

Towards ZEB (Zero Energy Buildings) in Europe and USA

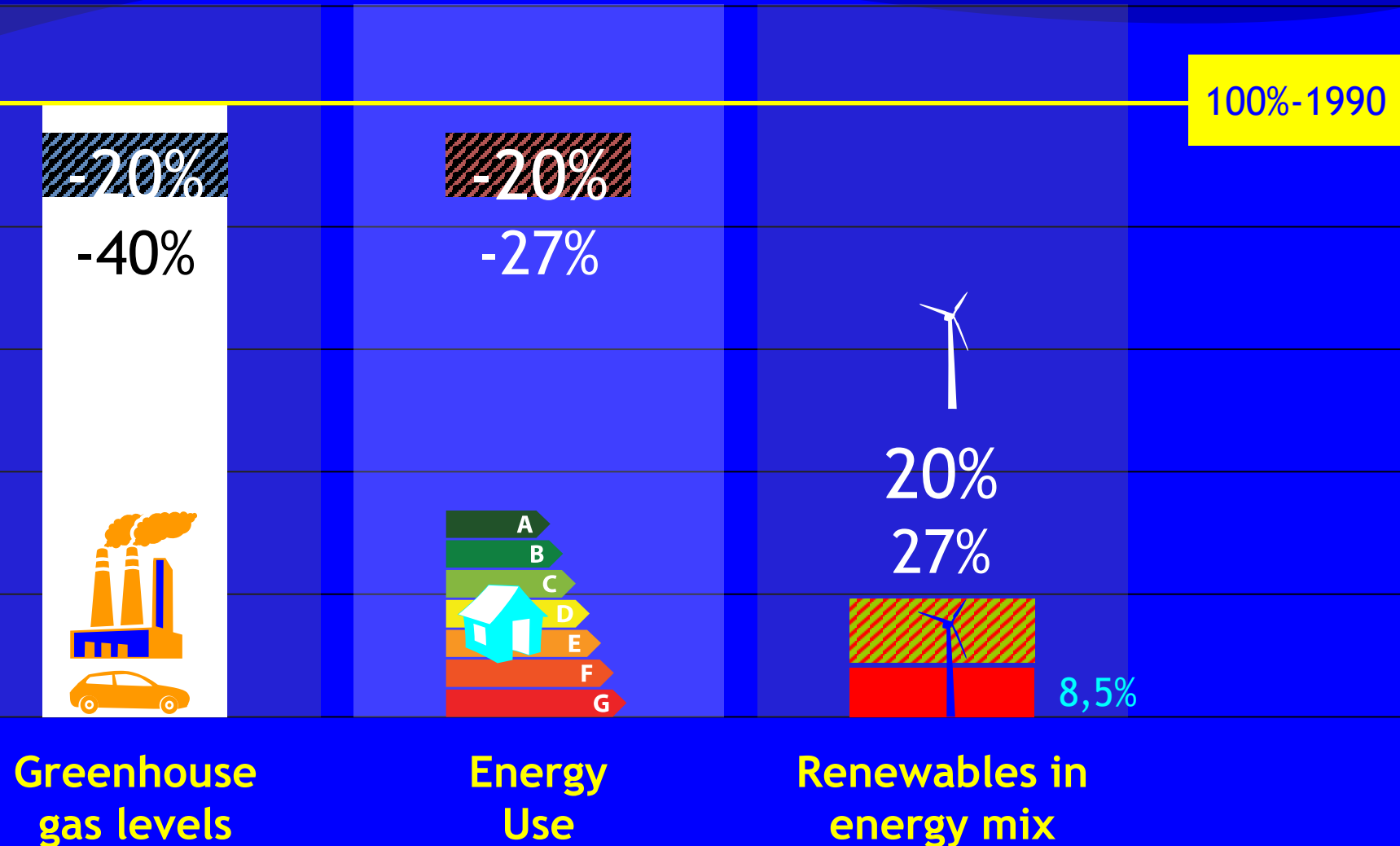
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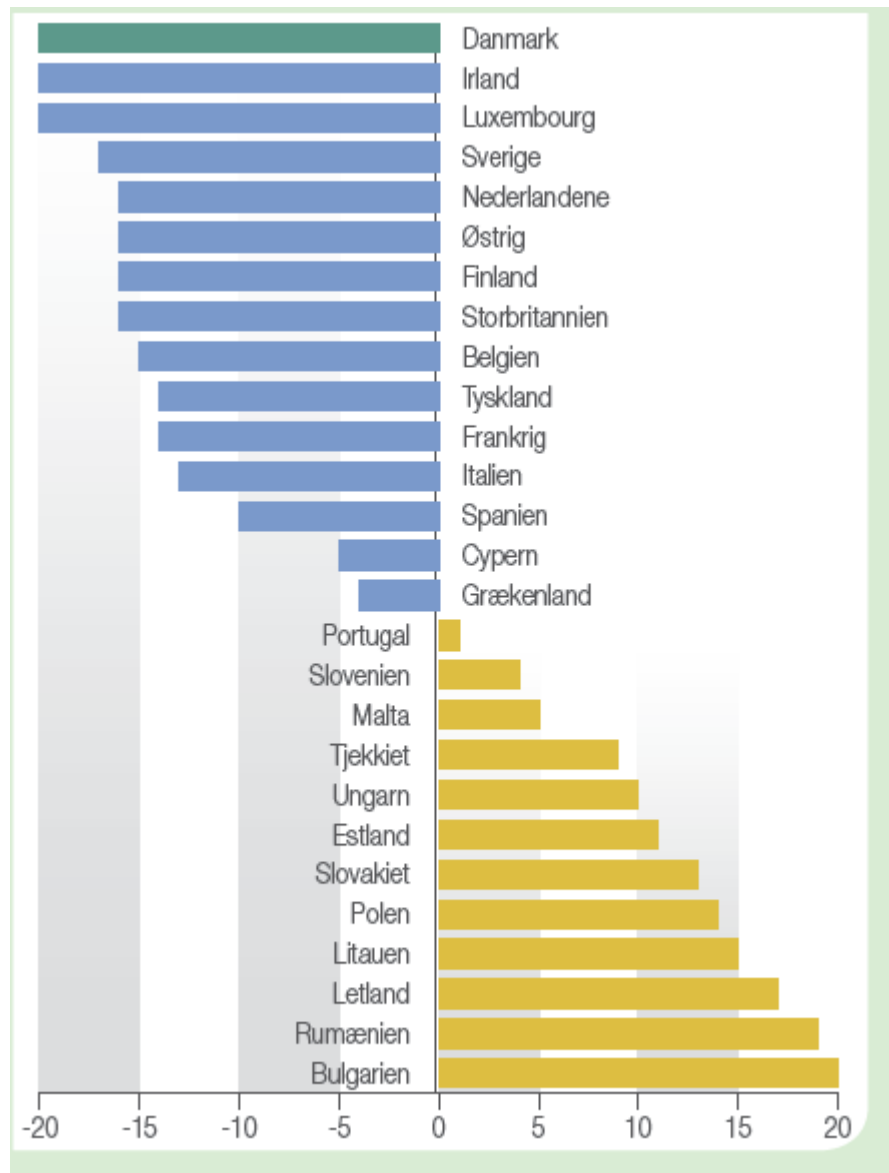
Energy Demand-Energy Efficiency- Renewable Energy Sources

- **Decrease energy demands (building design)**
- **Increase energy efficiency (HVAC systems)**
- **Increase use of renewable energy sources (wind, solar, geothermal, biomass)**
- New energy sources (fuel cell,fracking)

The 20-20-20 EU policy by 2020

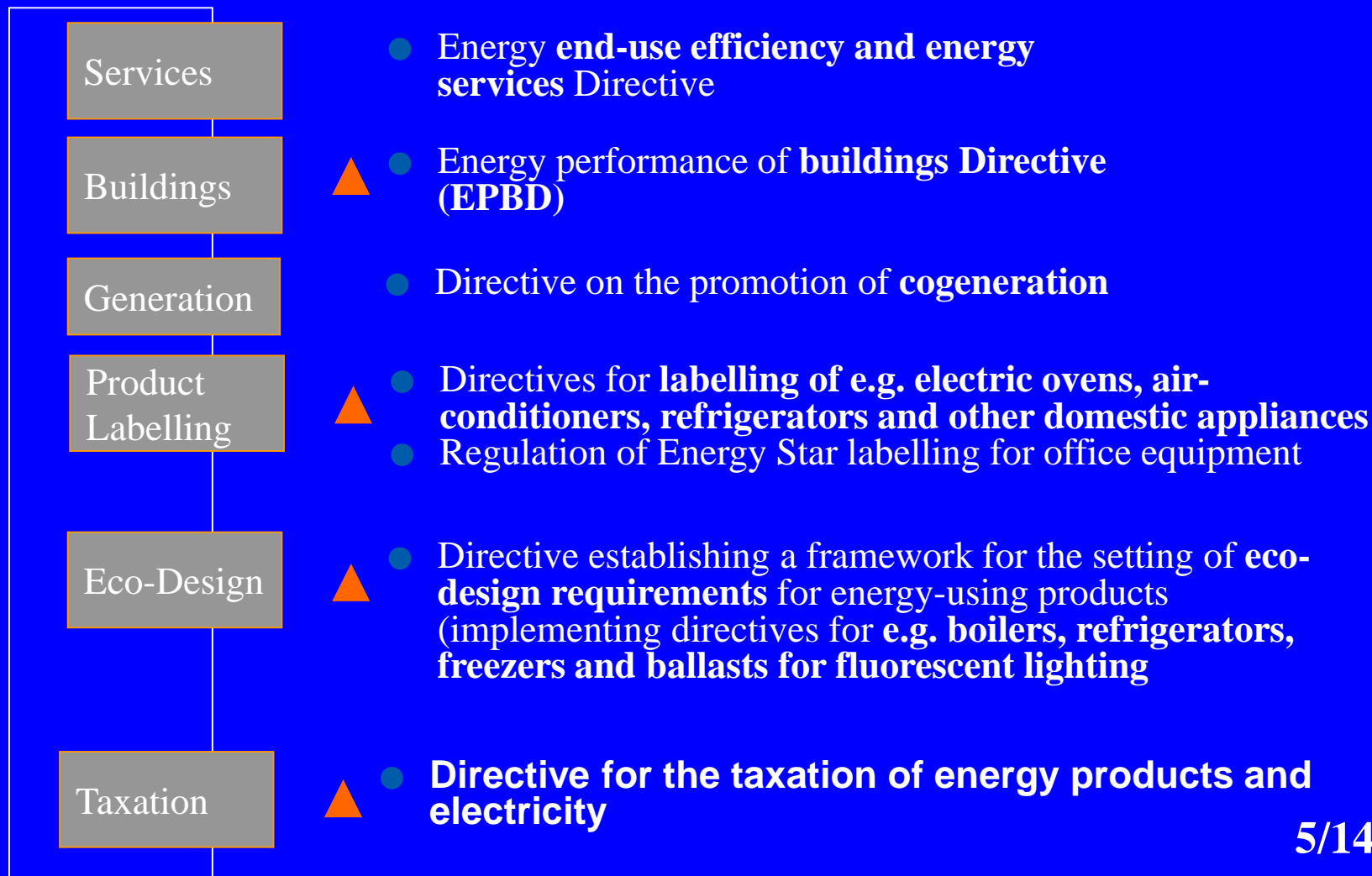
New policy for 2030 proposed





Required reductions in
energy use in European
countries
2020 in relation to 2005

Comprehensive set of legislation to enhance energy efficiency



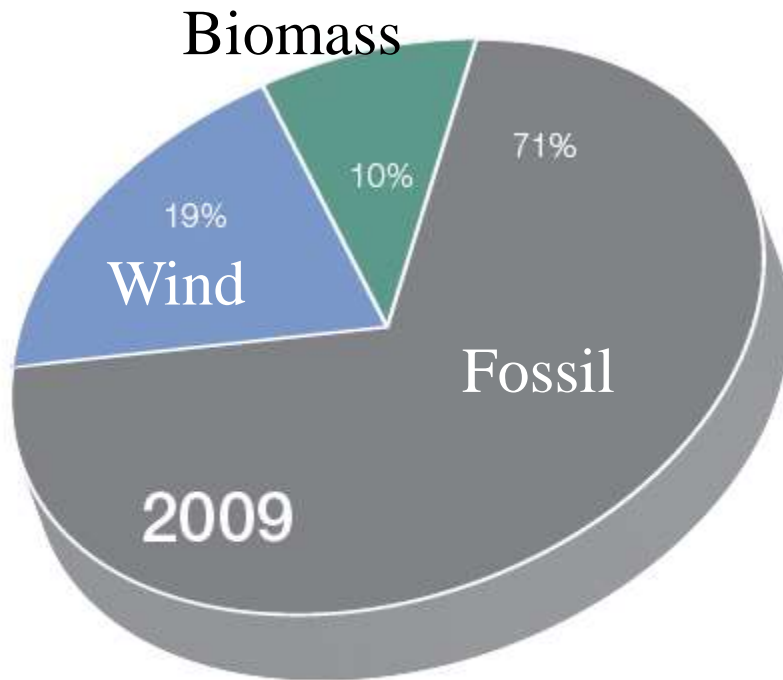
**Directive 2009/28/EC (Renewable Energy Directive 2009)
of the European Parliament and of the Council of 23 April
2009 on the promotion of the use of energy from
renewable sources**

National overall targets for the share of energy from renewable sources in gross final consumption of energy in 2020

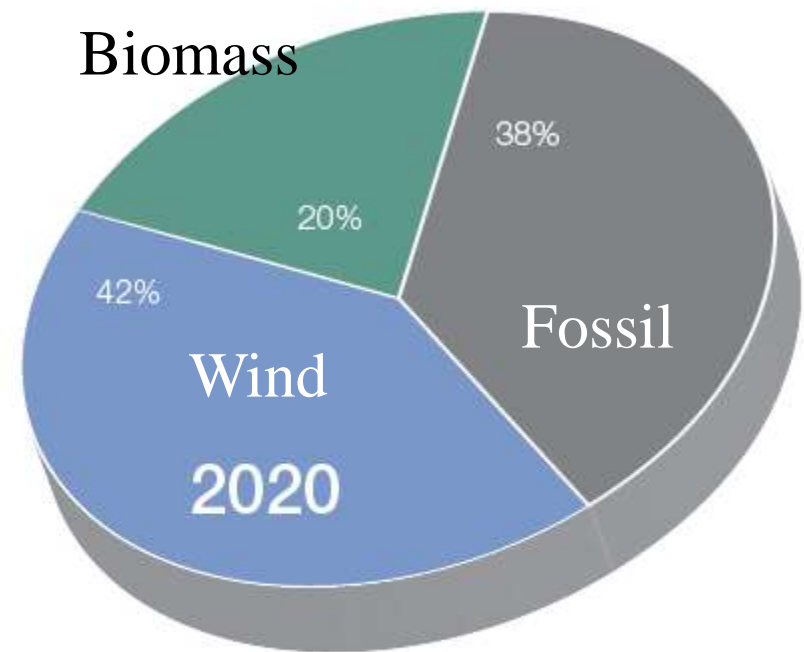
	2005-2020	
Belgium	2,2	13 %
Bulgaria	9,4	16 %
Czech Republic	6,1	13 %
Denmark	17,0	30 %
Germany	5,8	18 %
Estonia	18,0	25 %
Ireland	3,1	16 %
Greece	6,9	18 %
Spain	8,7	20 %
France	10,3	23 %
Italy	5,2	17 %
Cyprus	2,9	13 %
Latvia	32,6	40 %
Lithuania	15,0	23 %
Luxembourg	0,9	11 %

	2005-2020	
• Hungary	4,3 %	13 %
• Malta	0,0 %	10 %
• Netherlands	2,4 %	14 %
• Austria	23,3 %	34 %
• Poland	7,2 %	15 %
• Portugal	20,5 %	31 %
• Romania	17,8 %	24 %
• Slovenia	16,0 %	25 %
• Slovak Republic	6,7 %	14 %
• Finland	28,5 %	38 %
• Sweden	39,8 %	49 %
• United Kingdom	1,3 %	15 %

Part of renewable energy sources (wind and bio-fuel) in power generation in Denmark



■ Vind ■ Biomasse ■ Fossil energi



■ Vind ■ Biomasse ■ Fossil energi

4.2 Andel vedvarende energi i elproduktion 2009 og 2020

Research Program

Innovation opportunities in Europe

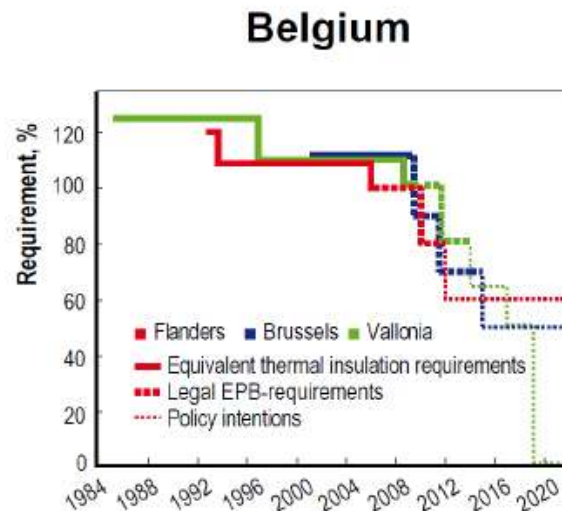
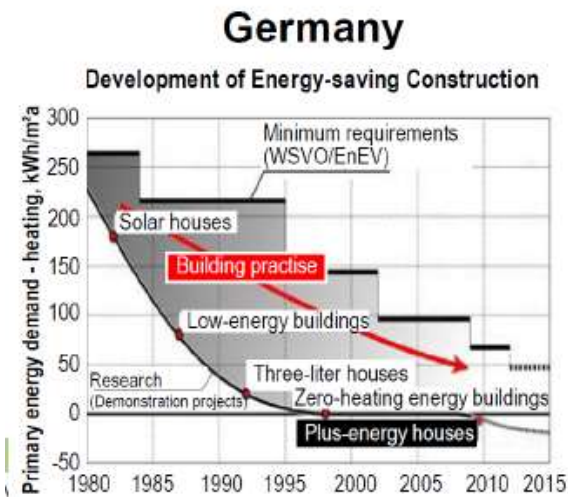
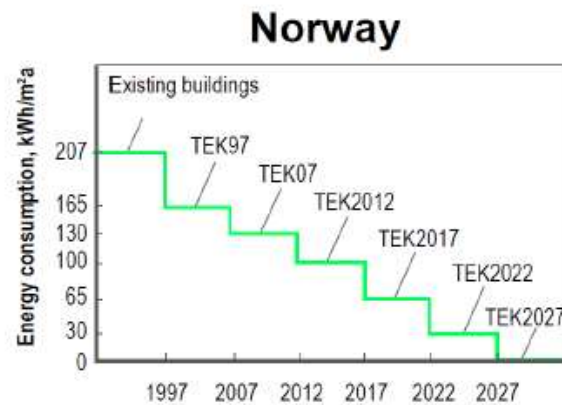
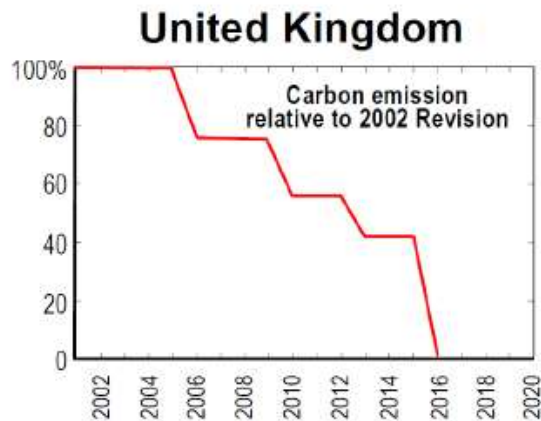
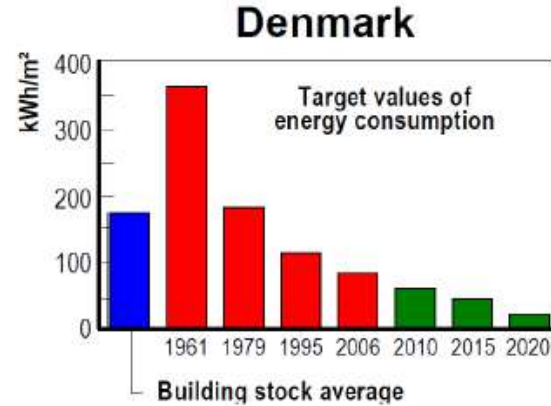
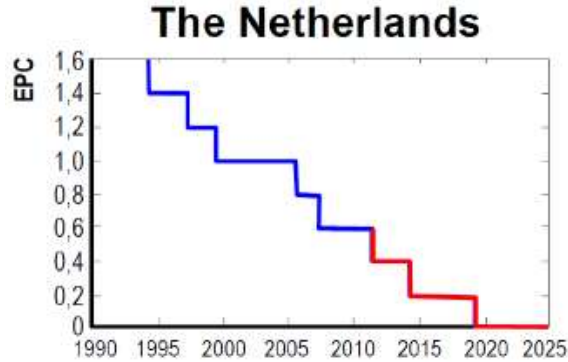
- ▶ EU RTD and Innovation framework program
HORIZON 2020



Energy Efficiency

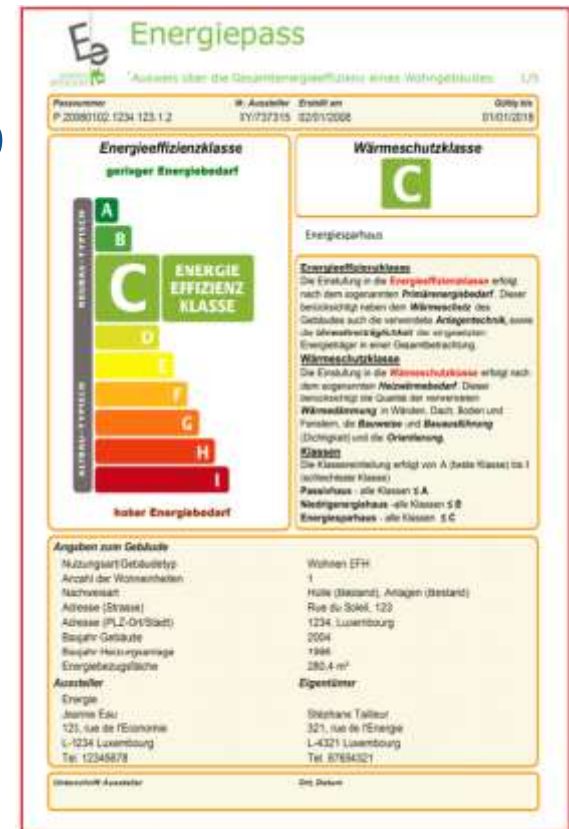
- ▶ Heating and cooling8
- ▶ EE 1 – 2017: Waste heat recovery/heat recycling from urban built spaces (buildings and transport infrastructures) and from urban waste water for district heating networks 9
- ▶ EE 2 – 2017: Demonstration of the applicability of low temperature district heating in areas of buildings with high energy standards 10
- ▶ EE 3 – 2017: Replication of successful approaches for the retrofitting of inefficient district heating networks guaranteeing substantial primary energy savings and efficiency gains 11
- ▶ EE 4 – 2016: Standardised installation packages for the integration of multi-components (hybrid) renewable and energy efficiency solutions including thermal energy storage into buildings 12
- ▶ EE 5 – 2016: Development and demonstration of low-energy heating and cooling systems and of heating and cooling solutions using low and very low temperature resources 13
- ▶ EE 6 – 2016: Models and tools for heating and cooling mapping and planning 14

The effect of building regulations



New in the recast EPBD

- Introduction of “nearly zero-energy buildings” by 2021/2019
- “Cost-optimal methodology”
- Extension of minimum requirements to ALL buildings but no obligation to renovate
- Strengthening of Energy Performance Certificates and Inspections
- Requirements for technical building systems in existing buildings, optional for new



“Nearly zero-energy buildings”

Article 9: Member States shall ensure, that

- **After 31 December 2018, new buildings occupied and owned by public authorities** are nearly zero-energy buildings, and;
- **After 31 December 2020 all new** buildings are nearly zero-energy buildings
- **MS shall develop national plans** for increasing the number of nearly zero-energy buildings including a detailed application of the definition in practice
- **MS shall develop policies and take measures** to stimulate refurbishments into nearly zero-energy buildings

Commission launched a study end of 2011

EPBD recast – Nearly zero energy buildings nZEB

- In the directive 'nearly zero-energy building' means 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.

⇒ **nZEB = very high energy performance + on-site renewables**

- Definition of "a very high energy performance" and "significant extent of renewables" let for Member States

Table I. Primary energy frames for new buildings in Denmark 2006, 2010, 2015 and 2020.

Building Code	Energy frame kWh/(m ² a) BR06	Energy frame kWh/(m ² a) BR10	Energy frame kWh/(m ² a) BR10 - Class 2015	Energy frame kWh/(m ² a) BR10 - Class 2020
Residential	70 + 2200/A	52.5 + 1650/A	30 + 1000/A	20
Non-residential	95 + 2200/A	71.3 + 1650/A	41 + 1000/A	25

Table II. Estonian primary energy requirements (VV No 68: 2012), which came into force since 9.1.2013. The requirements and corresponding energy certificate classes are shown in terms of primary energy for three building types out of nine.

	nZEB A kWh/(m ² a)	Low energy B kWh/(m ² a)	Min.req. new C (cost opt.) kWh/(m ² a)	Min.req. maj.ren. D (cost opt.) kWh/(m ² a)
Detached houses	50	120	160	210
Apartment buildings	100	120	150	180
Office buildings	100	130	160	210

Continuity from the product to the system energy performance assessment



JWG ISO TC 163/ISO TC 205

Holistic approach



ISO TC 205 (System TC)

Technical Building Systems,
bldng environment design
(System loss calculation)

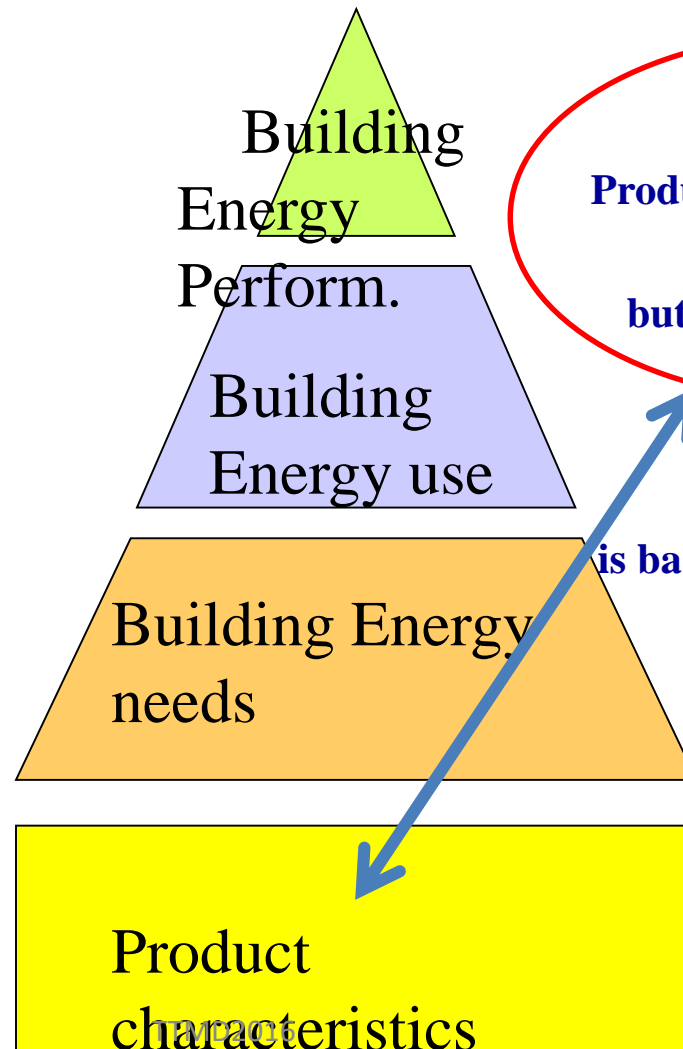


ISO TC 163 (Building TC)

Bldng energy use, envelope
characteristics, climatic data
(Building energy use calculation)



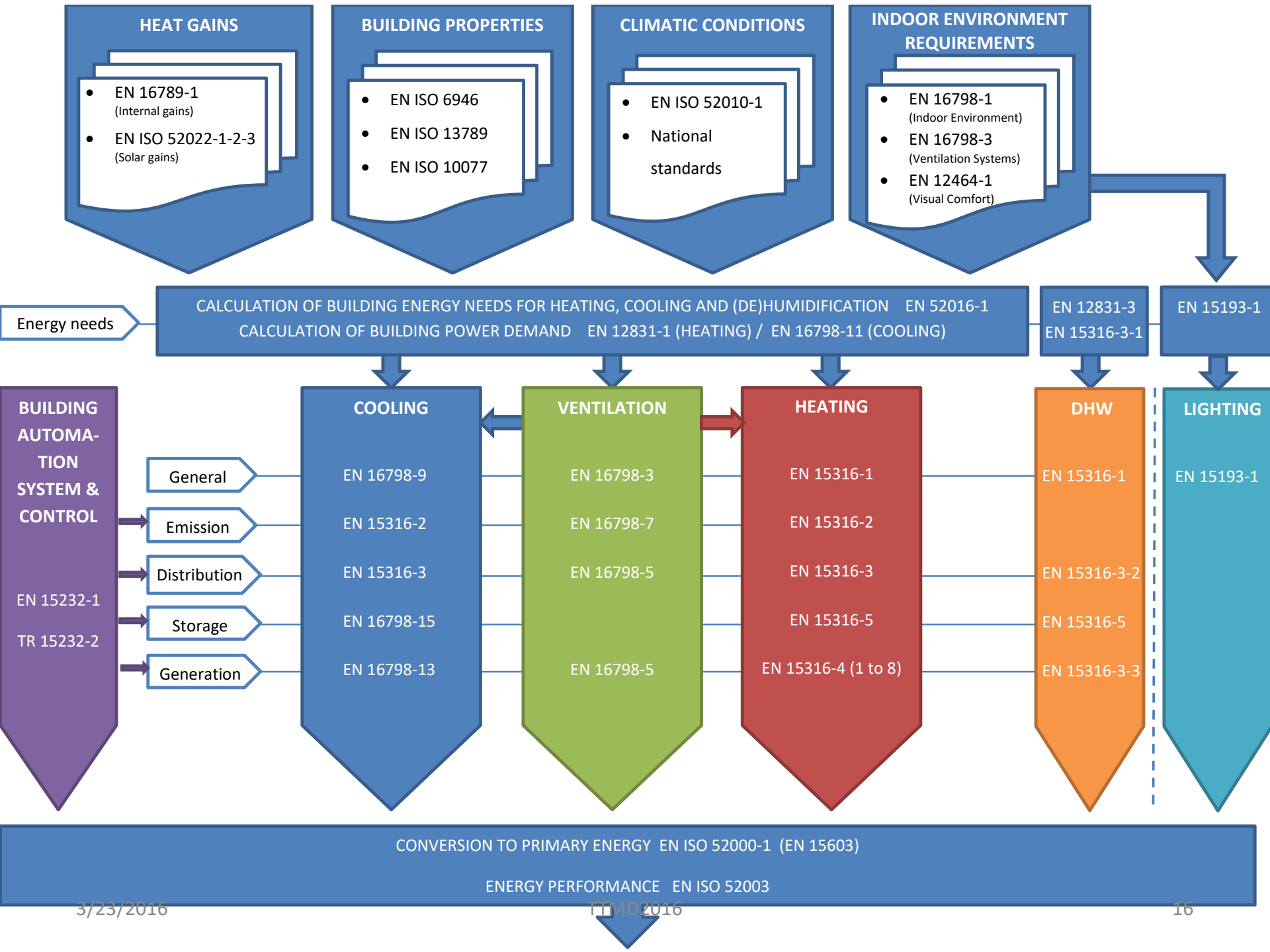
**Product TC's like ISO/TC 86;115;117;
118; etc....(Evaluation of product
characteristics)**



**Product no longer evaluated
as a product
but as a part of a system**

**IMPORTANT:
Holistic approach
is based on (tested) product
characteristics**

Various
CEN
product
TC's like:
48; 57; 62;



US developments towards ZEB

- Often driven by private organization like ASHRAE
- Very different from state to state
- Several states are referring to ASHRAE standard 90.1
- California has the most strict criteria in their California Building Standards Code ,Title 24
- DOE (department of Energy) has established a national definition of ZEB

Solar decathlon is a competition among technical universities from all over the world to design , build and operate plus energy houses.

<http://en.sdeurope.org/>

<http://www.solardecathlon.gov/>





USA
Europe
China
Caribien

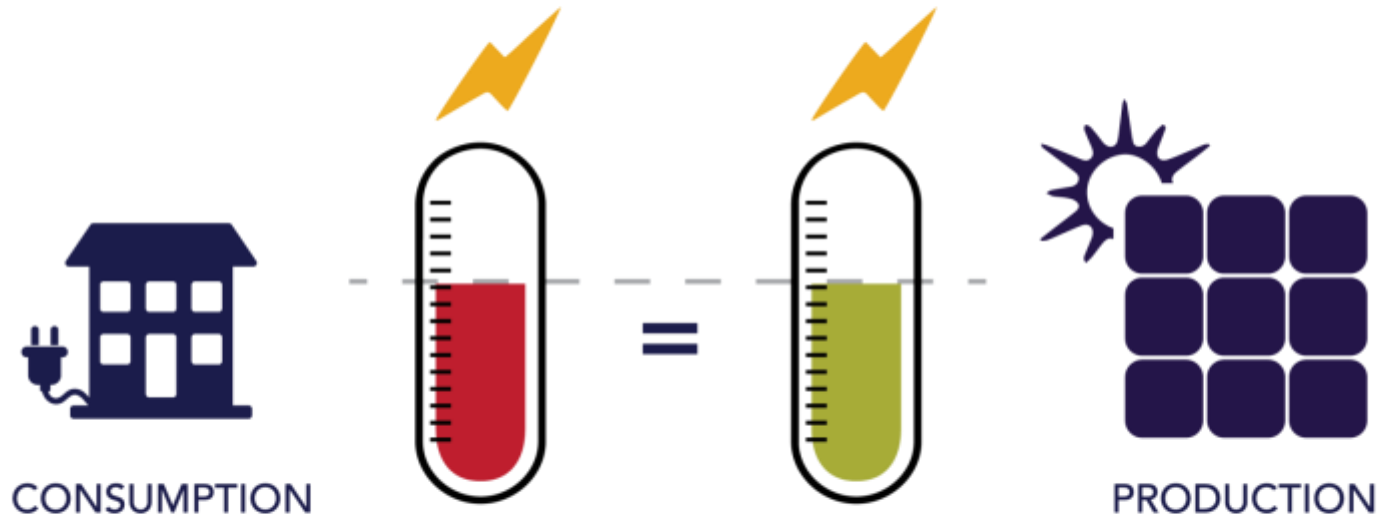


Different Types of (Net) Zero Energy Buildings

- Site energy ZEB
- Source energy ZEB
- Zero Energy Cost Building
- REC-ZEB

Site Energy (n)ZEB

A building where the actual annual delivered energy \leq on-site renewable exported energy as measured at the site.





**Can all buildings balance energy use with
only on-site renewable energy?**

(Net) Zero Energy Building (ZEB) Definition

An energy-efficient *building*, where on a *source energy* basis, the actual *annual delivered energy* is less than or equal to the on-site renewable *exported energy*.

Using “Zero Energy Building” Designation

- Only buildings that have demonstrated through actual annual measurements that the on-site renewable exported energy is greater than or equal to delivered energy.
- Buildings designed to be zero energy, but have not yet had a full year of operation are encouraged to identify their intent to be a *Zero Energy Building*.

Building Sustainability Certification

- LEED
- BREAM
- CASBEE
- Etc.

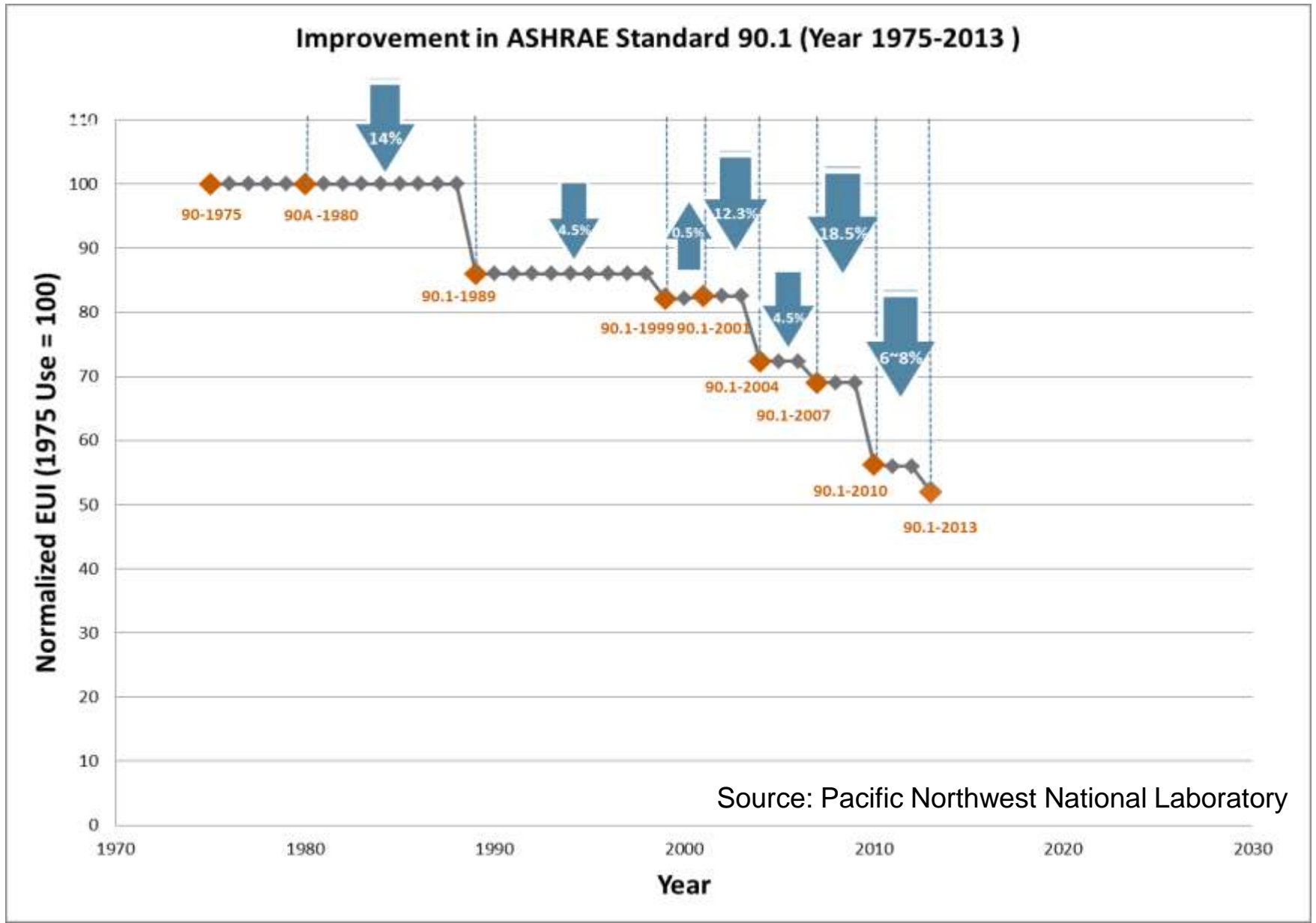
ASHRAE's contribution to ZEB

- Standards
- Handbooks
- Advance Energy Design Guides

Major Standards under Review/Revision



ANSI/ASHRAE/IES Standard 90.1-2013 -- Energy Standard for Buildings Except Residential Buildings



Advanced Energy Design Guides: 522,000 in circulation

Four 50% AEDGs



Being Implemented

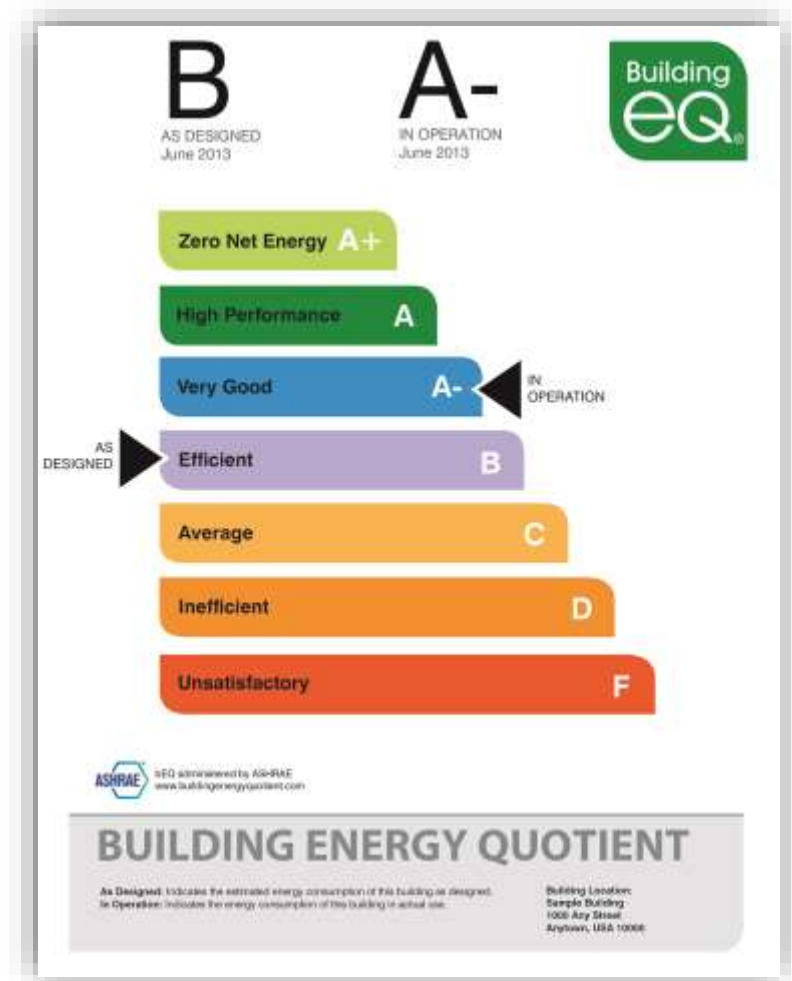
- 50% Grocery Stores
 - Quick Serve Restaurants
 - Places of Assembly

Under Discussion

- Net Zero
 - K-12 Schools (2)
 - Quick Serve Restaurants
 - Places of Assembly
 - “Net Zero Ready” Guidance

Building Energy Quotient

- In Operation Rating (Operational) launched in March 2012
- As Designed Rating (Asset)
 - Launched in May 2013
 - Research project underway to develop expanded median EUI (Energy Utilization Intensity) tables
- EPA-Energy Star rating



COMFORT-PRODUCTIVITY

Building costs

People	100
Maintenance	10
Financing	10
Energy	1

**This clearly show that buildings are for
people
not for saving energy**