

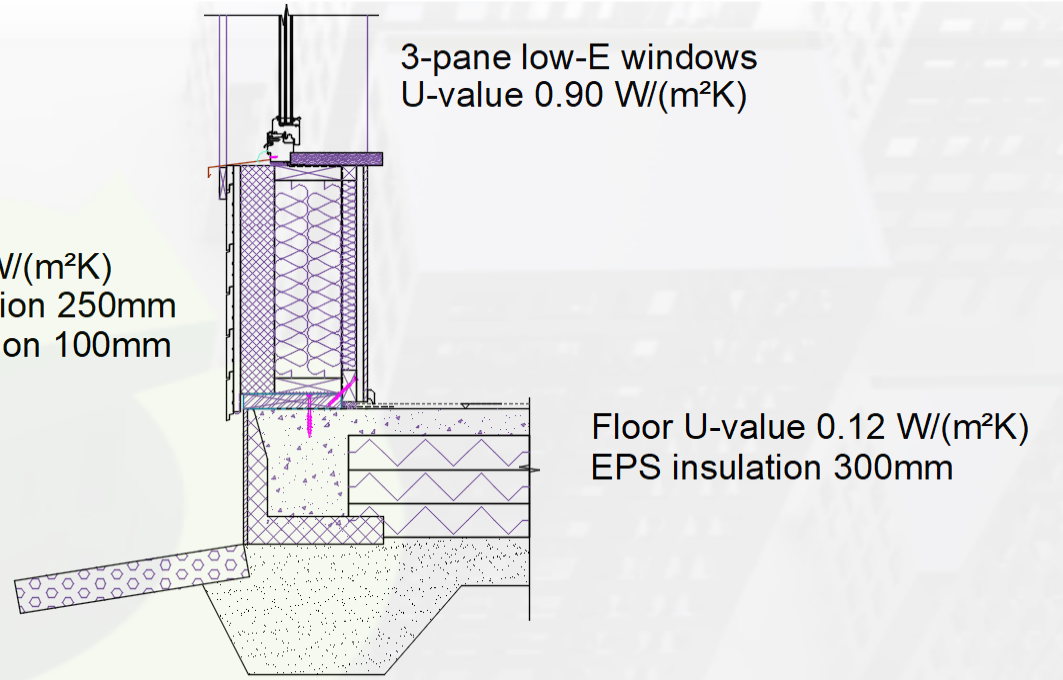
Mida on meil õppida Taani energiatõhususe nõuetest?

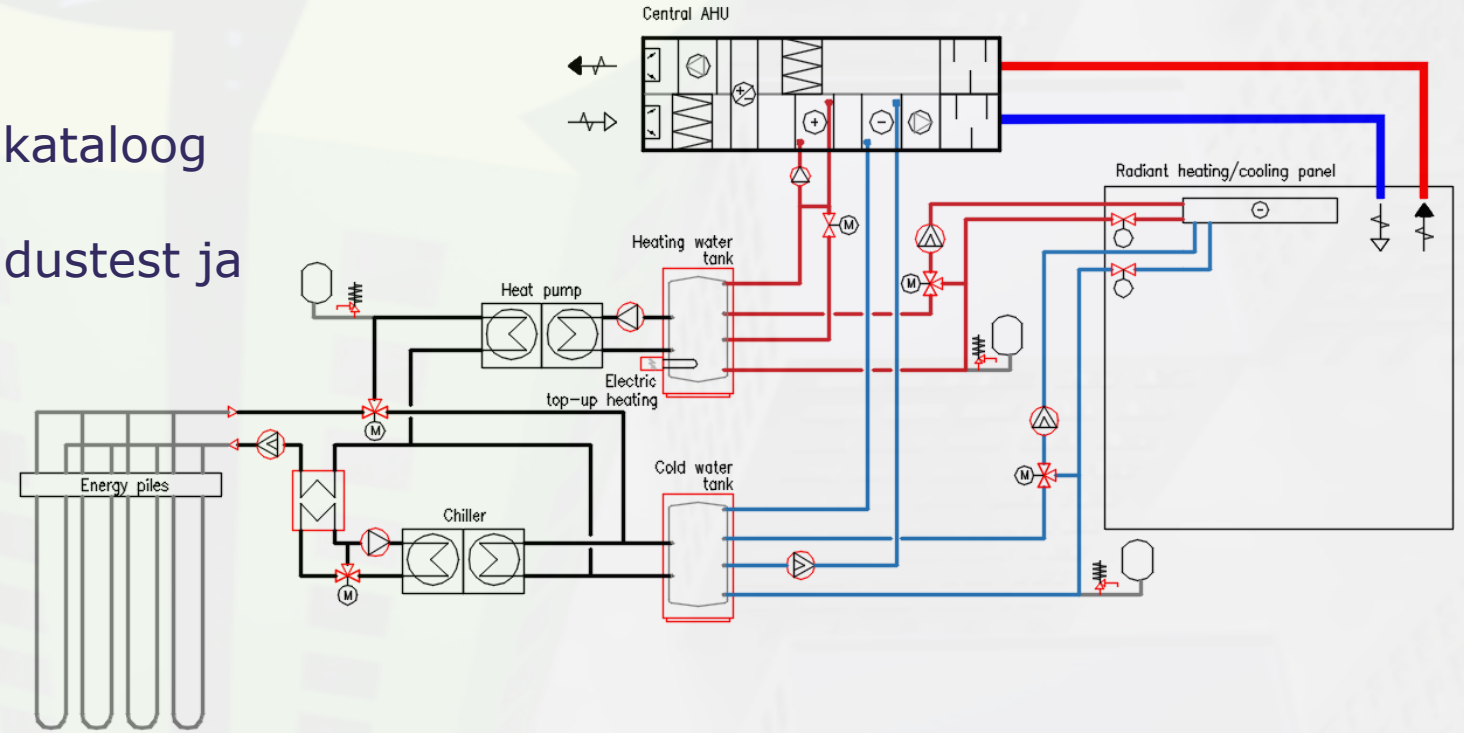
Raimo Simson

Teadmistepõhine ehitus
03.11.2022

NORDIC-BALTIC NZEB PROJECT

- Kaasatud riigid: Taani, Soome, Eesti, Läti, Leedu
- Koguda kokku häid näiteid NZEB lahendustest
- Võrrelda riikidevahelisi NZEB nõudeid ja arvutusmetoodikat
- Koostada NZEB tehniliste lahenduste kataloog
- Jagada kogemusi NZEB hoonete lahendustest ja ehitusest





TAL TECH

AALBORG UNIVERSITY

NZEB TASEMED EUROOPA LIIDUS

- Erinevad kliimatsoonid
- Neto primaarenergia (PE) nõuded
- NZEB PE nõuded taastuvenergiaga (RES)



Energy use	Zone			
	Medi-terranean Zone 1	Oceanic Zone 4	Continen-tal Zone 3	Nordic Zone 5
	Catania, Athens, Larnaca, Luga, Seville, Palermo	Paris, Amsterdam, Berlin, Brussels, Copen-hagen, Dublin, London, Prague, Warszawa	Budapest, Bratislava, Ljubljana, Milan, Vienna	Stock-holm, Tallinn, Helsinki, Riga, Gdansk, Tovarene
Net PE kWh/(m^{2}đy)	0-15	15-30	20-40	40-65
PE w/o RES kWh/(m^{2}đy)	50-65	50-65	50-70	65-90
on-site RES kWh/(m^{2}đy)	50	35	30	25

EC collected data from 2018

- Comprehensive study of building energy renovation activities and the uptake of nearly zero-energy buildings in the EU *Annex to final report* *https://ec.europa.eu/energy/sites/ener/files/documents/2.annex_to_final_report.pdf*
- The Primary Energy Requirements contain indicative information about the range of primary energy requirements for new buildings
- However, it should be noted that different calculation approaches might exist on national level, therefore values cannot easily be compared to each other

Member States	NZEB Defnintion Status*	Primary Energy Requirements (new buildings) (kWh/(m².a))
Austria		160-170
Belgium (Brussels)		45-85
Belgium (Flanders)		32-45
Belgium (Wallonia)		95
Bulgaria		30-50
Croatia		30-80
Cyprus		100
Czech Republic		43-51
Denmark		20
Estonia		50-100
Finland		78-150
France		40-105
Germany		36-45.75
Greece		-
Hungary		50-72
Ireland		45
Italy		15-20 & Class A1
Latvia		95
Lithuania		A++
Luxembourg		45 & Class A/Class AAA
Malta		55-115
Netherlands		0-25
Poland		65-75
Portugal		33
Romania		93-117
Slovakia		32-54
Slovenia		50-80
Spain		40-70 & Class A
Sweden		30-75
United Kingdom		39-46
* status April 2018		
	Yes	
	Under development	

NZEB NÕUDED ELUHOONETELE

Country	Apartment building kWh/(m²/y)	Detached house kWh/(m²/y)	Energy uses included
EU-Nordic	**40…65**	**40…65**	HVAC
EU-Oceanic	**15…30**	**15…30**	HVAC
Denmark	**30 + 1000/A_{gross}**	**30 + 1000/A_{gross}**	HVAC
Estonia	**105** (120)	**145** (165) (A_{net} <120m²) **120** (140) (120≤A_{net}≤220m²) **100** (120) (A_{net} >220m²)	HVAC, appliances, lighting
Finland	**90**	**200-0.6 A_{net}** (50 <A_{net}≤150m²) **116-0.04 A_{net}** (150<A_{net}≤600m²) **92** (A_{net}>600m²)	HVAC, appliances, lighting

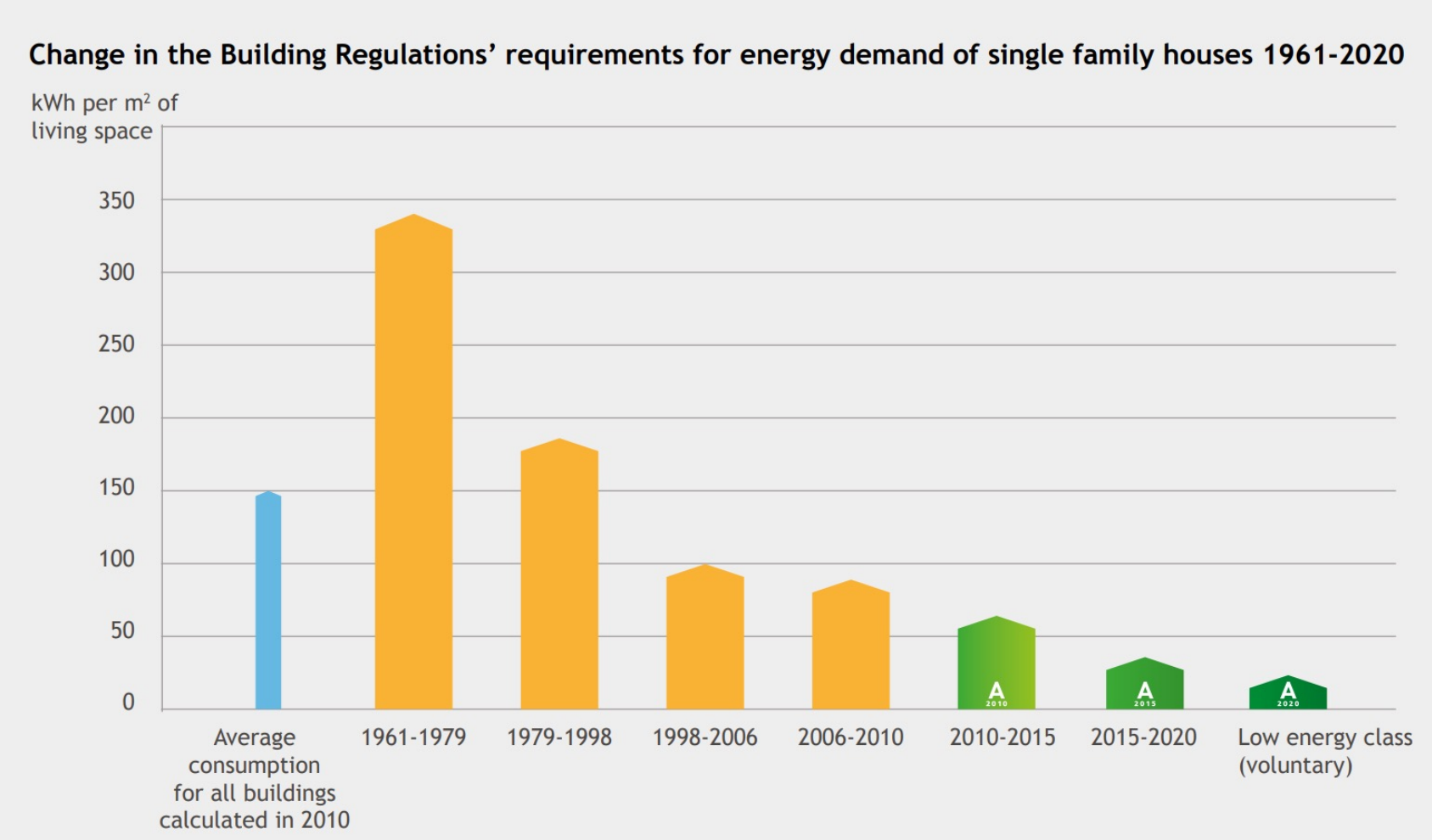
TAL TECH

NZEB NÕUDED BÜROOHOONETELE

Country/Region	PE limit kWh/(m²/y)	Energy uses included
EU-Nordic	**70** (incl. 30 RES)	HVAC, DHW, aux
EU-Oceanic	**55** (incl. 45 RES)	HVAC, DHW, aux
Denmark	**41 + 1000/A_{gross}** (incl. max 25 RES)	HVAC, DHW, lighting
Estonia	**100** (130*)	HVAC, DHW, aux, appliances, lighting
Finland	**100**	HVAC, DHW, aux, appliances, lighting

TAL TECH

TAANI ENERGIATÕHUSUSE NÕUDED



- Esimesed nõuded hoonetele (komponendi-põhised) - 1961
- Hoone kui terviku energiatõhususe rakendamine - 1995
- Esimesed nõuded hoone energia-tõhususele ja arvutusmetoodika - 2006
- Vabatahtlik NZEB *„Building Class 2020"* - 2015
- NZEB - 2020

TAANI ENERGIATÕHUSUSE NÕUDED

 New buildings	 Change of use	 Extensions	 Conversions and other alterations	 Replacements of building elements and installations	 Reparations*
Energy requirements	Energy requirements	Energy requirements	Energy requirements (cost-effective)	Energy requirements §§ 250-258	No energy requirements

	Mandatory 2010	Class 2015	Class 2020
Maximum energy demand/year (residential) HFS is the building's heated floor space in m^2	52.5 kWh/m^2 + 1650 kWh/ HFS	30 kWh/m^2 + 1000 kWh/ HFS	20 kWh/m^2
Ditto (non-residential)[1]	71.3 kWh/m^2 + 1650 kWh/ HFS	41 kWh/m^2 + 1000 kWh/ HFS	25 kWh/m^2
Max. air leakage/second (test pressure 50 Pa)	1.5 l/m^2	1.0 l/m^2	0.5 l/m^2
Max. design transmission loss[2], single-storey	5 W/m^2	4 W/m^2	3.7 W/m^2
Min. energy gain[3] through windows/glazed walls	-33 kWh/m^2year	-17 kWh/m^2year	0 kWh/m^2year

1. Includes demand for lighting.
2. Average heat loss through 1m^2 of the non-transparent parts of the building envelope at 20˚C inside temperature and -12 ˚C outside.
3. Solar heat gain minus heat loss through 1 m^2 of window (facing south-east) during a standard Danish winter.

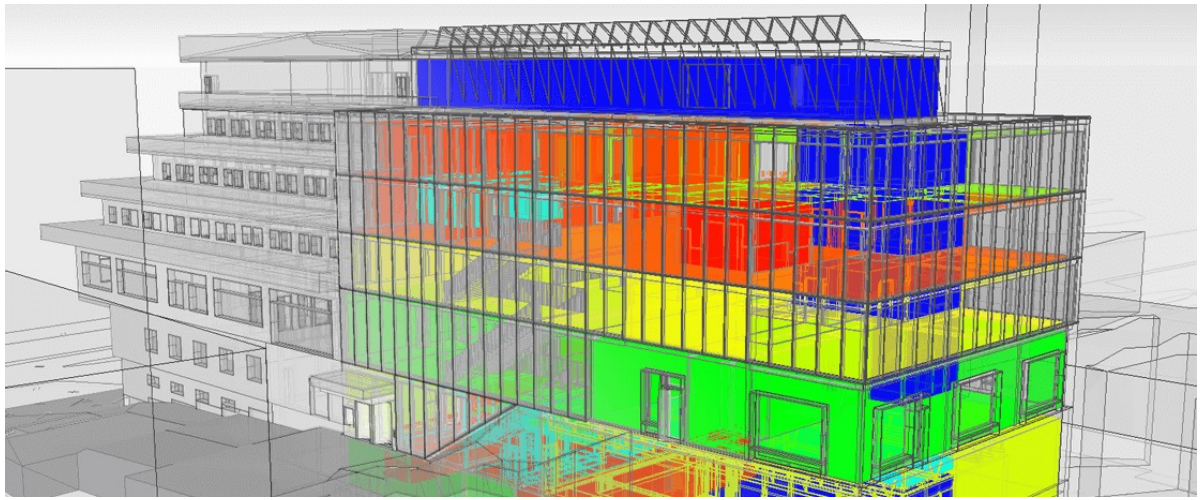
ENERGIAARVUTUS TAANIS

- Kas dünaamiline simulatsioon või arvutus

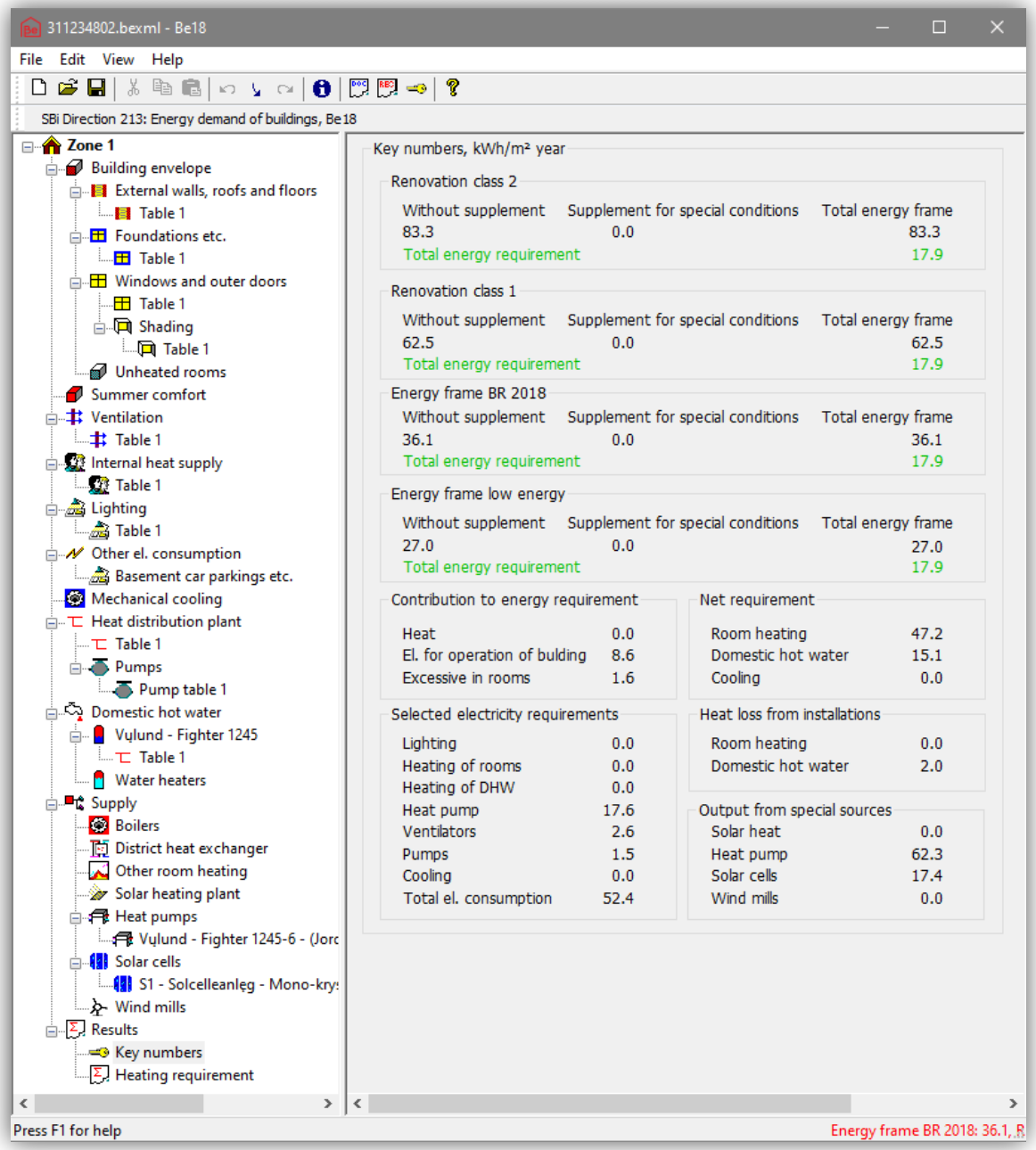
riikliku tarkvaraga

- Väga detailsed sisendid tehnosüsteemidele

nt sooja tarbevee tsirkulatsiooni ja ventilatsiooni torustike soojuskadude arvutus



TAL TECH



TAANI ENERGIATÕHUSUSE NÕUDED – RENOVEERIMINE JA KULUTÕHUSUS

$$\frac{\text{Lifetime in years x annual savings in DKK}}{\text{Extra investment}} \geq 1.33$$

Energy performance framework for existing buildings			
Dwellings, student accommodations, hotels, etc.			**Energy label**
Renovation class 1	$52.5 + \frac{1,650}{\text{heated floor area}}$	kWh/m² per year	A 2010
Renovation class 2	$110 + \frac{3,200}{\text{heated floor area}}$	kWh/m² per year	C
Offices, schools, institutions, etc			**Energy label**
Renovation class 1	$71.3 + \frac{1,650}{\text{heated floor area}}$	kWh/m² per year	A 2010
Renovation class 2	$135 + \frac{3,200}{\text{heated floor area}}$	kWh/m² per year	C

Lifetimes that can be used to calculate cost-effectiveness	**Years**
Retro-fitted insulation to building elements	40
Windows with secondary windows and coupled frames	30
Heating systems, radiators and underfloor heating and ventilation ducts and fittings including insulation	30
Heat appliances, etc., for example boilers, heat pumps, solar heating systems, ventilation units	20
Lighting fittings	15
Automation for heating and climatic control equipment	15
Joint sealing works	10

TAL TECH

OLULISEMAD NÜANSID TAANI HOONETE ENERGIATÕHUSUSE VALDKONNAS

- Energiatõhususe ekspertiis sõltumatu eksperdi poolt hoone valmimisel
- BACS süsteemi katsetused ja KVJ süsteemi toimimise kontroll hoone valmimisel
- Õhupidavuse mõõtmine kõikides uutes hoonetes
- Maksusoodustused igasugusele hoone energiatõhusust parendavale investeeringule
- Atraktiivne laenusüsteem madalate intressidega
- Hästi implementeeritud meetodid energiatõhususe meetmete rakendamiseks läbi teadlikkuse tõstmise:
  - detailsed juhised ja näited
  - kampaaniad
  - näidishooned
  - tasuta koolitused
  - heal tasemel teadus- ja arendustegevus (Danish Building Research Institute)

TAL TECH

NÕUETE VÕRDLUSE METOODIKA

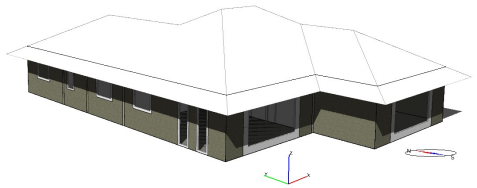
- Comparing climatic data for calculations
- Comparing national requirements by the key numbers
- Calculating building performance –national methods
- Calculating building performance - EN 16798-1:2019
- Adjusting local renewable energy (RE)

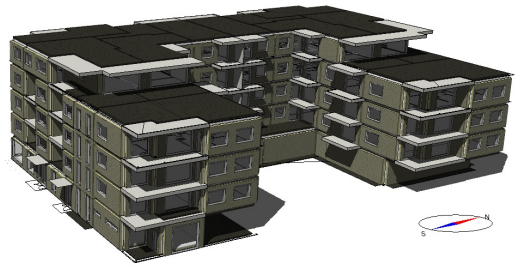
production to meet the requirements

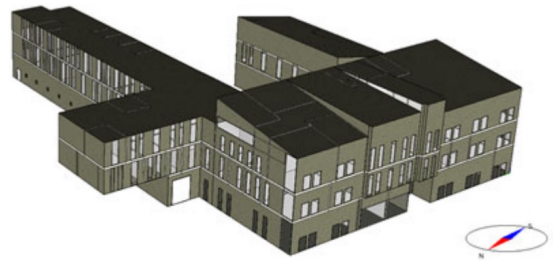




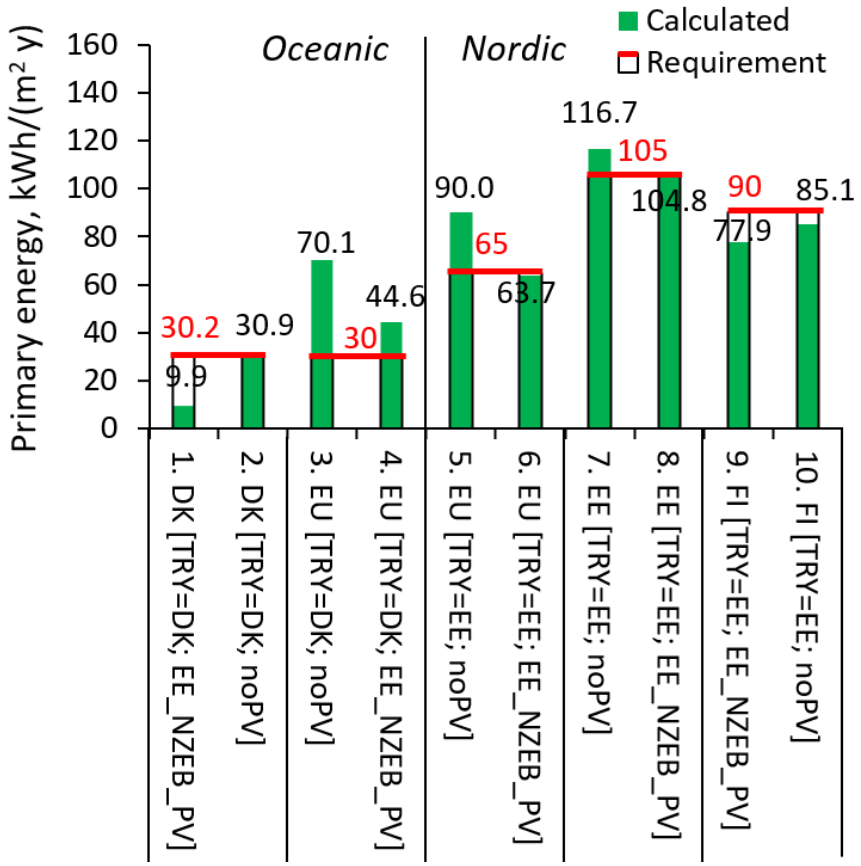




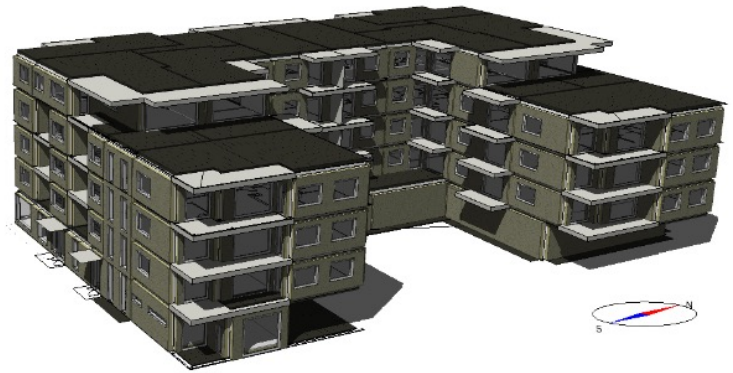




NZEB NÕUETE VÕRDLUS KORTERELAMU NÄITEL : EESTI - SOOME - TAANI

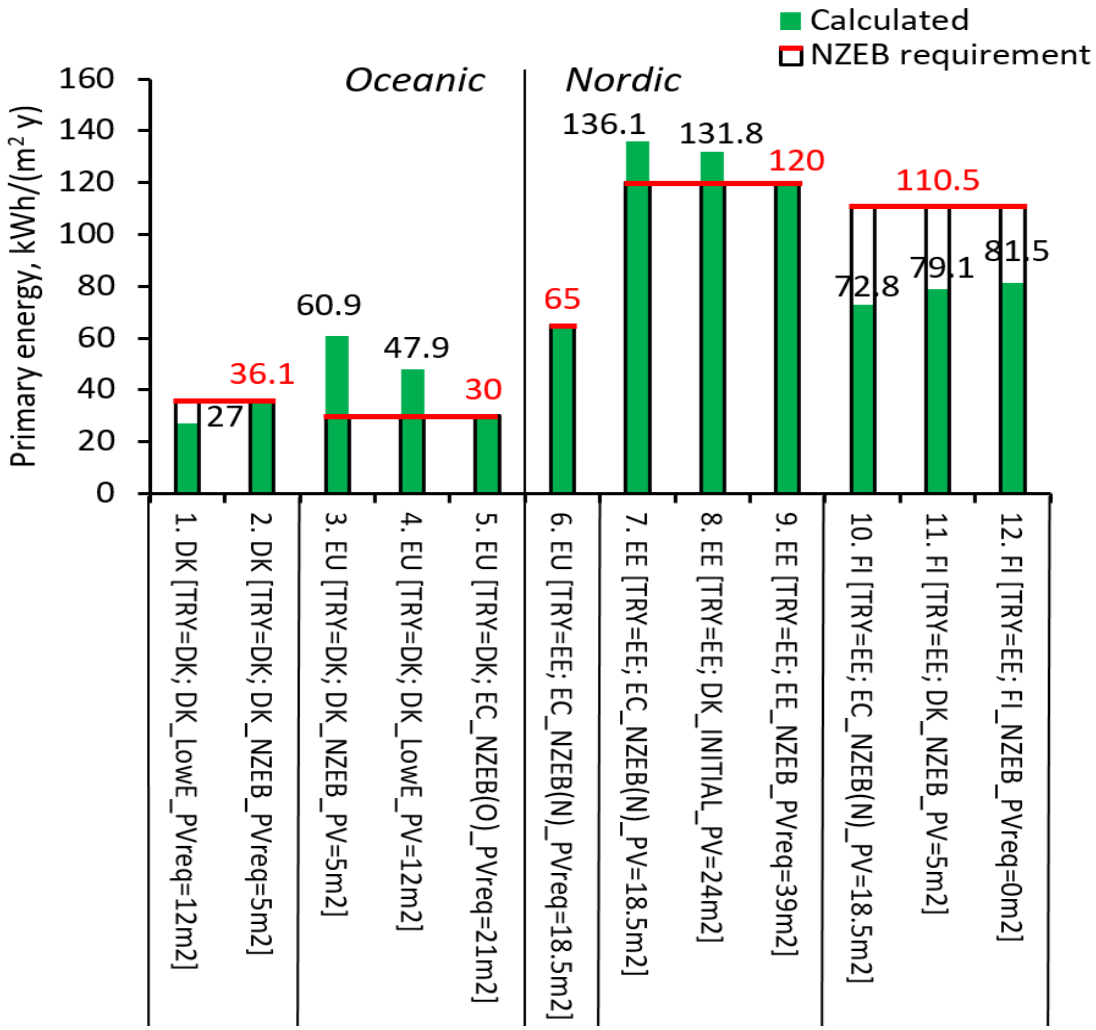




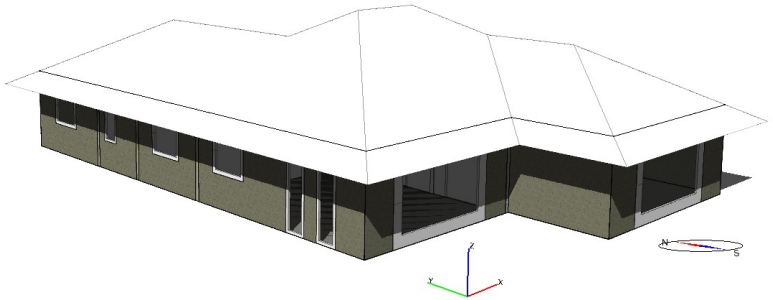


- EE NZEB apartment building EP = 104.8 corresponds to EC recommendation, 63.7 < 65
- EE NZEB in DK (=over insulated) fulfils Danish NZEB, but not Oceanic zone EC recommendation, 44.6 > 30
- Finnish NZEB requirement fulfilled without PV system
- EE NZEB requirement the most stringent (however U-value normalisation to DK climate not done)

NZEB NÕUETE VÕRDLUS ÜKSIKELAMU NÄITEL : EESTI - SOOME - TAANI



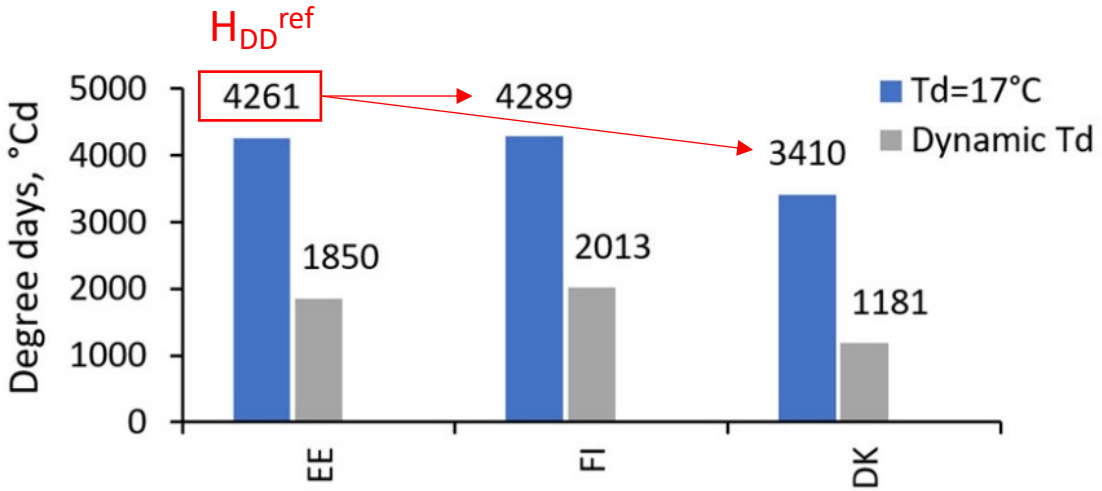




SOOJUSLÄBIVUSE KORRIGEERIMINE KRAADPÄEVADEGA

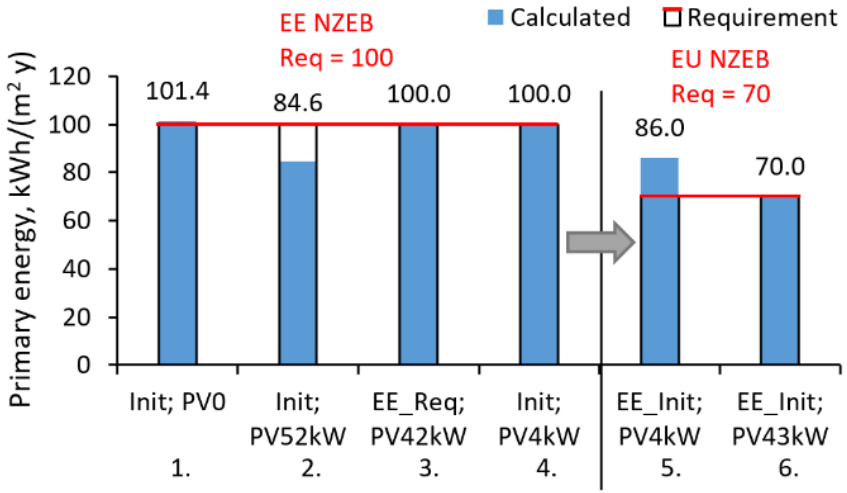
- U-value correction based on climatic differences
- Correction factors calculated from heating degree days

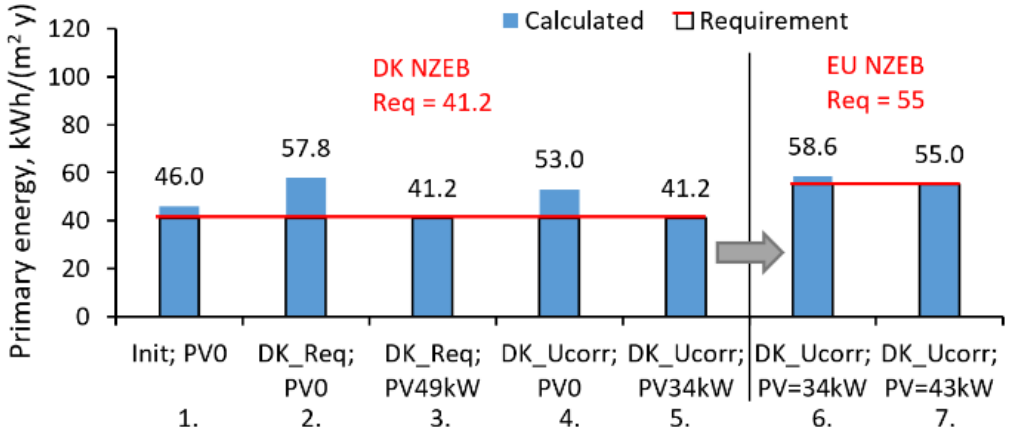
$$U_{opt}^{ref} = U_{opt}^{j}\sqrt{\frac{H_{DDj}}{H_{DD^{ref}}}}$$



Envelope element	Correction factor, -			U-value, W/(m² K)		
	EE	FI	DK	EE	FI	DK
Roof	1.000	1.017	0.914	0.10	0.098	0.109
Ext. walls				0.15	0.147	0.164
Floor				0.15	0.147	0.164
Windows				1.00	0.983	1.094

NZEB NÕUETE VÕRDLUS - KONTORIHOONE





- EP-value of an office building that exactly fulfils EE NZEB requirement needs to be reduced by 23% to reach EC recommendation
- EP-value of office building with normalized U-values that fulfils DK NZEB requirement needs to be reduced by 7% to reach EC recommendation
- DK has stringent requirement than EE

https://vbn.aau.dk/ws/portalfiles/portal/471932541/Nordic_Baltic_NZEBs.pdf



KOKKUVÕTE ENERGIATÕHUSUSE NÕUETE VÕRDLUSEST

- Uuring illustreeris kahetasemelise nõude vajadust – nõuded hoonele ja nõuded lokaalsele taasstuvenergia tootmisele
- Riiklikele nõuetele vastavalt projekteeritud hooned ei küündinud Euroopa komisjoni soovitusteni
- Nõuetele vastavus saavutatav nõudlike tehniliste lahenduste ja suure hulga PV paneelidega – oluliselt ületades rahvuslike nõudeid
- Euroopa Komisjoni soovitused Taani puhul 7% ja Eesti puhul 23% üle riikliku nõude
- Soome nõuded kõige leebemad

TAL TECH



Foto: www.mustjoekodu.ee

TAL TECH

Aitäh!