CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

New building codes for NZEB

Key elements and overall picture in EU countries

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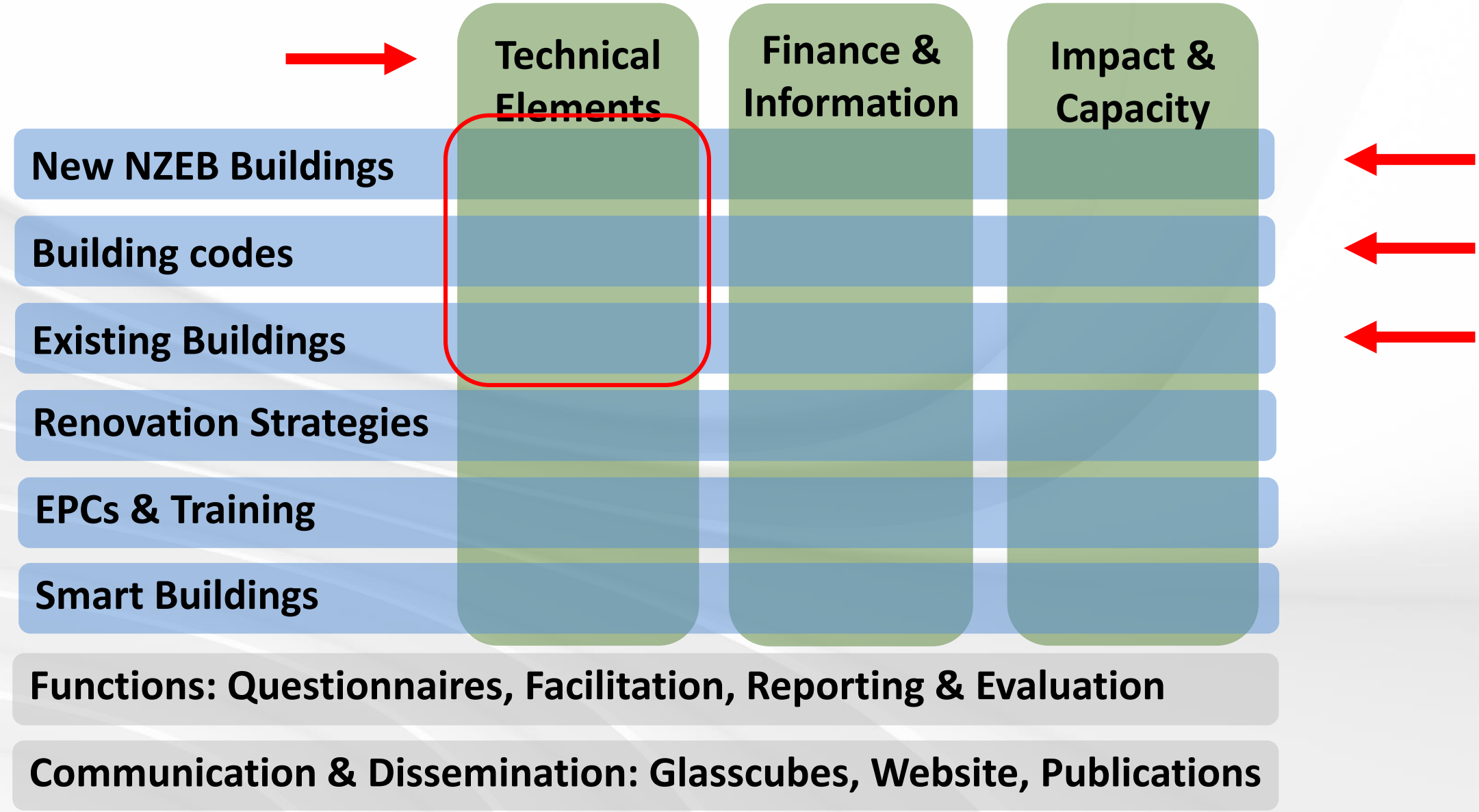
Concerted Action EPBD V – NZEB Building Codes



Building Codes in EPBD

Overall Energy Performance / Cost Optimality

- **For new buildings there is a strong focus on energy performance based building codes**
  - Setting overall performance by construction
- **All Member States must set these requirements**
  - But level are left to Member States
  - And exact implementation
- **Request to use cost optimality**
  - If cost efficient it must be included
  - Member States must document these levels
- **Also requirements for existing buildings**
  - When undergoing major renovation

Article 6

New buildings

1. Member States shall take the necessary measures to ensure that new buildings meet the minimum energy performance requirements set in accordance with Article 4.

For new buildings, Member States shall ensure that, before construction starts, the technical, environmental and economic feasibility of high-efficiency alternative systems such as those listed below, if available, is considered and taken into account:

(a) decentralised energy supply systems based on energy from renewable sources;

(b) cogeneration;

(c) district or block heating or cooling, particularly where it is based entirely or partially on energy from renewable sources;

(d) heat pumps.

2. Member States shall ensure that the analysis of alternative systems referred to in paragraph 1 is documented and available for verification purposes.

3. That analysis of alternative systems may be carried out for individual buildings or for groups of similar buildings or for common typologies of buildings in the same area. As far as collective heating and cooling systems are concerned, the analysis may be carried out for all buildings connected to the system in the same area.

Building Codes Focus on the path to Nearly Zero Energy

- **Tightening requirements towards NZEBs**
  - NZEB in public buildings since 1 January 2019
  - NZEB all buildings from 1 January 2021
- **NZEB is based on Cost optimality**
  - Nearly zero-energy buildings (NZEBs) have very high energy performance.
  - The low amount of energy that these buildings require comes mostly from renewable sources.
- **All MS have Energy Performance requirements for new buildings**
- **All have defined NZEBs**

NZEB:

'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;

Requirements New Buildings- nZEB

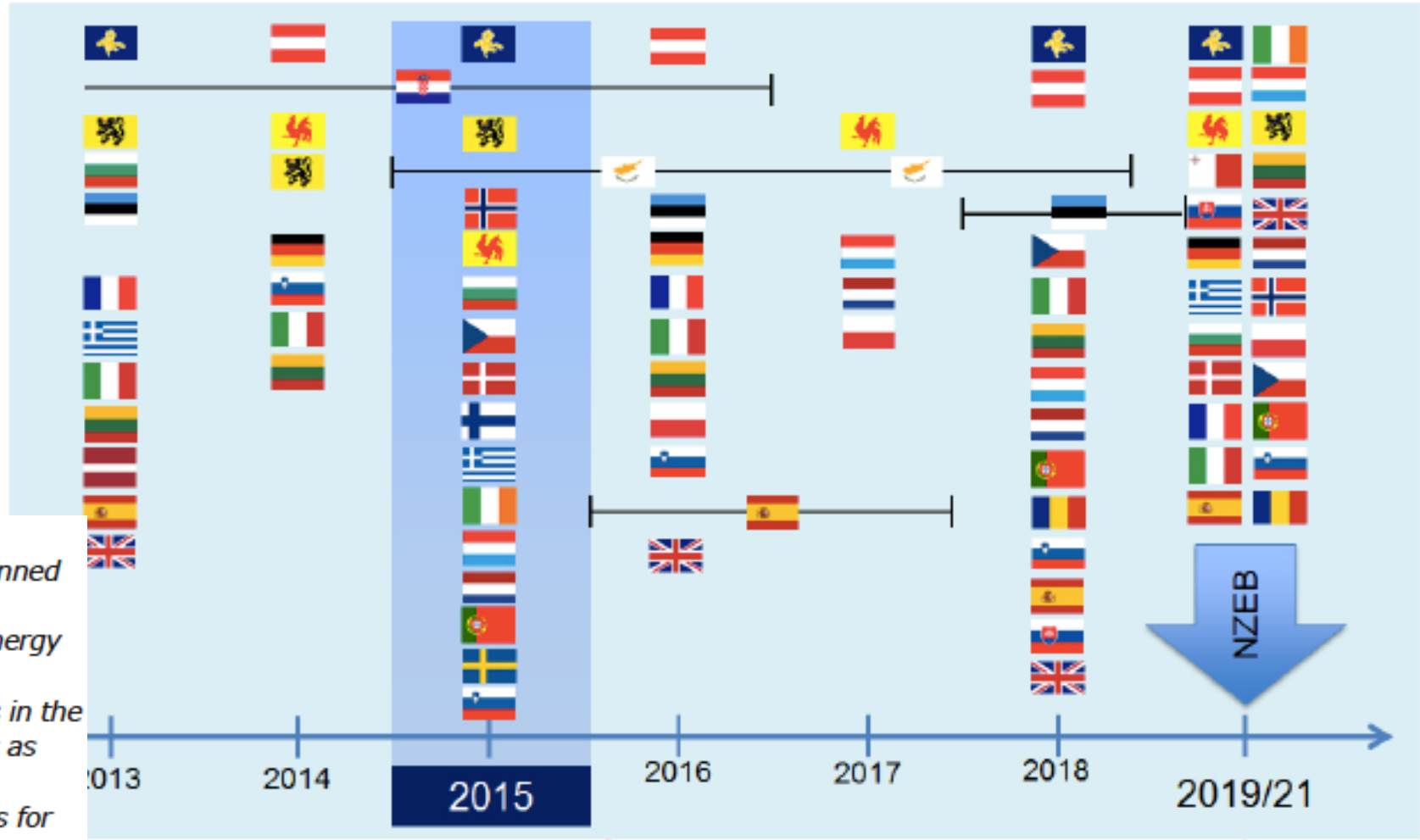


Figure 6: Timing of planned intermediate targets for energy performance requirements in the different MSs as stated in the national plans for NZEBs, and the deadline for NZEBs

16 + 11 (around 80 %)

Close to all

All countries publish new building codes these years (2019 & 2020)

NZEBs become mandatory for all new buildings by 31st December 2020 at the latest

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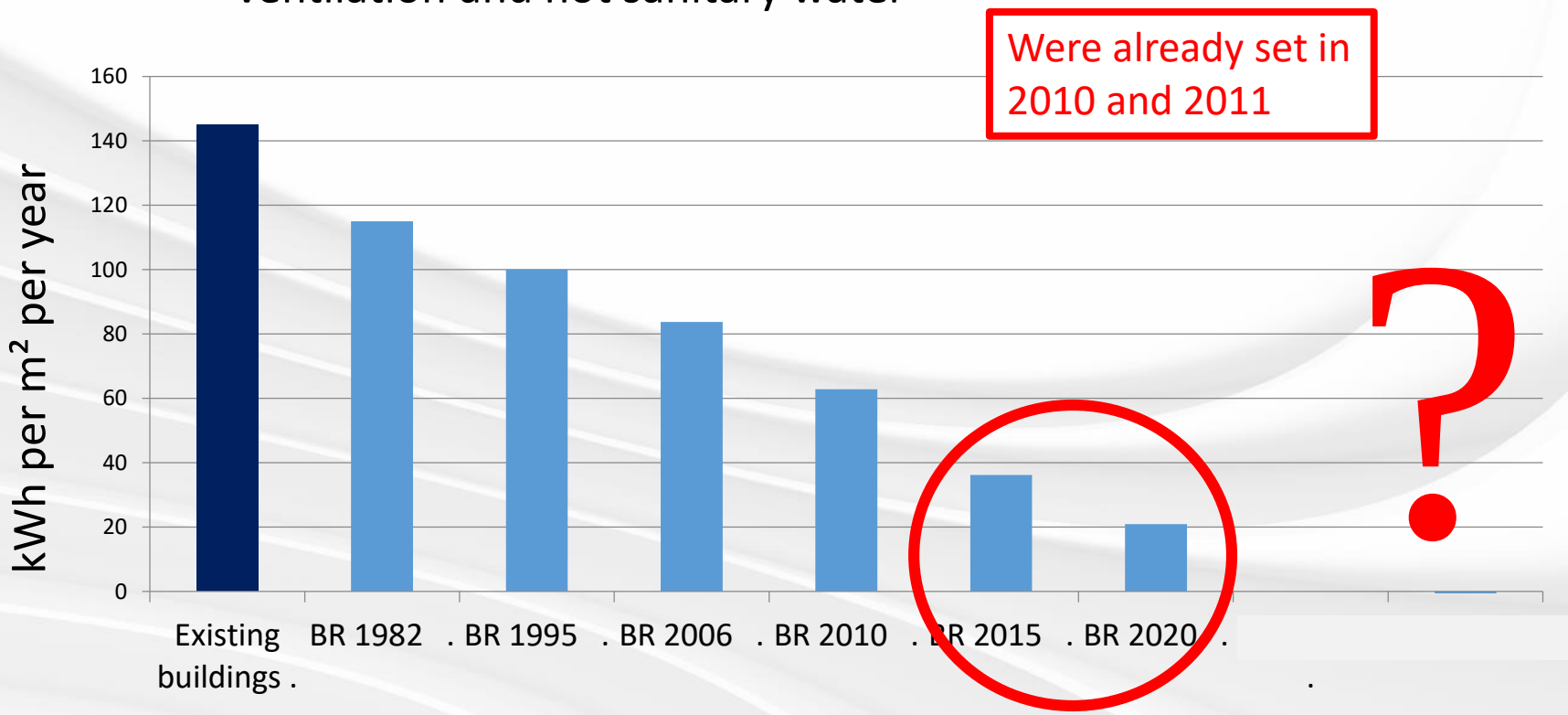
Danish Building Codes – Giving security for the future

Gross energy including heating, cooling, ventilation and hot sanitary water



Is it possible and logic to continue this trend ?

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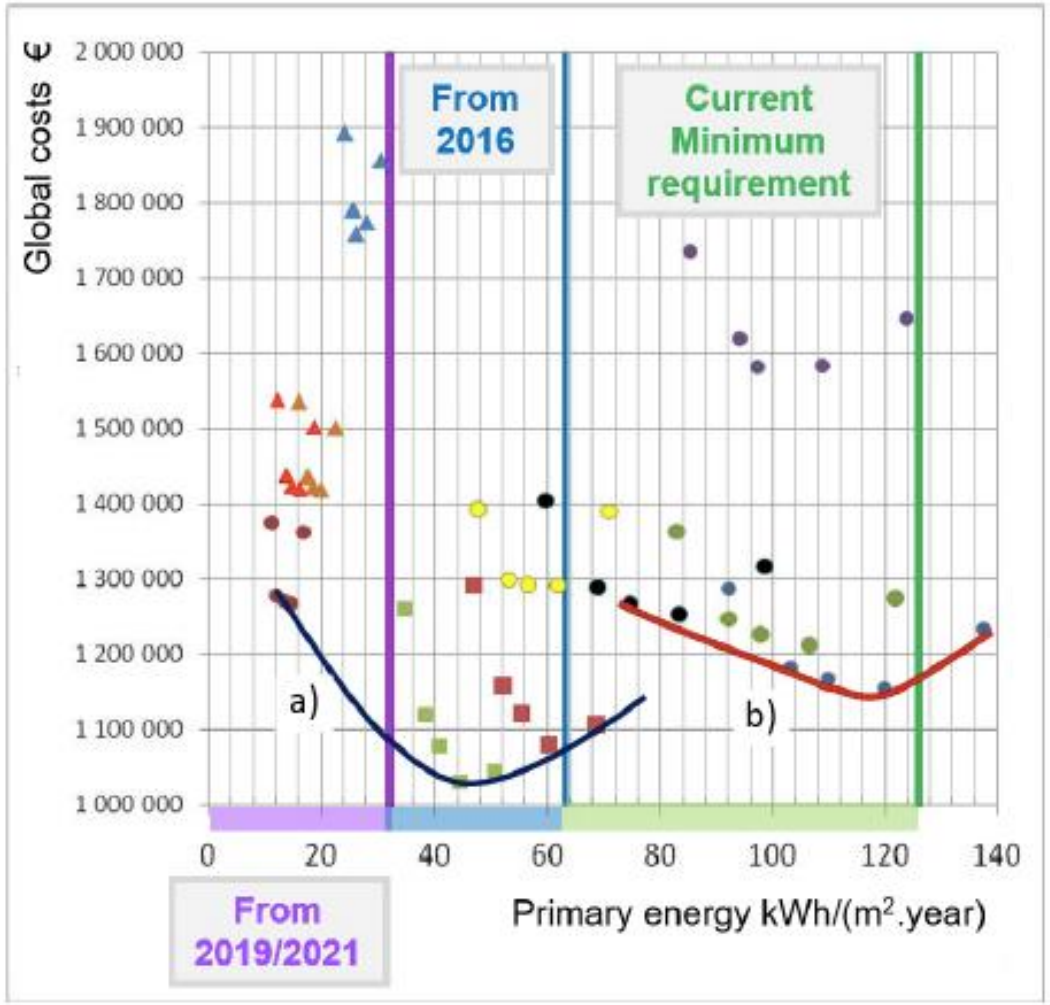
Cost Optimality CA EPBD

All countries do Cost Optimality Studies as they must use these for the building codes

Cost optimality moves so Building Codes needs to be tightened at least every 5 years



- 1a. District heating-gas
- 1b. District heating-biomass
- 2. Condensing gas boiler
- 3. Condensing gas boiler+heat recovery
- 4. Condensing gas boiler+solar thermal collectors
- 5. Biomass boiler
- 6. Biomass boiler+heat recovery
- 7. Air water heat pump
- 8. Groundwater heat pump
- 9. Biomass boiler+solar thermal collectors
- 1c. District heating-CHP

Large work has been done on Cost Optimality – LCA's

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Cost Optimality CA EPBD - examples

Building type	Heat supply	Cost optimum kWh/m².year	Deviation between cost-optimal and BR10 requirements (%)		
			2010-2015 Minimum requirements	LEB2015 Voluntary class	B2020 Voluntary class
Single-family house	District heating	68.7	-15.7%	-44.9%	-57.0%
	Heat pump	51.1	-2.8%	-49.8%	-58.0%
Multi-family house	District heating	53.6	-9.2%	-36.1%	-44.7%
Office building	District heating	51.7	31.2%	-16.0%	-37.3%
Weighted	DK mix.		2.8%	-34.4%	-48.8%

Table 1: Comparison of energy performance levels for new and existing buildings in Flanders, Belgium.

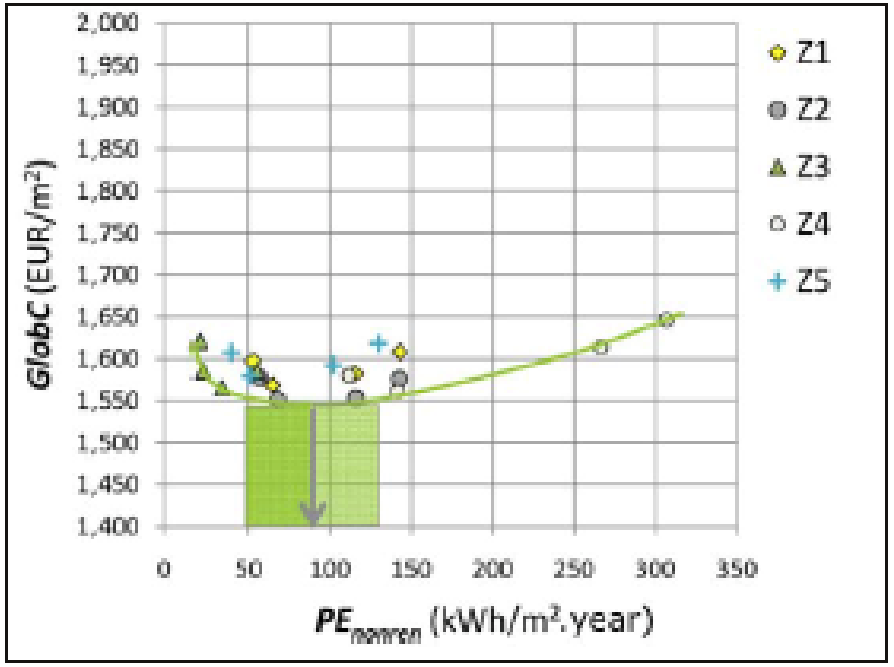

Table 2: Cost optimal requirements for new buildings in the Danish Building Regulations 2010. For the different building types and heat supply, the table shows the cost optimum in kWh/m².year primary energy and the percentual gap between the cost-optimal level and the 2010-2015 requirements

	Existing buildings		New buildings	
	Previous levels	Optimal level	Previous levels	Optimal level
Single-family	no E-level, only U-values	(E90)	E70 (2012), E60 (2014)	E50
Multi-family	no E-level, only U-values	(E90)	E70 (2012), E60 (2014)	E50
Office buildings	no E-level, only U-values	(E72 (office), E49 (school))	E70 (2012), E60 (2014)	E57

Good examples Belgium and Denmark

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Setting Building Codes / Renewable Energy

- Cross Europe
- **Energy Performance requirements in Building Codes are set in different ways:**
- **Typically as:**
  - One overall value for energy use / primary energy
  - One overall value for environmental impact
  - Better than a reference building
  - These values might depend on size, type or use
- **Renewable energy:**
  - Included in maximum
  - Specific requirements for use of renewable energy (percentage)
- **Some Examples based on the CA EPBD KIDs**
  - Key Implementation Decisions

Overall Performance Value - Finland

- **Maximum Primary Energy**

Type of building	**Maximum value for energy consumption per year, primary energy (calculated with weight factors of energy source)**		
Single-family houses	*Heated net area, A_{net} m^2*	*E-value $kWhE/m^2$ per year*	*Massive wood construction maximum values*
	A_{net}<150 m^2	200 - 0.6 A_{net}	(200 - 0.6 A_{net}) x 1.15
	150 m^2 ≤ A_{net} ≤ 600 m^2	116 - 0.04 A_{net}	(116 - 0.04 A_{net}) x 1.15
	A_{net}> 600 m^2	92	92 x 1.15
Row houses		105 *kWh_E/m^2 per year*	105 x 1.10
Apartment buildings		90 *kWh_E/m^2 per year*	90 x 1.10
Offices		100 *kWh_E/m^2 per year*	100 x 1.10
Shops etc.		135 *kWh_E/m^2 per year*	135 x 1.10
Hotels, motels etc.		160 *kWh_E/m^2 per year*	160 x 1.10
Schools and day care centres		100 *kWh_E/m^2 per year*	100 x 1.10
Sports halls		100 *kWh_E/m^2 per year*	100 x 1.10
Hospitals		320 *kWh_E/m^2 per year*	320 x 1.10
Other buildings	Energy consumption has to be calculated but no limit values		-

Requirements are given as a fixed value (kWh_E/m^2 - primary energy).

Overall Performance - Latvia

- **Maximum Energy plus additional requirements**
- Energy performance requirements for residential
- Minimum permissible level of energy performance of buildings, energy performance assessment for heating of new buildings:
  - for multi-apartment buildings - ≤ 60 kWh/m^2 per year
  - for one-apartment or two-apartment buildings - ≤ 70 kWh/m^2 per year
- Minimum energy performance requirements (Building heat transfer coefficient and U values) (normative / maximal):
- For residential buildings + hospitals + kindergartens + homes for elderly:
  - Roofs – 0.15 k / 0.20 k
  - Floors – 0.15 k / 0.20 k
  - Walls – 0.18 k / 0.23 k
  - Windows – 1.30 k / 1.80 k
  - Doors – 1.80 k / 2.30 k
  - Thermal bridges – 0.10 k / 0.15 k
- All 3 levels must be complied with

Overall Performance – Climate Zones

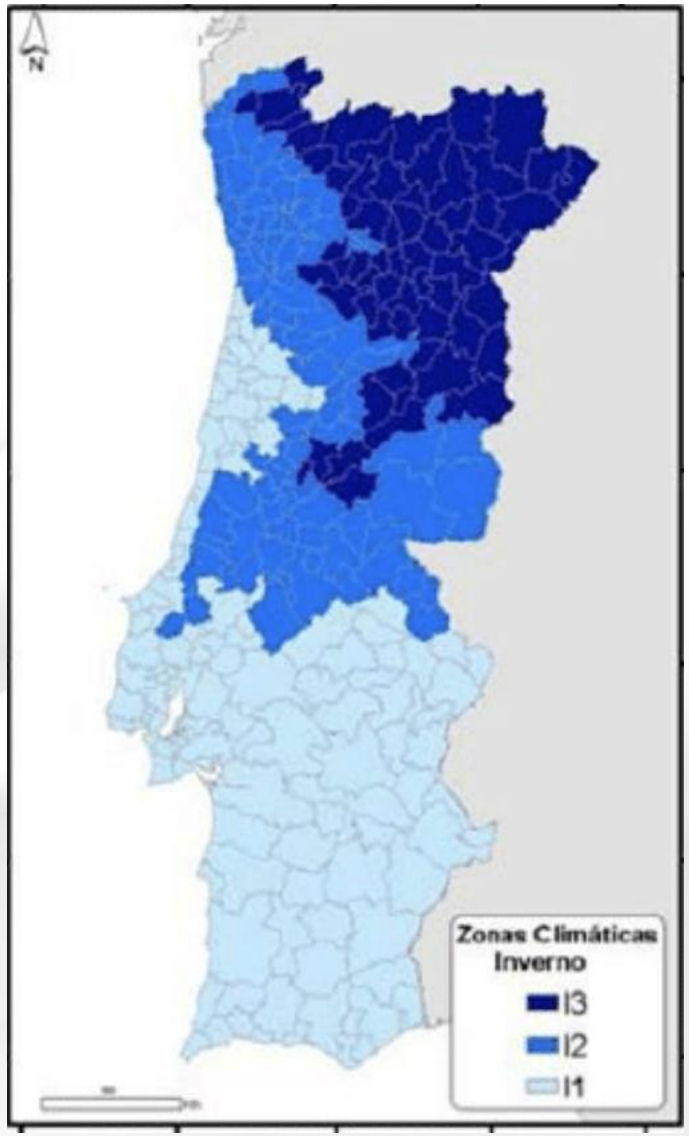
- **Maximum Overall Energy**

- Portugal:
- Maximum primary energy consumption based on climate zone:
  - I1 – 73 kWh_{ep}/m^2
  - I2 – 97 kWh_{ep}/m^2
  - I3 – 140 kWh_{ep}/m^2

Climatic adapted values

- Malta:
- Mean Primary energy balance of 85kwh/m^2 per yr.

- Slovenia:
- Primary energy <= 200 +1,1 (60 f(0) - 4,4 T(L)) kWh/(m2a);
  - Every km^2 is climatic zone;
  - T(L) – average yearly temperature,
  - f(0) – shape factor
  - Mean Primary energy balance of 85kwh/m^2 per yr.



Reference Building - Germany

- **Better energy performance than reference building**

- Energy performance requirements for residential
  - A maximum non-renewable primary energy demand which is determined individually for each building using a reference building with similar geometry, orientation and use, but with a certain quality of all energy-relevant systems and components

  and

  - A requirement for the energy performance of the building's thermal envelop, which is determined by using the reference building approach

  - The reference building has same shape, size and characteristics and fixed u-values, efficiency etc.

  - In addition a minimum quota of renewable energies used for heating, DHW and cooling; the quota is different for the different technologies

- Similar requirements for Non residential but depending on type and use

Building must be better better than a model fulfilling a set of requirements having same size, shape and function

Reference Building - Italy

- **Better energy performance than reference building**

- Energy performance requirements for residential
- **Better energy indexes** (listed below) than the corresponding values of the **“reference building” 2015**:
  - Global EPgl index [kWh/m2] (Heating, cooling, hot water, ventilation services)
  - Specific energy needs for Heating and Cooling
  - Efficiencies of the technical systems (ηH, ηC, ηW, ηV)
- **Additional limits** for the building envelope:
  - H’T Transmission heat transfer coefficient
  - Summer effective solar area
  - Mass of external walls (or alternatively their periodical transmittance)
  - U-values of inter-building walls/floors
- **RES integration**
  - 35% share for heating, cooling and DHW
  - 50% share for the only DHW
  - Electric power installed per building footprint unit surface [kW/m^2]: 0,015 (0,02 from 2017)
  - In the case the required RES integration should not be feasible, the building has to respect a proportionally lower EPgl limit value

Reference Building – Other Examples (factor)

- **Better energy performance than reference building / particular year - factor**

- Austria:
  - $f_{GEE} \leq 0.85$
  - f_{GEE} = relation between final energy demand of the building and final energy demand of the corresponding reference building

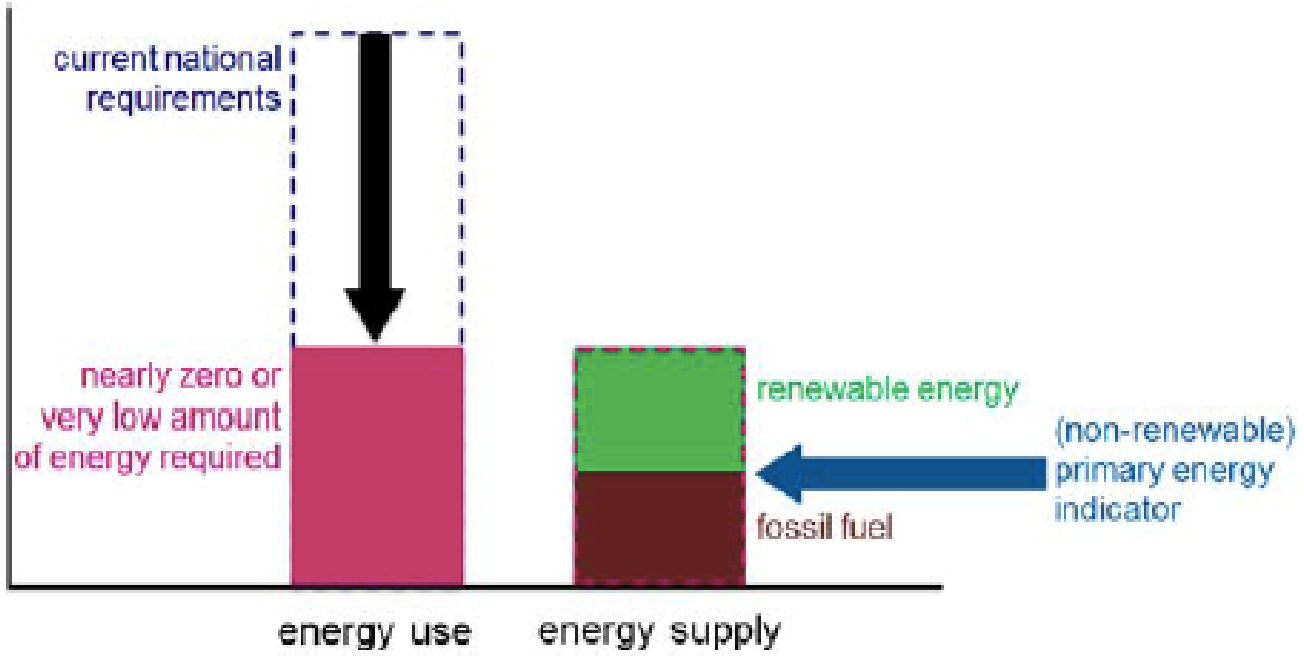
- Netherlands:
  - EPC ≤ 0.4
  - EPC is an energy factor calculated in relation to a reference building with same form, function and characteristics

Changing !

- Reference buildings are in particular used for Non-Residential
  - As this can help to adjust for type, use and complexity

Requirements New Buildings – NZEB – share of RES

Figure 3:
Graphical interpretation of the NZEB definition according to A and 9 of the EPBD.



Rules for NZEB Public Buildings are in force (since 1st of January 2019)

All Countries have Definitions for new Buildings and must implement these for all new constructions by end of this year

All member states have NZEB defined – 60 % had these in place since 2015

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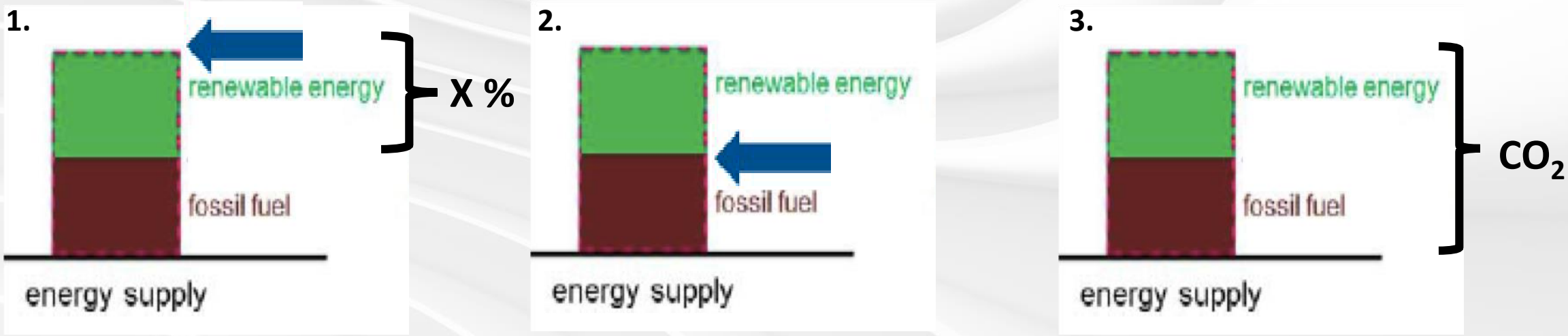
Different ways to set NZEB levels – the role of RES

- Countries choose different ways to set the NZEB level / handle RES integration

1. Requirements on energy efficiency (maximum final energy use in kWh per m^2) supplemented with a demand for use of renewable energy
2. Requirements for total energy use after deduction of renewable energy (in kWh per m^2)
3. Requirements for the emission of CO_2 - set as a total value



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Different ways to set NZEB levels – the role of RES

- Integration of RES is supported different in the 3 options

Renewable energy can be directly included in value:

- RES kwh counts as zero

Can be complemented with specific demands in kwh / %

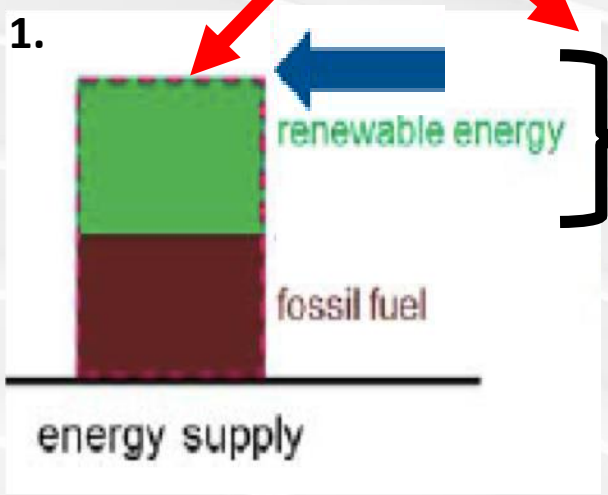
What about grid based Renewable Energy & Waste Heat ?

Renewable energy can also be included model building

All nearby Renewable Energy sources are directly included.

- Counts as zero

1.



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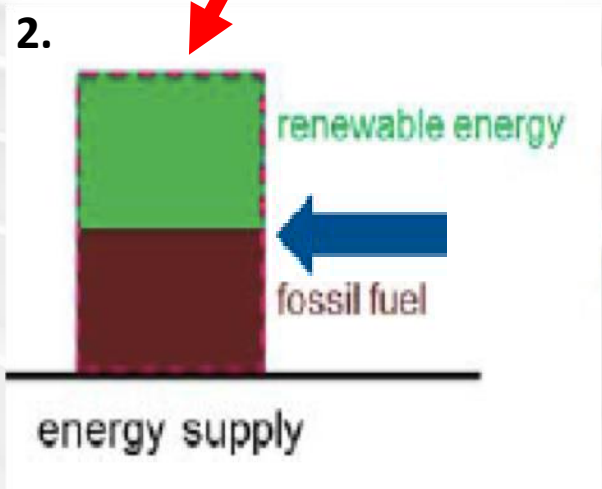

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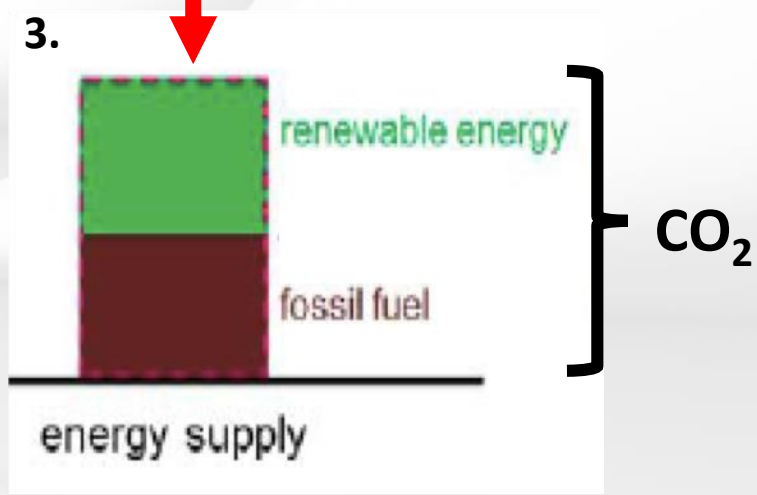

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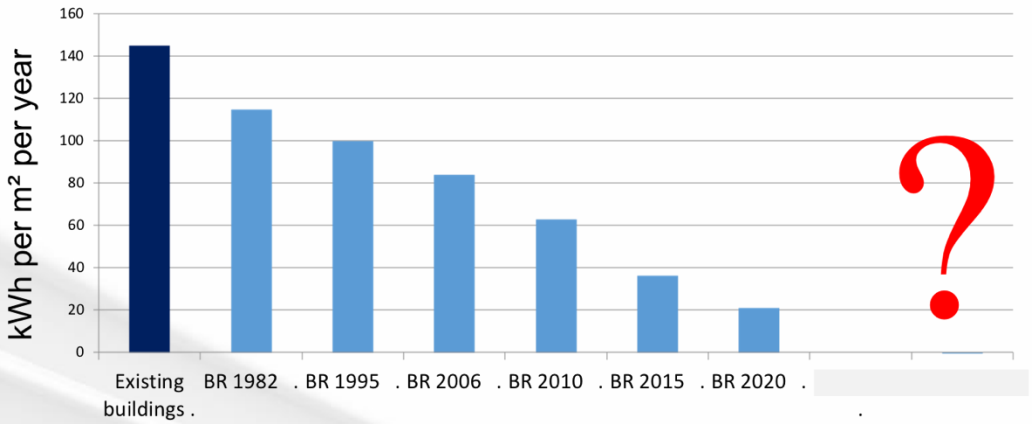
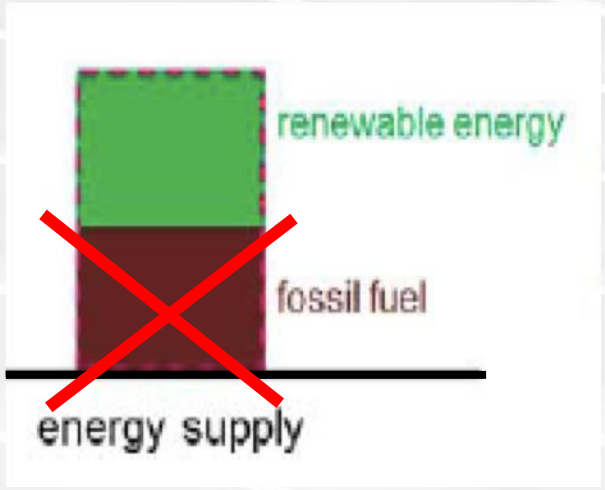
How to continue beyond 2020 NZEB levels – EE or RES ?



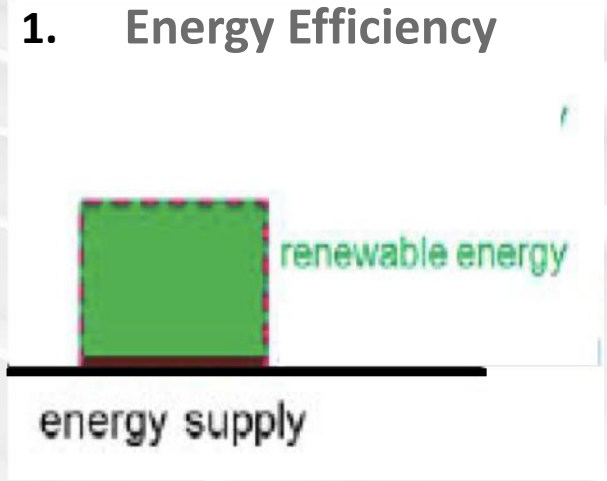
- A question of costs:
- Increased energy efficiency become more expensive beyond NZEB level
- Supply of Renewable energy through grids are becoming cheaper

Going towards Zero energy / Zero CO_2

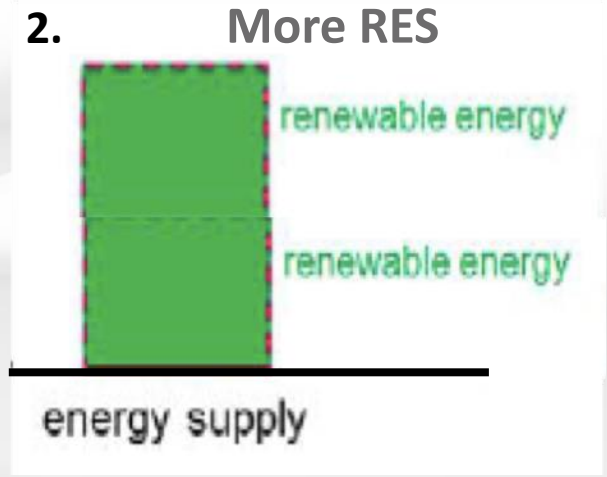
A combination is needed



1. Energy Efficiency



2. More RES



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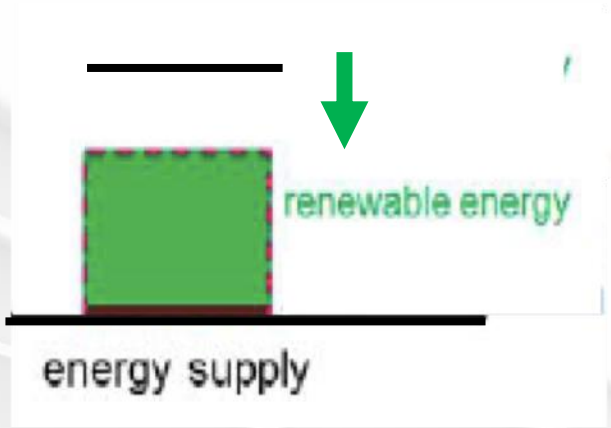
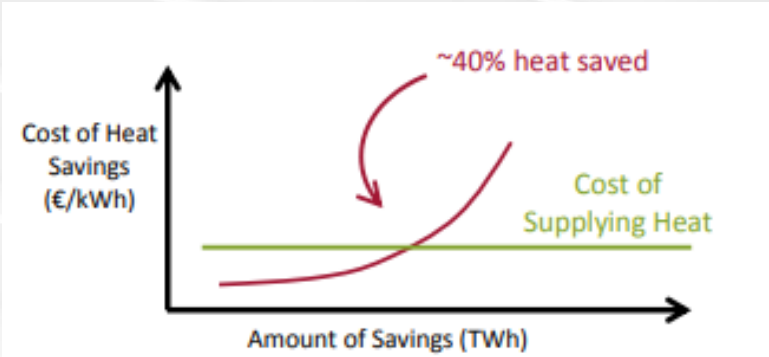
How to continue beyond 2020 NZEB levels – EE and RES

- How to go forward





Source: Future Green Buildings

- **Going beyond current NZEB levels**
  - Will require a combination of EE and RES
  - Should be based on Cost Optimality
- **This falls between / overlaps the CAs**
- **Requests for more collaboration**
- **Some questions:**
  - Rules for cost optimality in different systems
  - Supply versus energy efficiency
  - How to handle RES and waste heat in the different BR options ?
  - Could NZEB districts be part of this ?
  - Finance ?

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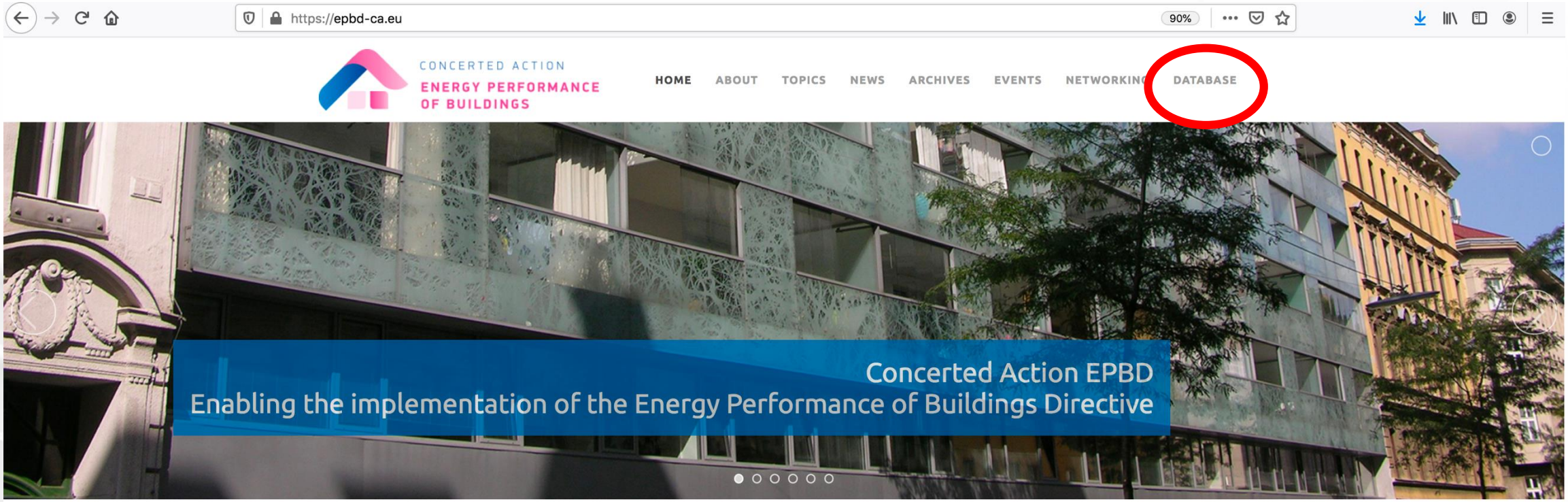

CA EPBD Website:

https://epbd-ca.eu/

Database - Country Reports

The various outputs of the Country category can be accessed and downloaded from the individual links in the database below.

Publications	Year/ Country Report	Country Report (HTML)	Country Report (PDF)	Year/ KIDs	KIDs (PDF)
Country/region					
Austria	2016	HTML	PDF	2016	PDF
Belgium – Brussels Capital Region	2016	HTML	PDF	2016	PDF
Belgium – Flemish Region	2016	HTML	PDF	2016	PDF
Belgium – Walloon Region	2017	HTML	PDF		
Bulgaria	2016	HTML	PDF	2016	PDF
Croatia	2017	HTML	PDF	2016	PDF
Cyprus	2016	HTML	PDF		
Czech Republic	2016	HTML	PDF		
Denmark	2016	HTML	PDF		
Estonia	2016	HTML	PDF		
Finland	2016	HTML	PDF	2016	PDF
France	2016	HTML	PDF		
Germany	2016	HTML	PDF	2016	PDF
Greece	2016	HTML	PDF	2016	PDF
Hungary	2016	HTML	PDF	2016	PDF
Ireland	2016	HTML	PDF		
Italy	2016	HTML	PDF	2016	PDF
Republic of Latvia	2016	HTML	PDF	2016	PDF
Lithuania	2016	HTML	PDF		
Luxembourg	2016	HTML	PDF		
Malta	2016	HTML	PDF	2016	PDF
The Netherlands	2016	HTML	PDF	2016	PDF
Norway	2016	HTML	PDF	2016	PDF
Poland	2016	HTML	PDF		
Portugal	2016	HTML	PDF	2016	PDF
Romania	2018	HTML	PDF		
Slovak Republic	2016	HTML	PDF	2016	PDF
Slovenia	2016	HTML	PDF	2017	PDF
Spain	2016	HTML	PDF		
Sweden	2016	HTML	PDF	2016	PDF
United Kingdom – England	2016	HTML	PDF	2016	PDF
United Kingdom – Wales	2016	HTML	PDF	2016	PDF
United Kingdom – Northern Ireland	2016	HTML	PDF	2016	PDF
United Kingdom – Scotland	2016	HTML	PDF	2016	PDF
Compilation of all Country Reports	2016		PDF		

Country information & KIDs, (Key Indicators and decisions) will be updated in this year.

Special focus on NZEB building codes.

THANK YOU
FOR YOUR ATTENTION

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