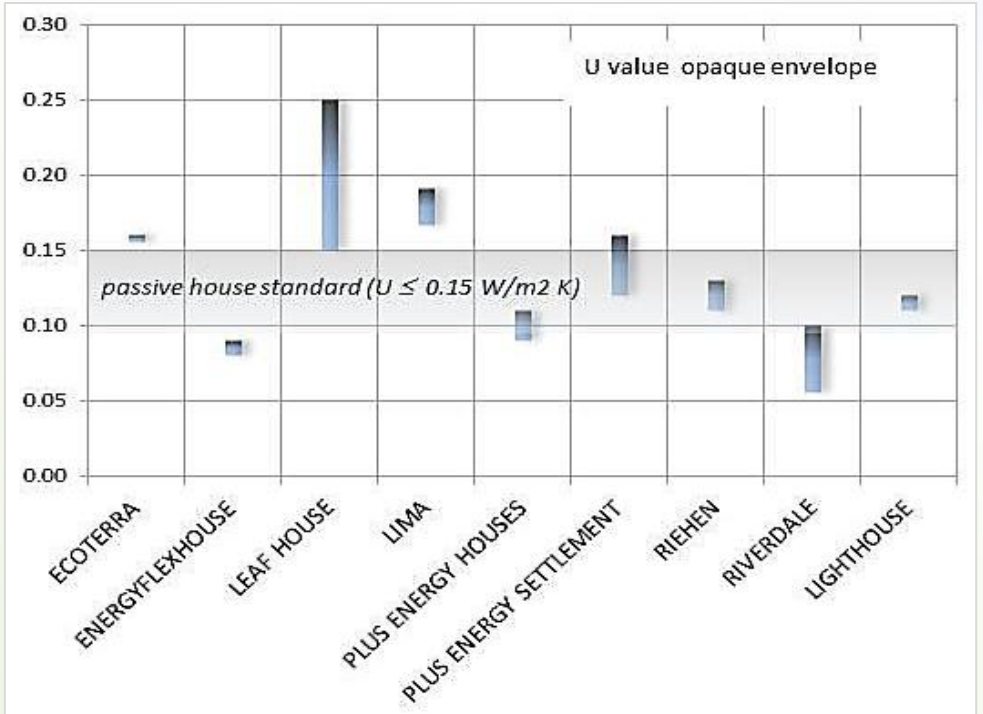
NZEB design - PASSIVE APPROACHES

SOLAR TRANSMITTANCE

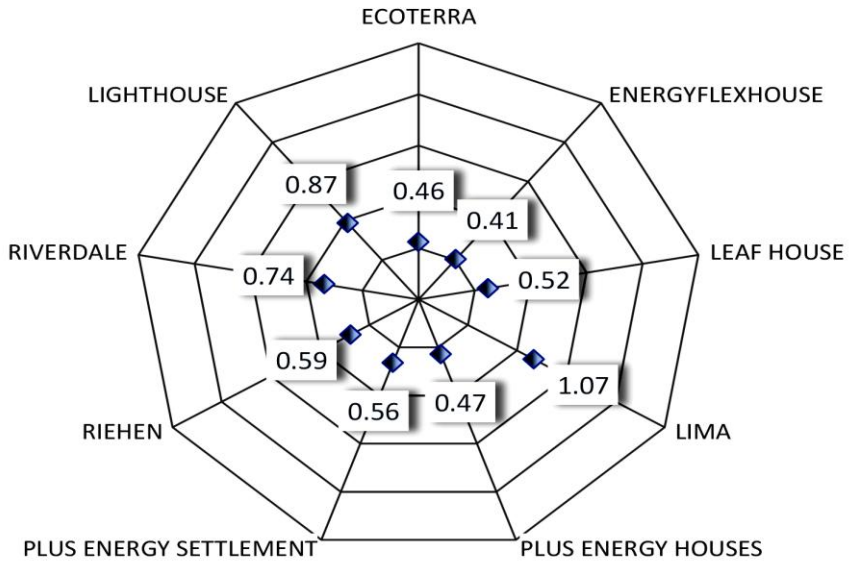


U - value [W/m².K]





COMPACTNESS



CHALLENGES

heating, cooling and DHW

lighting and other occupants electric use

EFFICIENT ENERGY SYSTEMS

- radiant heating
- efficient mechanical ventilation-air heat recovery
- low power lighting
- efficient electrical equipment
- load management system

RENEWABLE ENERGY SYSTEMS

- photovoltaic systems
- solar thermal collectors
- geothermal
- biomass
- air source heat pump
- mixing strategies: BIPV, geothermal combined with low exergy systems-radiative heating

NZEB design - Matrix of design solutions

Passive Approaches

Energy Efficiency Systems

Renewable Energy Systems

geothermal heat pump

other (air heat pump, biomass, CHP)

photovoltaic

solar thermal collectors

- no standard approach for designing a NZEB - many different possible combinations of passive and efficiency measures, utility equipment and on-site energy generation technologies
- zero-energy buildings design is a progression of passive sustainable design

Final remarks

Thank you

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