Danish nZEB application and energy calculation methodology

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Danish energy ambitions

Turning the back to fossil fuels:

2020 – 50% of electricity covered by wind energy

2030 – No more use of coal in power plants

2035 – All electricity and heating covered by renewable energy

2050 – All energy covered by renewable energy (electricity, heating, transports, industry)

Danish Energy Agreement – 2012

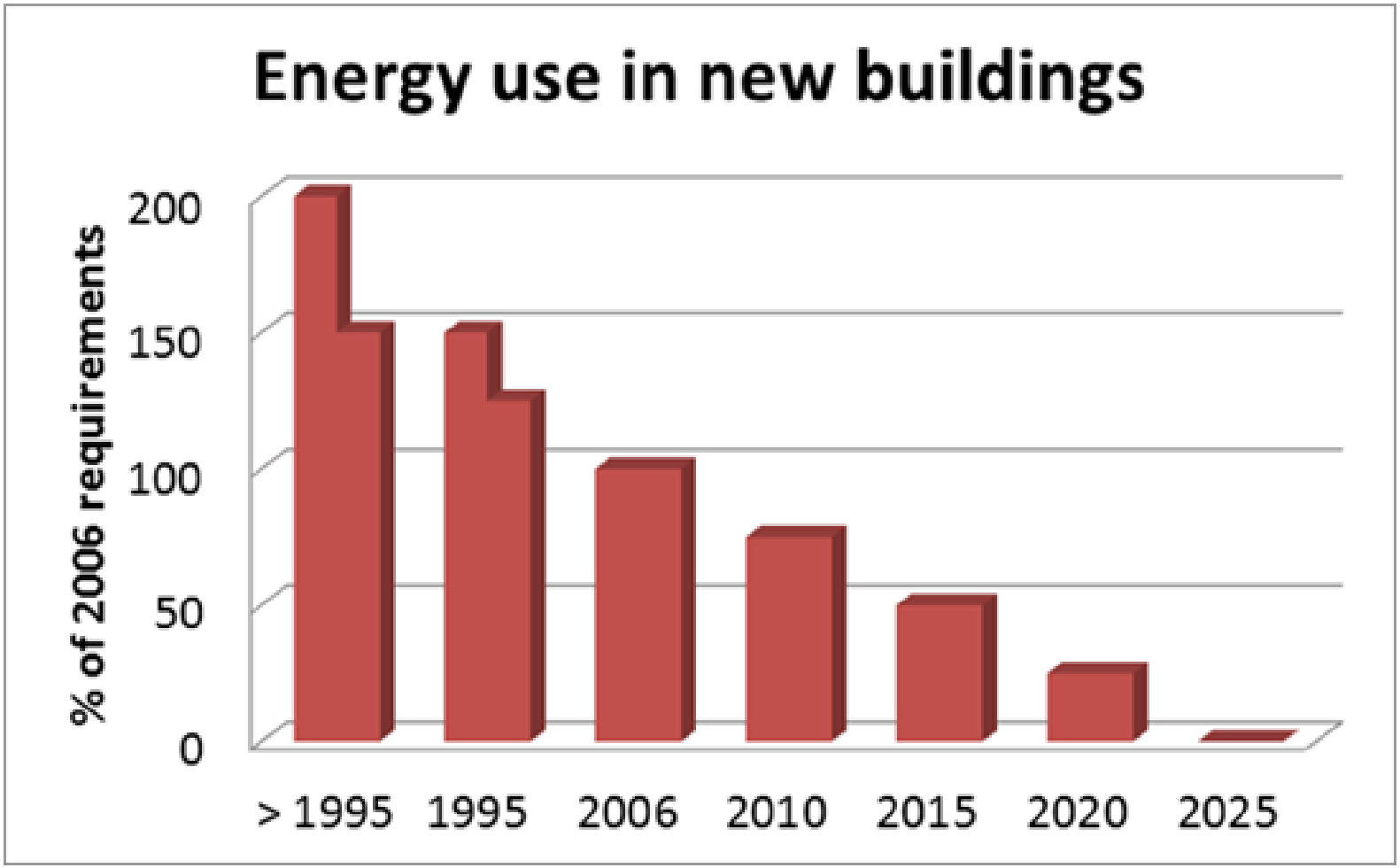
- Broad coalition in the parliament agrees on a new energy agreement
- Set the directions until 2020
- Initiatives on energy infrastructure, taxation, conditions for energy intensive industries etc.
- Continuing improvement of the energy efficiency in new buildings
- Strategy for energy renovations of the existing building stock

Energy requirements to new building in Denmark

The Danish Building Regulations 2010 includes:

- Mandatory minimum energy requirements to all new buildings
- Voluntary requirements to Low Energy Buildings 2015
- New voluntary requirements to Buildings 2020 (introduced in 2012) [nZEB]
- Buildings 2020 was introduces on requests from the building industry with the purpose to gain the advantages of an early development of components, materials and solutions that comply with future requirements.

Requirements for new buildings

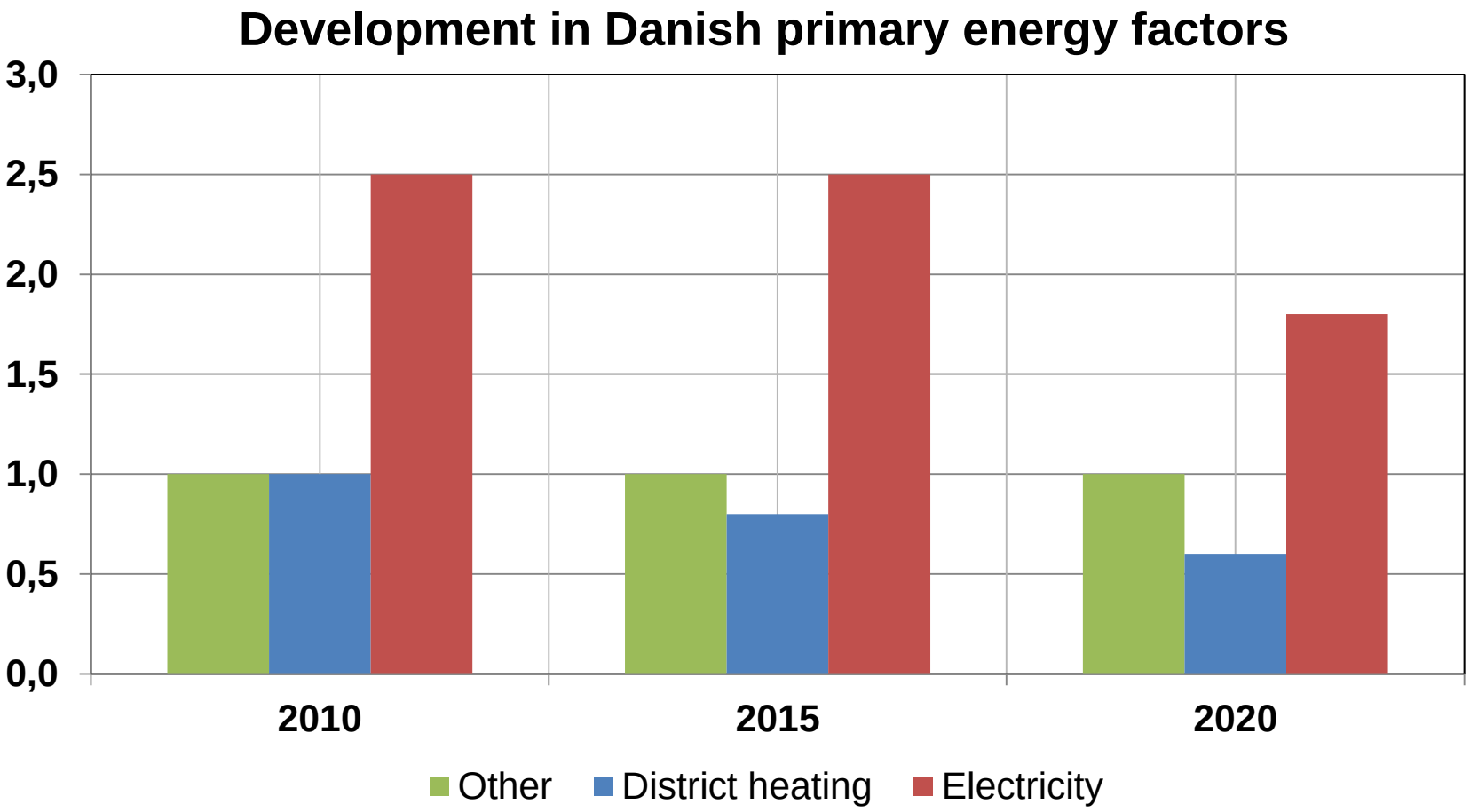


Energy demand

Calculated primary energy for: heating, ventilation, domestic hot water, electricity for building operation and electricity for lighting (non-residential) incl. of system efficiency and potential overheating (+26 ºC).

- Two building types, residential and non-residential
- Standard conditions for building use
- Addition to the energy frame for special needs: high ventilation, lighting etc. (only non-residential)
- Subtraction of RES contribution e.g. wind and solar
- One national calculation core for new and existing buildings (certification) based on CEN standards

Primary energy factors in Denmark



Energy frames[1]

Residential		Non-residential	
2010		**2010**	
52.5 + 1650/A	kWh/m² year	71.3 + 1650/A	kWh/m² year
2015		**2015**	
30 + 1000/A	kWh/m² year	41 + 1000/A	kWh/m² year
2020		**2020**	
20	kWh/m² year	25	kWh/m² year

1) *Primary energy for: heating, ventilation, domestic hot water, electricity for building operation, electricity for lighting (non-residential), system efficiency, internal energy transport, potential overheating penalty - RES*

Design[1] heat loss through the thermal envelope excl. windows and doors

	2010	2015	2020
1 storey	Q <= 5 W/m²	Q <= 4 W/m²	Q <= 3.7 W/m²
2 storeys	Q <= 6 W/m²	Q <= 5 W/m²	Q <= 4.7 W/m²
3+ storeys	Q <= 7 W/m²	Q <= 6 W/m²	Q <= 5.7 W/m²

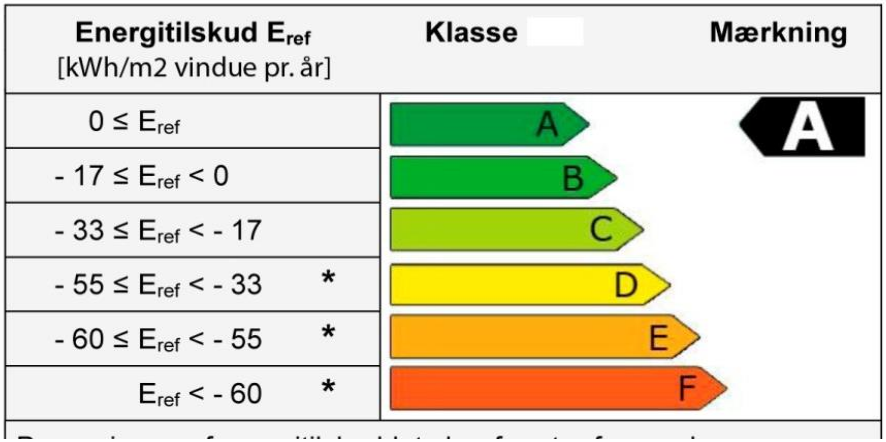
1) ΔT (to outdoor) = 32 °C

Windows - and energy gain reference

	2010	2015	2020
Facade windows	-33	-17	+ 0
Roof windows	-10	+0	+10

$$E_{ref} = I \cdot g_w - G \cdot U_w = 196{,}4 \cdot g_w - 90.36 \cdot U_w$$

Energy gain factor in kWh/(m^{2}year)



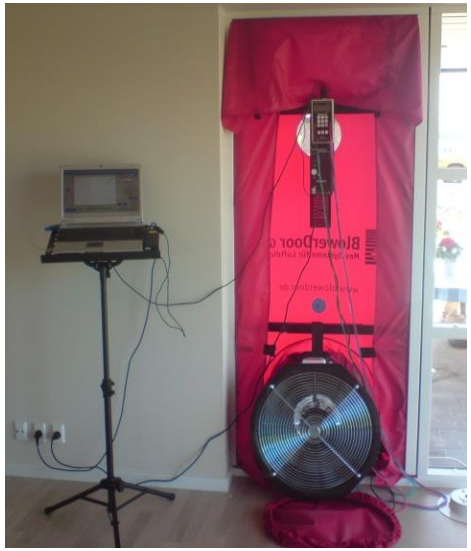
Airtightness

Air-change must not exceed X.X l/s per m² (heated floor area) demonstrated at a pressure difference of 50 Pascal

	2010	**2015**	**2020**
Tested air-change:	1.5	1.0	0.5

The municipality must require a pressure test in more than 5% of all new buildings

Fulfilment of 2015 or 2020 regulations require a pressure test



Thermal indoor climate

In buildings complying with Low Energy class 2015 or Building class 2020, thermal indoor climate must be documented via calculations

In dwellings, institutions, offices etc. the thermal indoor climate must not exceed 26°C, except during a limited number of hours compared with the reference year

For dwellings, a temperature of 26°C must not be exceeded for more than 100 hours per year, and a temperature of 27°C must not be exceeded for more than 25 hours per year

Documentation for the thermal indoor climate can be done according to "DS474 - Norm for specification of the thermal indoor climate" using dynamic simulation tools

For dwellings proof can be provided via a simplified calculation implemented in the compliance checking tool Be10 – Buildings energy demand 2010

Other requirements to 2020 Buildings

- In office buildings, schools and institutions complying with Building Class 2020, the CO_2 must not exceed 900 ppm in general (over longer periods).
- In 2020 Buildings the glazing area in the rooms must at least be 15 pct. (of the floor area) with a light transmission of 0,75 – or equivalent. Alternatively the daylight factor must be at least 3 pct.
- Heat recovery in ventilation systems must be at least 75 pct. in general – and 85 pct. in single dwelling systems.
- Specific power for transportation of air in ventilation system must not exceed 1.500 J/m^3 in general – and 800 J/m^3 in single dwelling systems.

Local RES electricity production

In BR10 on site or “near by” produced RES electricity can only be deducted in the energy frame up to the amount of electricity used for operating the building, i.e. electricity for pumps, fans, heat pumps, and lighting (non-residential buildings only)

- The economic settlement balancing period for locally produced electricity is hourly
- The current feed-in tariff for private households is 0.08 €/kWh while the price for buying electricity from the grid is approx. 0.30 €/kWh

New steps in 2015

- The planned tightening of EP requirements in the Danish Building Regulations 2015 are in process. (Send for EU notification end of April)
- Low energy class 2015 will become minimum EP requirements by the end of 2015
- Energy classes for existing buildings are introduced (1-2 classes from new buildings)
- Investigations on future (beyond 2020) energy/environmental building classes are to be carried out

Economical evaluation:
2015 Single family house with district heating

Additional investment excl. vat. (compared to 2010 building):

2014: 44 Euro/m^2

2018: 32 Euro/m^2

Typical total building cost: 1.600 Euro/m^2

Private economical return of investment:

2014: 1,06

2018: 1,37

Macro economical return of investment:

2014: 0,39

2018: 0,51

Economical evaluation:
2020 Single family house with district heating

Additional investment excl. vat. (compared to 2015 building):

2014: 56 Euro/m^2

2018: 45 Euro/m^2

Typical total building cost: 1.650 Euro/m^2

Private economical return of investment:

2014: 0,58

2018: 0,74

Macro economical return of investment:

2014: 0,18

2018: 0,24

Economical evaluation:
2020 Single family house with heat pump

Additional investment excl. vat. (compared to 2015 building):

2014: 49 Euro/m^2

2018: 37 Euro/m^2

Typical total building cost: 1.700 Euro/m^2

Private economical return of investment:

2014: 0,41

2018: 0,55

Macro economical return of investment:

2014: 0,15

2018: 0,21

Thank you for your attention