

19

### Zero Emissions Buildings and Neighborhoods

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Longyearbyen, 13.06.2017

# Energy efficiency first



#### • Part I SINTEF & NTNU

• Part II

Longyearbyen



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• Part II

Longyearbyen





### 2 FME centres

- FME = Forskningssenter for Miljøvennligenergi
- ZEB (2009 2016)
- ZEN (2017 2024)



The Research Centre on Zero Emission Buildings



THE RESEARCH CENTRE ON Zero Emission Neighbourhoods in Smart Cities

### ZEB activities

- Advanced materials
- Climate adapted building envelopes
- Energy systems
- Users and implementation
- Concepts, strategy and pilot buildings
- Laboratories



VIP Leca Isoblokk



ZEB Living Lab





Membrane heat exchanger



#### ZEB Pilot buildings



### ZEB example: Kjørbo

- Office building totally renovated
- Focus on choice of material
- Well insulated envelope and air tightness
- Simplified ventilation and heating system
- Solar panels on the roof



### The path of energy efficiency



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### ZEN activities

### WORK PACKAGES

WP1: Analytical Framework for Design and Planning of ZEN

WP2 Policy measures, innovation and business models





### **Pilot Projects/Living Labs**

Oslo: Furuset

Bergen: Zero Village Bergen

Elverum: Ydalir

Trondheim: Knowledge Axis

**Bodø:** Airport area

Steinkjer: Residental area

**Evenstad**: Campus

Population of 30 000 people Built floor area of more than 1 million m<sup>2</sup> ZEB Flexible Lab office building ZEB Living Lab residential building

10 Fremtidens Energiforsyning Longyearbyen - Workshop



# Part I SINTEF & NTNU

• Part II Longyearbyen







### Longyearbyen

#### Population:

- from 1000 in 1990s
- to 2000 today





### Longyearbyen

#### Buildings, residential:

- 450 buildings
- 1000 dwellings
- @ average 80 m<sup>2</sup>/dwe
- Total = 80,000 m<sup>2</sup>





### Longyearbyen

#### Buildings, non-residential:

- 650 buildings
  - 200 cabins
  - 150 garages
  - 150 industry

#### commercial

- 150 rest
- @ 600 m<sup>2</sup>/building
- Total = 180,000 m<sup>2</sup>

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### Energy use in Longyearbyen's buildings

Туре	Area [m²]	Thermal [GWh/y]	Electricity [GWh/y]	Thermal [kWh/m²y]	Electricity [kWh/m²y]	Total specific [kWh/m <sup>2</sup> y]
Dwellings	80,000	50	10			
Commercial	180,000	15	30			
Total	260,000	65	40			



### Energy use in Longyearbyen's buildings

Туре	Area [m²]	Thermal [GWh/y]	Electricity [GWh/y]	Thermal [kWh/m²y]	Electricity [kWh/m²y]	Total specific [kWh/m <sup>2</sup> y]
Dwellings	80,000	50	10	625	125	750
Commercial	180,000	15	30	83	167	250
Total	260,000	65	40			



### Energy efficiency potential

#### **Energy intensity**

	Oslo	Longyearbyen	
HDD Heating Degree Days	4,000	7,000	
Space heating TEK10 (Passive house) [kWh/m2y]	50 (15)	100 (30)	
Domestic Hot Water [kWh/m2y]	25	50	
Total thermal energy [kWh/m2y]	75	150	

Factor 4 reduction!

#### + improved comfort

#### **Building activity**

- Dwelling stock
  - > 30% built after 2000
  - > 50% dwellings built 1970 1990
- Average lifetime
   Norway: 125 years
   Svalbard ??: 50 years ?
   (extreme weather, permafrost)
- Renovation or demolition + build new?





# Longyearbyen in 20 years ?

+ 50 % population
+ 50 % building stock
- 50 % heating demand

No expansion of district heating needed + supply new buildings on return pipe with lower temperature

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### Does it cost more?

- TEK 10 is the required standard for all new constructions also in Longyearbyen
  - ightarrow no aditional cost
- Passive house additional cost ca. 1,000 kr/m<sup>2</sup> (varies for new / renovated and residential / commercial)
- New + renovated (or re-built) area: 100,000 m<sup>2</sup>
- Additional cost with Passive house
  - ightarrow ca. 100 mill NOK ( 0.1 billion NOK )

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# Energy efficiency first



Tank you for your attention!

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Teknologi for et bedre samfunn