



**AiCARR**

Cultura e Tecnica per Energia Uomo e Ambiente

Associazione Italiana Condizionamento dell'Aria Riscaldamento e Refrigerazione

REHVA



Federation of  
European Heating,  
Ventilation and  
Air-conditioning  
Associations

 POLITECNICO DI MILANO



## **NZEB, nearly zero energy building: what it means in the EPBD perspective**

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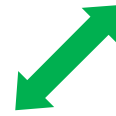
## A balance between European Union and Member States needs



European Union



Member States





Energy Performance of Buildings Directive – EPBD 2002,  
revised in May 2010

## Ü **EPBD Recast 2010**

Renewable Energies Directive (RES) – April 2009

- Increase the use of renewables up to 20%, biofuels up to 10% in EU
- require energy consumers (**also buildings**) to include a given proportion of energy from renewable sources in their consumption:
  - **Minimum RES levels** for new and existing buildings by end 2014
  - **Public buildings to lead by example** by beginning 2012

Energy Efficiency Directive Recast (EEDR) – November 2012

- District heating, CHP, renovation 3% each year, public procurement, public buildings as exemplary model

- By **31 Dec 2020**, all new buildings are **nearly zero energy buildings**
- After **31 Dec 2018**, public authorities that occupy and own a new building shall ensure that the building is a nearly zero energy building
- Minimum energy performance requirements based on calculation of **cost-optimal levels**, with the methodology developed by the Commission
- Primary energy target values have to be set in kWh/m<sup>2</sup>
- Different target values for new and existing buildings
- Specific regulations for building envelope and HVAC systems for renovated buildings

In the directive ‘nearly zero-energy building’ is defined as:  
*“a building that has a very high energy 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 energy from renewable sources produced on-site or nearby”*.

Since the Commission does not give minimum or maximum harmonized requirements, it will be up to the Member States to define what for them exactly constitutes a **"very high energy performance"** on the base of the cost optimal performance level.



EPBD recast instructs Member States on how to set energy performance requirements: “*with a view to achieving cost optimal levels*”

**Cost optimal** = “*the energy performance that leads to the lowest cost during the estimated economic lifecycle*” (the latter determined by Member States)

Ũ Aimed at ensuring high ambition level in Member States.

For the **actual minimum** energy performance requirements

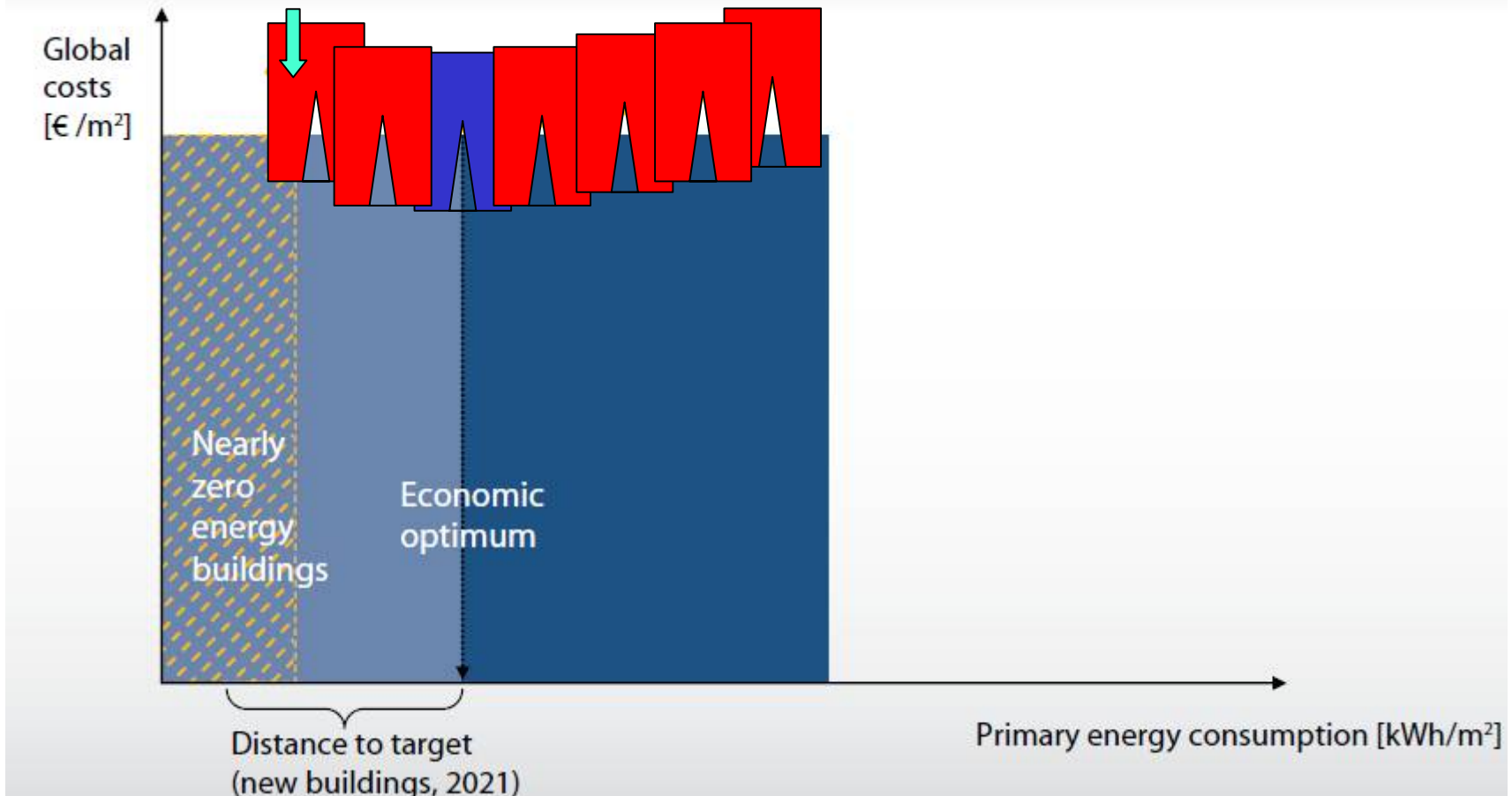
Ũ Reports from Member States due by March 2013.

Ũ Current state: **25 reports received so far on 28.**

*Greece, Malta and Spain are still missed*



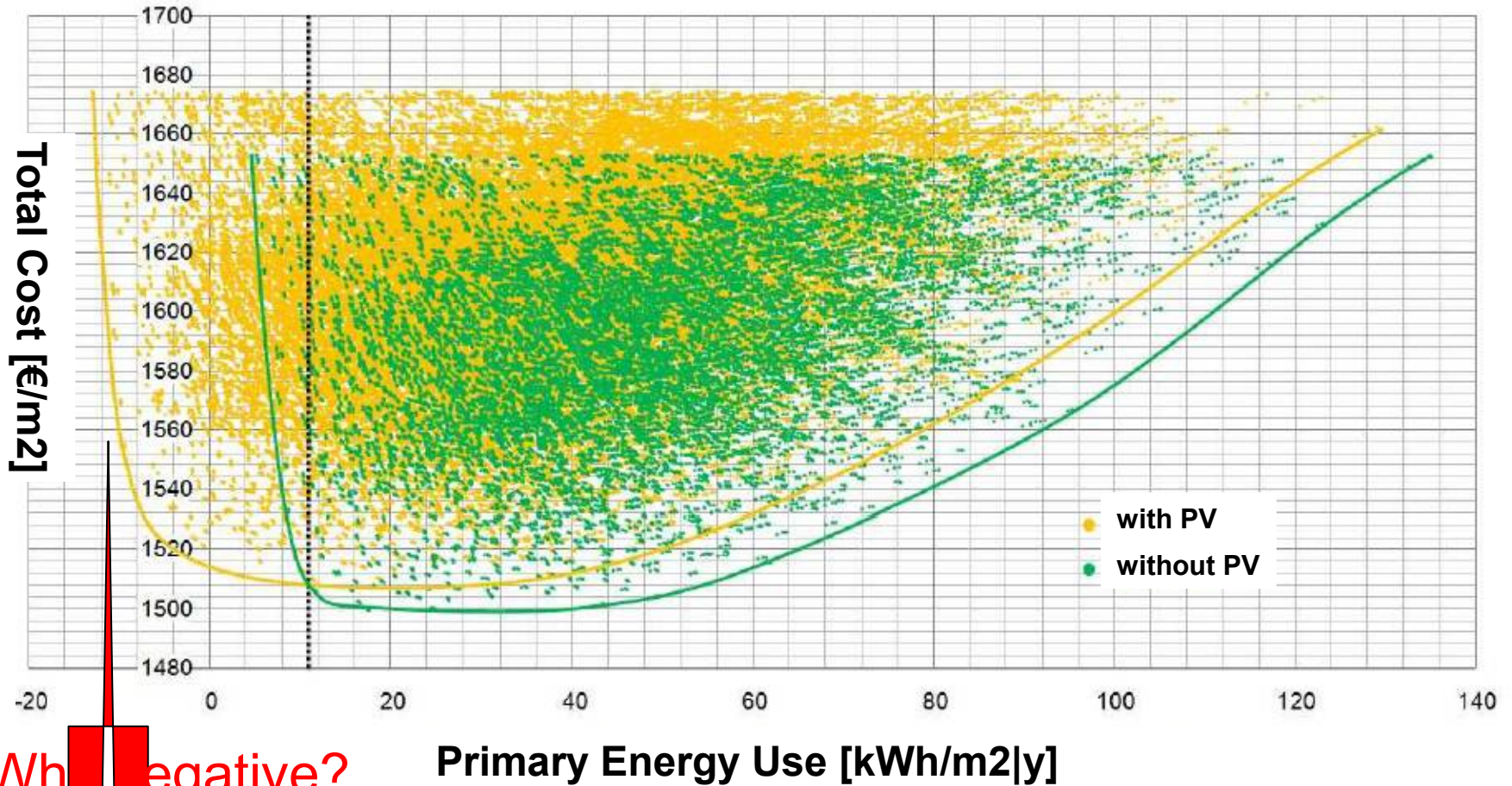
# Cost optimal performance levels



Source: The Buildings Performance Institute Europe (BPIE):  
[http://dl.dropbox.com/u/4399528/BPIE/BPIE\\_costoptimality\\_publication2010.pdf](http://dl.dropbox.com/u/4399528/BPIE/BPIE_costoptimality_publication2010.pdf)



# Example of cost optimal calculation



Why negative?

Primary Energy Use [kWh/m2|y]

Source: Laurea Thesis, Matteo Muscherà, Politecnico di Milano





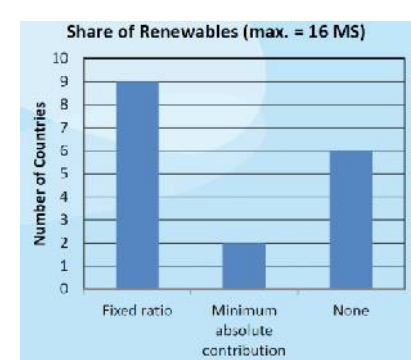
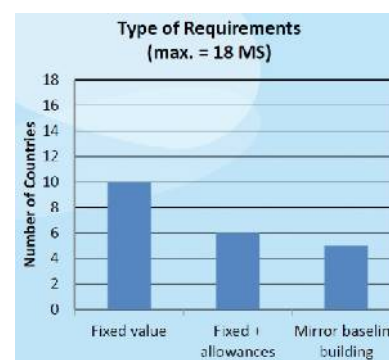
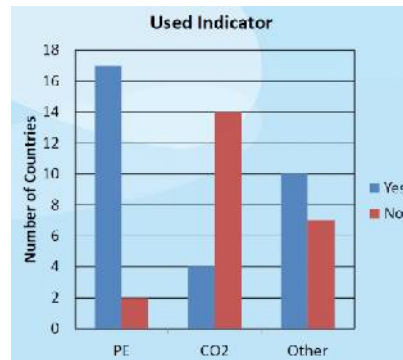
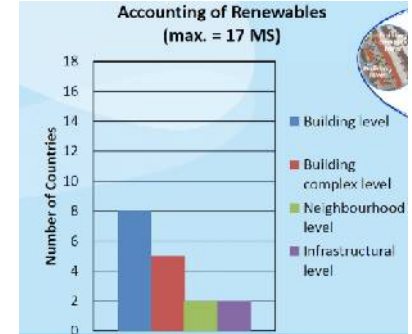
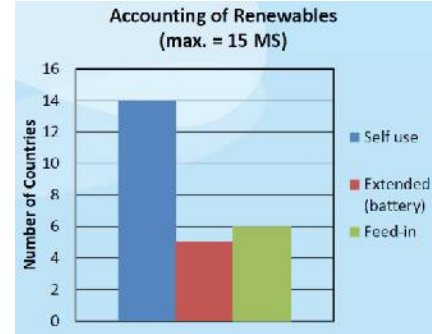
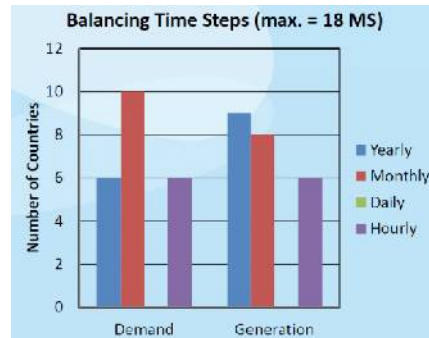
Energy aspects included in the NZEB calculation for residential and non-residential buildings (status March 2013, maximum is 19 MS)

	Total
Heating	19 MS/19 MS
(Domestic) hot water	19 MS/19 MS
Cooling	17 MS/18 MS
Ventilation	17 MS/19 MS
Lighting	8 MS/19 MS
Auxiliary energy	17 MS/18 MS
Household/office equipment	5 MS/ 7 MS
Lifts and external lighting	0 MS/ 1 MS

Renewable energy generation included in the NZEB calculation (status March 2013, maximum is 18 MS)

	Total
Solar thermal	18 MS
Photovoltaic	17 MS
Passive solar, daylighting, biomass	18 MS
Heat recovery, passive cooling	15 MS
Geothermal	15 MS
Biogas	14 MS
Micro wind generators, micro CHP	13 MS
Ambient air (heat pump), biofuel	13 MS
Waste heat (industry/server)	9 MS
Solar cooling	9 MS
Waste heat from hot water	8 MS

**CONCLUSION**  
**S:** there is a large difference in implementing the NZEB definition in practice among all Member States





How has to be  
technically defined  
an NZEB building for  
satisfying the EPBD  
requirements?





# Starting Point: “*the NZEB paradigm*”

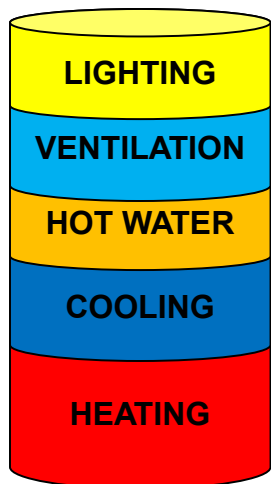
The characteristics of a nearly zero energy building (NZEB) are those of a building, which shall meet the following requirements:

- a) the **ENERGY NEEDS** reduced to the extent reasonably practicable (insulation, increased use of daylight, thermal activation of the mass, etc.);
- b) the **ENERGY USE** of the plants reduced as much as economically feasible (heat recovery, increase the efficiency of air conditioning systems, etc.);
- c) the ENERGY REQUIREMENT, **needs** and/or **use**, **covered** significantly by production of heat and electricity on-site or nearby **from renewable sources** (solar thermal, heat pumps, district heating powered by renewable fuels);
- d) these provisions must be obtained under the economic and / or financial sustainability or with a sustainable additional cost.

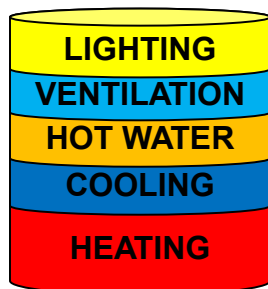


## Energy needs

(never zero)

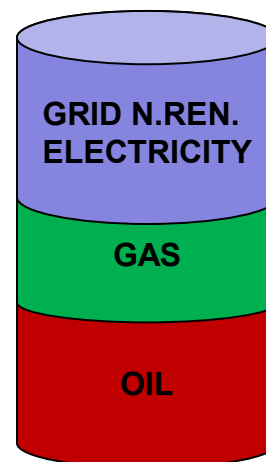


NZEB

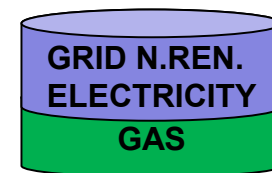
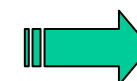


## Energy use

(non-renewable)



NZEB

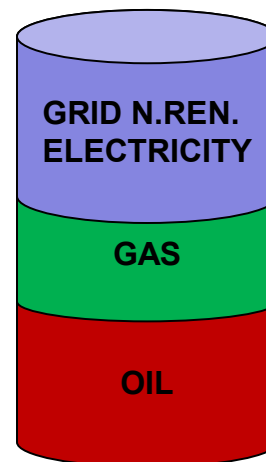
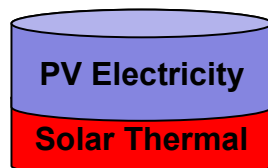
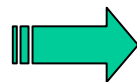


## Share of Renewables

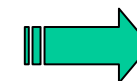
(produced on site)

Zero use of renewable energies

NZEB



ZEB



Zero use of non-renewable energies



# Still confusion between NZEB e nZEB

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NZEB = nearly zero energy building

nZEB = net zero energy building

The first may contain the second.

The second may not comply with the first.

nZEB Industry Committee's definition. :

*"a net zero energy building is where, as a result of the very high level of energy efficiency of the building, the overall **annual primary energy consumption** is equal to or **less** than the energy production from renewable energy sources onsite"*

February 2011 © European Council for an Energy Efficient Economy



It is an electric grid connected building which owns some electricity generator, using renewable energy sources / carriers, to produce what it needs and export as much energy is possible to the grid.

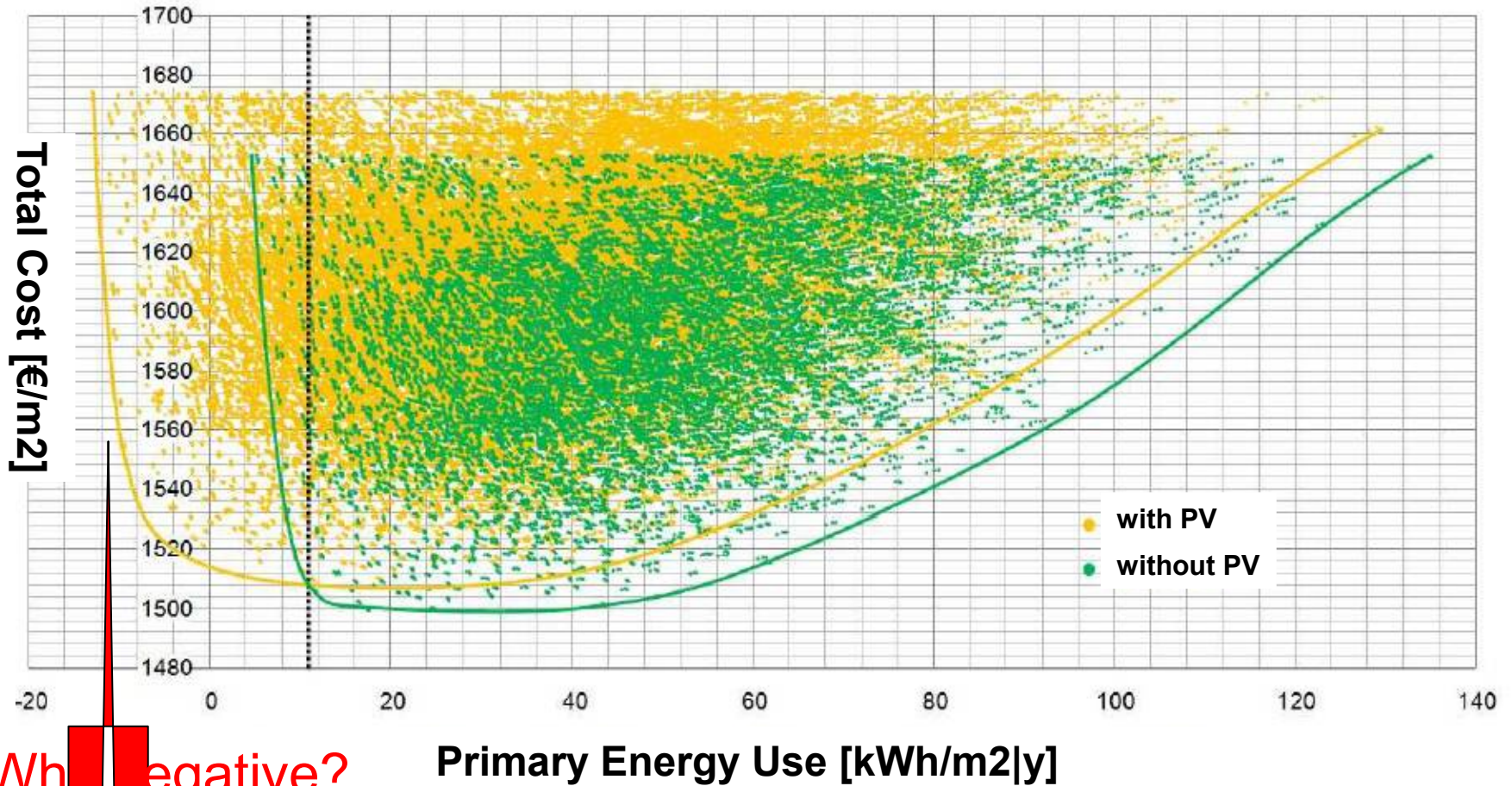
This is not necessary the reference base for the NZEB building the EPBD directive is asking for.

Two negative characteristics:

- **net ZEB primary energy use can be  $< 0$  !**, if, for instance, more PV electricity is exported than imported.
- the energy balancing to get zero can involve indifferently
  - a small amount of imported/exported energy carriers (10 - 10 = 0 kWh)



# Example of cost optimal calculation



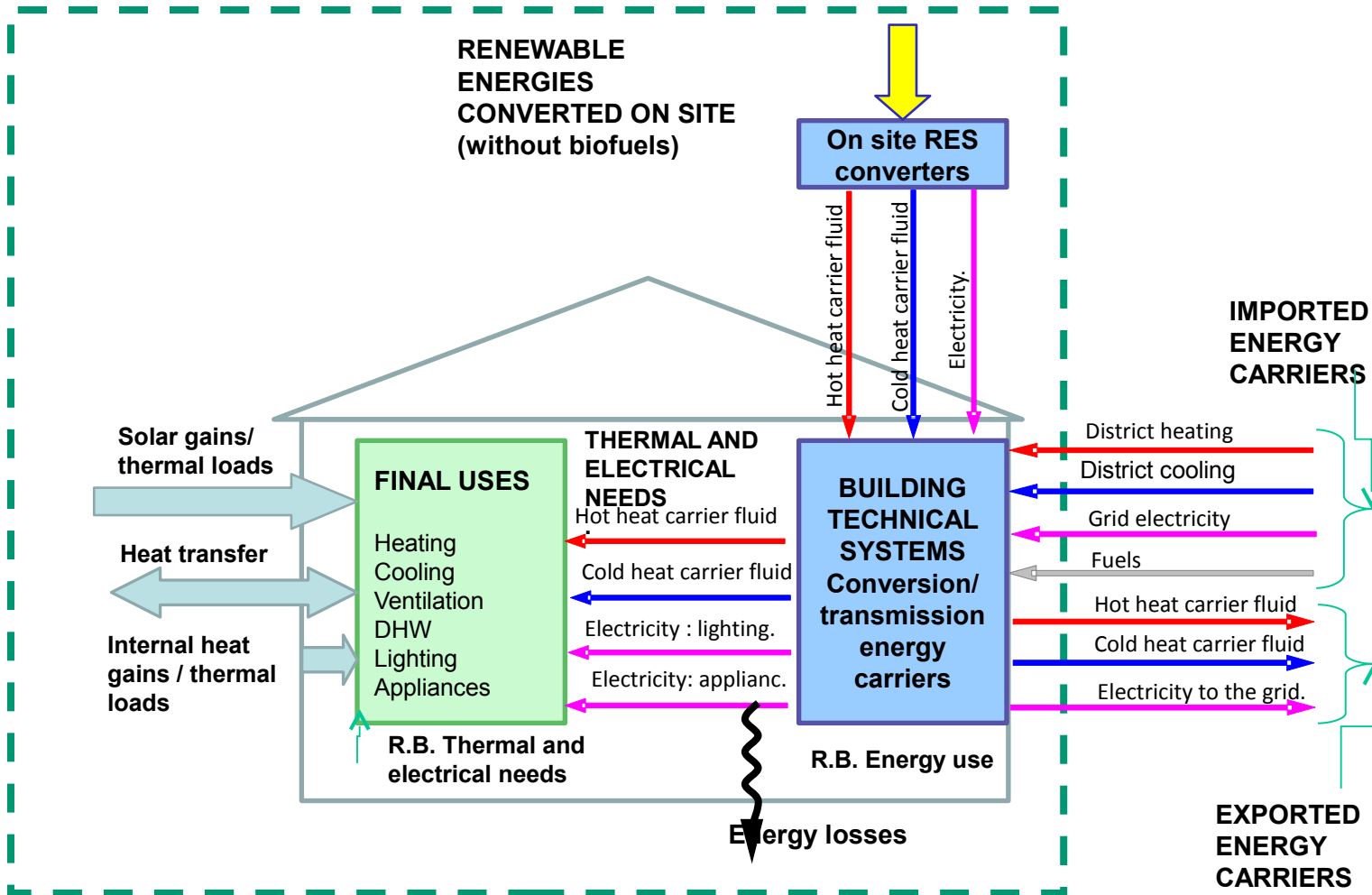
Why negative?

Primary Energy Use [kWh/m2|y]

Source: Laurea Thesis, Matteo Muscherà, Politecnico di Milano



# Building Reference Boundary: **on site**

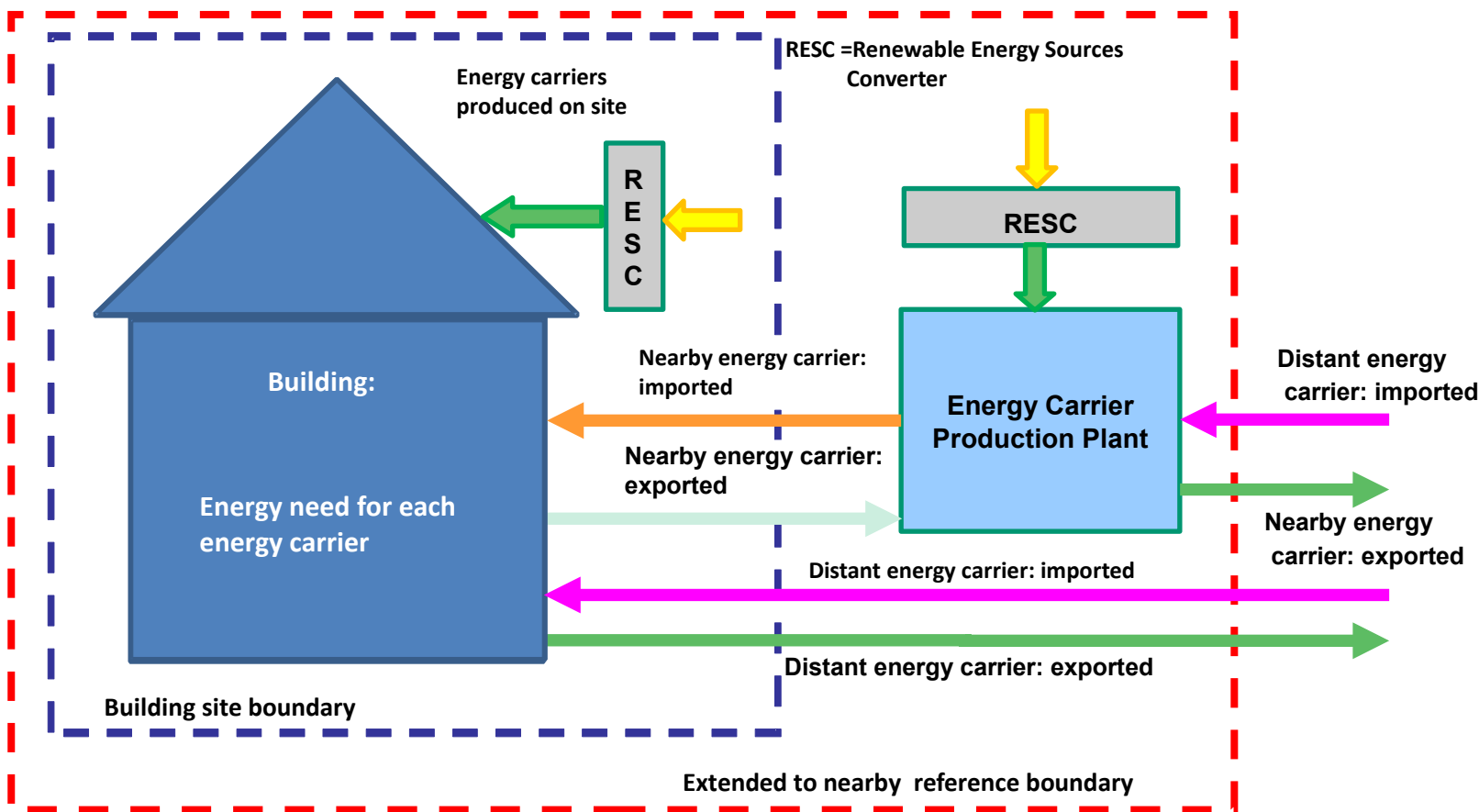


On Side Reference Boundary (OSRB) of the building (building site boundary)





OPEN QUESTION: what does it mean *nearby*





## nearly zero energy building (NZEB)

Technically reasonable achievable national energy use  $EP > 0$  kWh/(m<sup>2</sup> a) of **non-renewable primary energy of delivered energy carriers** achieved with best practice energy efficiency measures and renewable energy technologies which may or may not be cost optimal:

$$0 < EP_x < EP_x \Big|_{\text{lim}}$$

where the lower limit is the Zero Energy Building (ZEB) and the upper limit has to be defined on national base according to the cost optimal procedure.

$$EP_{P,x} = \frac{E_{P,x}}{A_u} = \frac{1}{A_u} \left[ \sum_i (E_{imp,i} \cdot f_{imp,i})_x - \sum_j (E_{esp,j} \cdot f_{esp,j})_x \right]$$

# DETRACTORS SAY ... “such



.. buildings as  
“green” distributed  
electric generators

NZEB does not  
account for ...





- The NZEB paradigm, as the EU Directive states, does not look at the building as possible “green” distributed electric generator
- To use the net ZEB definition to account for that **IS DANGEROUS** and **CONFUSING**
- It is possible to **ADD** an other index which is qualifying the production of electricity from renewable energy or "CO2-free" generators:

**CO2 Neutral Exported Electrical Energy Index,  
NEEE**



# CO2 Neutral Exported Electrical Energy Index, NEEE

*the share of export of CO2 neutral electricity building production from renewable energy sources and from cogeneration systems per unit of useful area of the building*

$$NEEE = \left[ \sum_{RES=1}^N \left( W_{RES,ren,exp} \right) + W_{CHP,exp} \right] / A$$

where

$W_{RES,ren,exp}$  share of export of CO2 neutral electricity building production from renewable energy sources exploited on-site;

$W_{CHP,exp}$  share of export of CO2 neutral electricity building production from thermal driven building cogeneration systems.



- Any EU country is going to define its own nearly energy building (NZEB).
- Northern EU Countries are closer to the a definition which relay on the **net Zero Energy** Building.
- Mediterranean Countries are closer to a definition which is based on the “autonomous building”, i.e. the Zero Energy Building, achievable only not importing any non-renewable energy carriers.
- **GREAT CONFUSION !**
- There is still need of “technical” coordination.

Thank you for your attention.

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