

NZEB best practices and European energy performance scale

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BUILT ENVIRONMENT FACING CLIMATE CHANGE

Scope of the presentation

- Introduce typical nZEB office building solutions in (Northern) Europe
- Ask for your contribution to Office buildings' EPC common scale Task Force

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Nearly zero-energy building examples

- Office building in Estonia
- nZEB reached with the following technologies:
 - Well-insulated and designed façade
 - On-site PV
 - Energy wells connected with a heat pump and cooling system



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Nearly zero-energy building examples

- Office building in Estonia
- nZEB reached with the following technologies:
 - Well-insulated and designed façade
 - Compact shape
 - The contractor is responsible for reaching nZEB in reality
 - On-site PV readiness, but not needed so far



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Nearly zero-energy building examples

- Office building in Sweden
- nZEB reached with the following technologies:
 - Well-insulated and designed façade
 - Ground cooling system without a heat pump or chiller
 - Low speed ventilation
- Net-zero energy building reached with:
 - Nearby wind farm



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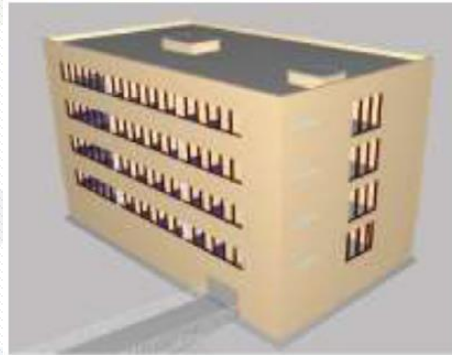
Nearly zero-energy building examples

- Office building in Sweden
- Net-zero energy building reached with:
 - Well-insulated and designed façade
 - Ground source heat pumps connected to boreholes
 - Extensive on-site PV



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Norwegian Zero Emission Building (ZEB) examples



SFH concept [28]



Multikomfort house, Snøhetta



Living Laboratory [26]



Office concept [35]



Powerhouse Kjørbo, Snøhetta



Campus Evenstad, Ola Roald Arkitekter



Heimdal high school, Rambøll

Wiik, Marianne Kjendseth, et al. "Lessons learnt from embodied GHG emission calculations in zero emission buildings (ZEBs) from the Norwegian ZEB research centre." *Energy and Buildings* 165 (2018): 25-34.

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Norwegian ZEB examples

	Type	Area, m ²	Year of construction
SFH concept	Residential	160	2013
Multi-komfort house	Residential	201.5	2014
Living Laboratory	Residential	102	2014
Office concept	Office	1980	2013
Powerhouse Kjørbo	Office	5180	2014
Campus Evenstad	School	1140	2016
Heimdal high school	School	26356	2018

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Norwegian ZEB examples – building envelope

	Type	U-value			
		Walls	Roof	Floor	Windows/doors
SFH concept	Residential	0.12	0.1	0.07	0.65
Multi-komfort house	Residential	0.11	0.1	0.08	0.75
Living Laboratory	Residential	0.11	0.1	0.1	0.65-0.97
Office concept	Office	0.12	0.09	0.11	0.75
Powerhouse Kjørbo	Office	0.13	0.08	0.12	0.8
Campus Evenstad	School	0.12	0.10-0.12	0.13	0.8
Heimdal high school	School	0.07-0.13	0.08-0.10	0.05-0.10	0.8

Wiik, Marianne Kjendseth, et al. "Lessons learnt from embodied GHG emission calculations in zero emission buildings (ZEBs) from the Norwegian ZEB research centre." *Energy and Buildings* 165 (2018): 25-34.

Norwegian ZEB examples – on-site electricity

	Type	PV peak power		CHP power	
		kW	W/m ²	kW	W/m ²
SFH concept	Residential	22.75	142	-	-
Multi-komfort house	Residential	22.75	113	-	-
Living Laboratory	Residential	12.48	122	-	-
Office concept	Office	22.75	11.5	-	-
Powerhouse Kjørbo	Office	312	60.2	-	-
Campus Evenstad	School	-	-	40	35.1
Heimdal high school	School	375.4	14.2	50	1.9

Wiik, Marianne Kjendseth, et al. "Lessons learnt from embodied GHG emission calculations in zero emission buildings (ZEBs) from the Norwegian ZEB research centre." *Energy and Buildings* 165 (2018): 25-34.

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Norwegian ZEB examples – heat source

		Solar collector area	Heat pump type	CHP power	
	Type	m ²		kW	W/m ²
SFH concept	Residential	11.5	Air-to-water	-	-
Multi-komfort house	Residential	16.8	Geothermal	-	-
Living Laboratory	Residential	4.2	Geothermal	-	-
Office concept	Office	28.7	Geothermal	-	-
Powerhouse Kjørbo	Office	-	Geothermal	-	-
Campus Evenstad	School	-	-	100	87.7
Heimdal high school	School	-	Geothermal	80	3.0

Wiik, Marianne Kjendseth, et al. "Lessons learnt from embodied GHG emission calculations in zero emission buildings (ZEBs) from the Norwegian ZEB research centre." *Energy and Buildings* 165 (2018): 25-34.

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Norwegian ZEB examples – ventilation

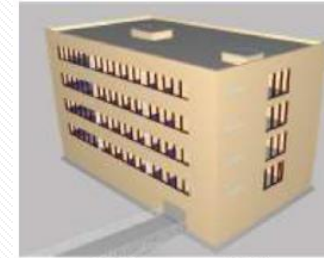
		Ventilation type	Temperature efficiency
	Type		%
SFH concept	Residential	Mechanical mixing	85
Multi-komfort house	Residential	Mechanical mixing	87
Living Laboratory	Residential	Hybrid mixing	85
Office concept	Office	Mechanical mixing	86
Powerhouse Kjørbo	Office	Mechanical displacement	70-75
Campus Evenstad	School	Hybrid mixing	85
Heimdal high school	School	Mechanical mixing and displacement	93

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Typical solutions used in nZEB examples

- Well-insulated building envelope
- On-site (or nearby) electricity production
- Heat pumps or other “green” heat sources
- Mechanical heat recovery ventilation
- Efficient electrical lighting (although not shown in examples)



SFH concept [28]



Multikomfort house, Snøhetta



Living Laboratory [26]



Office concept [35]



Powerhouse Kjørbo, Snøhetta



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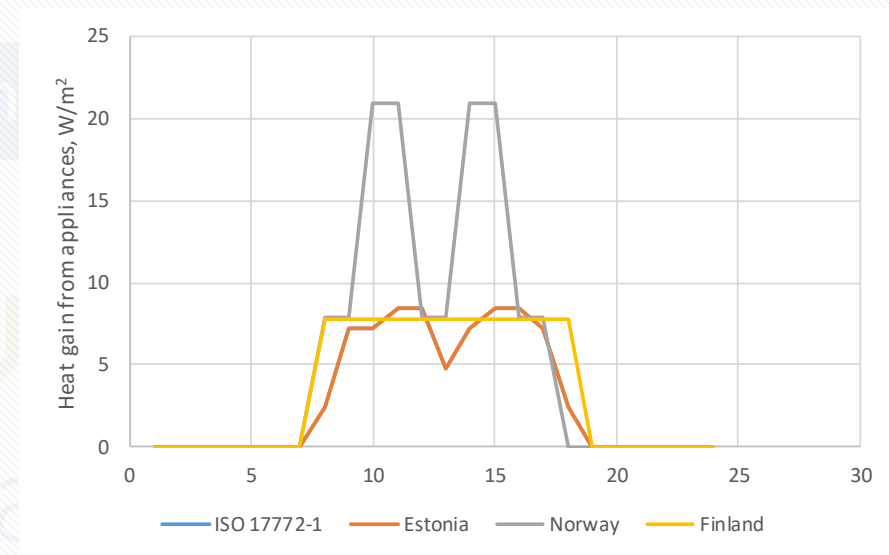
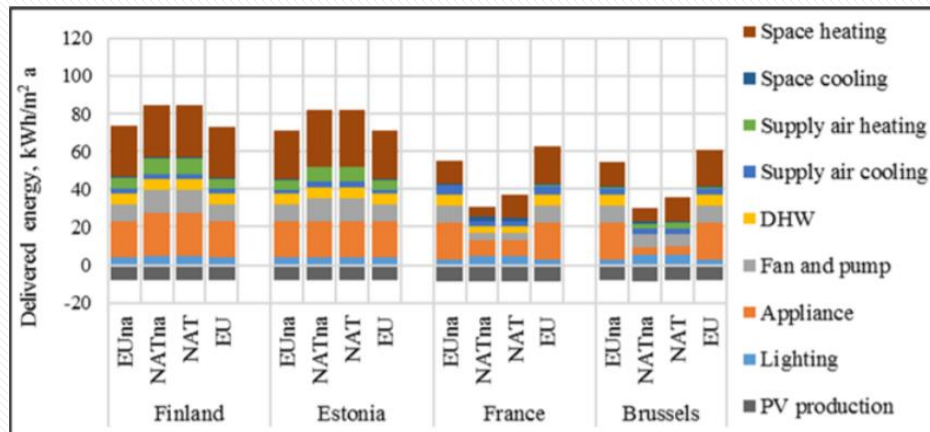
Heimdal high school, Rambøll



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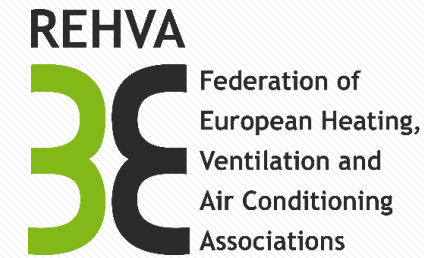
Office buildings' EPC common scale TF

- Objectives:
 - To illustrate office buildings' energy use in different climates and energy performance levels
 - Develop an energy performance scale
 - Investigate the strictness of nZEB requirements in selected European countries.
- Welcome information:
 - Detailed measured data from new office buildings
 - Data from local methodologies (ask for template)
 - Cost-effective office building solutions' description





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Thank You! Questions?

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