LowEx

- High efficient thermal energy supply in zero energy buildings

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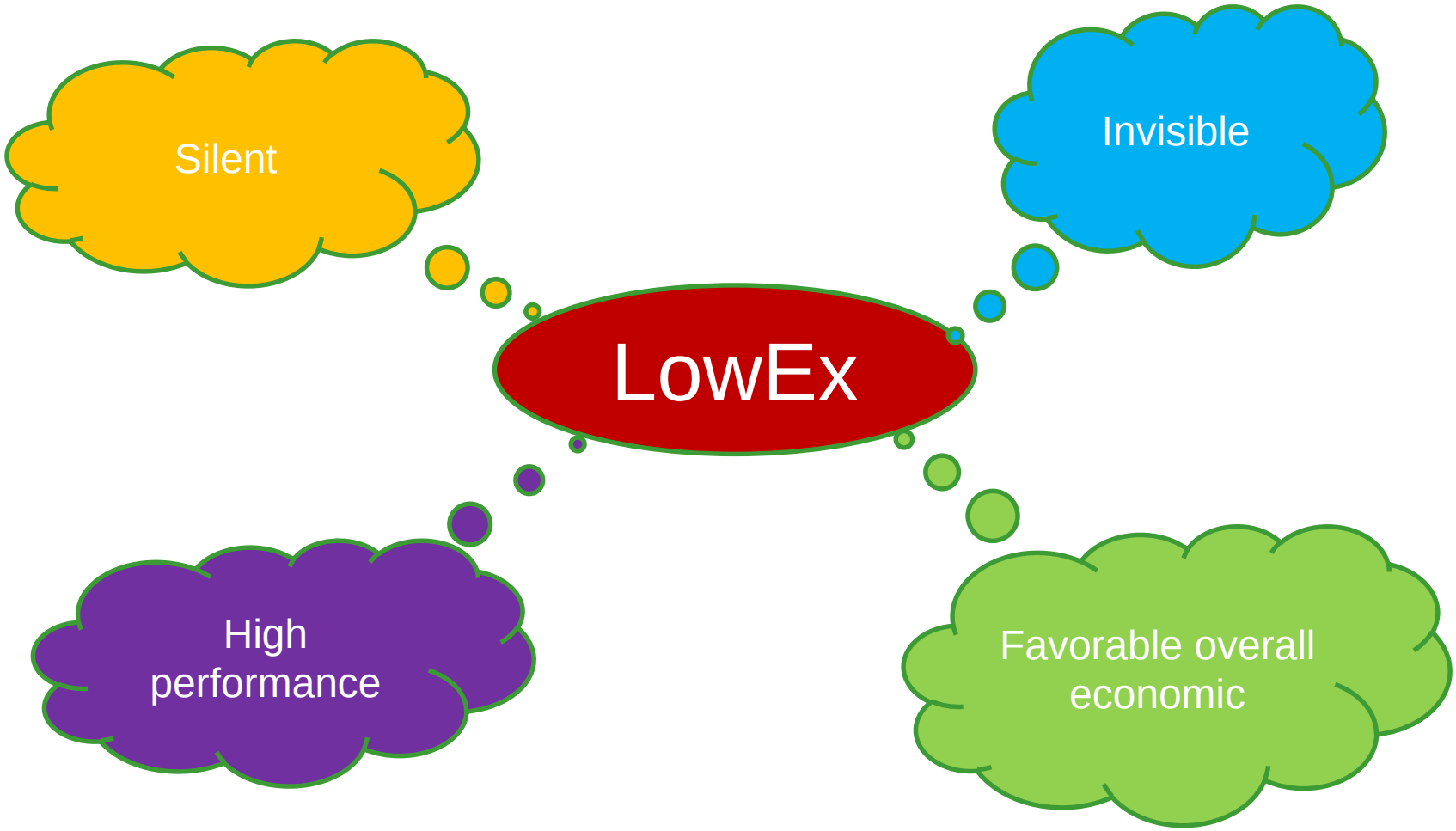
Ideally: «No installations»

But generally too great compromises regarding robustness, indoor air quality and flexibility

Wishes for the project



Idea

- The idea of the project is to develop a new total-concept for thermal energy supply in zero-energy-buildings and plus-houses, ***with a performance factor to be 2-2,5 times better than state-of-the-art of today.***

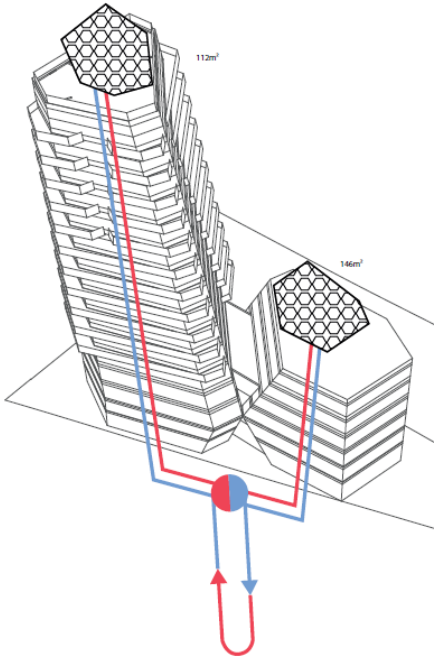
- The demand for sustainable and energy-efficient buildings with innovative and smart solutions is growing rapidly.
- Buildings in operation produces as much or more energy than they use, these buildings will be a key contribution to reduce energy use worldwide – and by this also to reduce greenhouse gas emissions.

Ambition

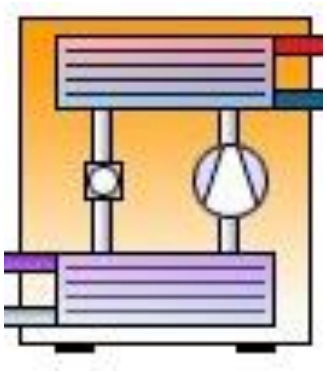
- To reach:
  - “Seasonal Coefficient of Performance” (SCOP) of 8-10
  - “Seasonal Energy Efficiency Ratio” (SEER) of 80-100
  - 80 % reduction in power demand for heating and cooling
    - Compared to buildings build regarding current building codes
  - Low total costs

The project idea

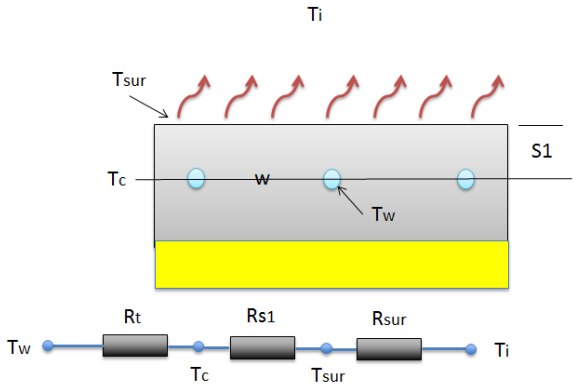
- To optimize – and combine



Energy well



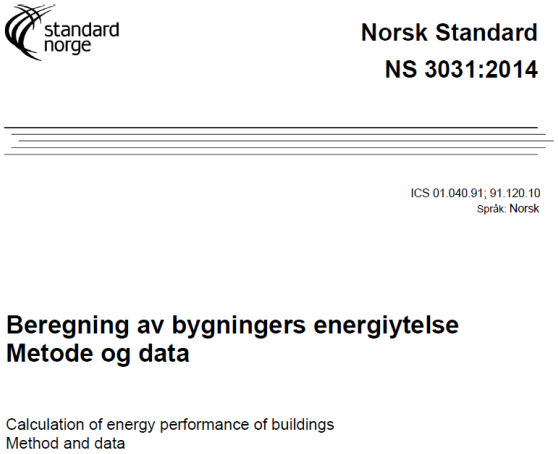
Heat pump



Heat delivery system

Conventional and State-of-the-Art solutions (in Norway)

- NS3031:2014
  - Water based system with geothermal heat pump: COP = 2,6
  - Cooling unit with water based cooling: COP = 2,5-2,7
- Powerhouse Kjørbo
  - Geothermal heat pump: COP = 4,2
  - Free cooling via energy wells: COP ≈ 20-30



standard norge

Norsk Standard
NS 3031:2014

ICS 01.040.91; 91.120.10
Språk: Norsk

Beregning av bygningers energiytelse
Metode og data

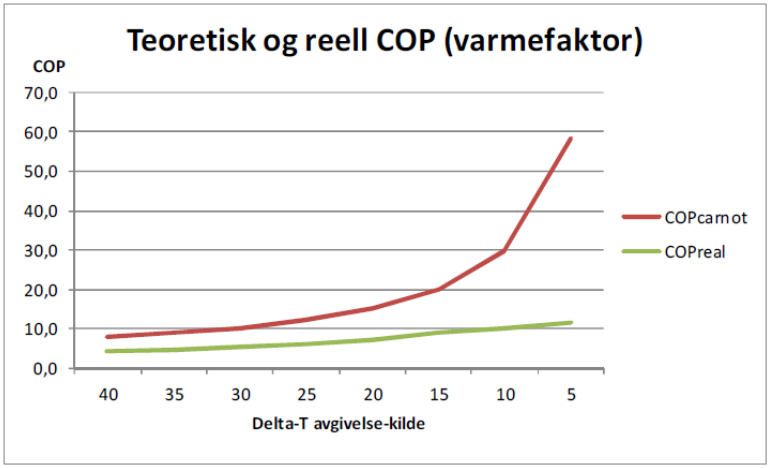
Calculation of energy performance of buildings
Method and data

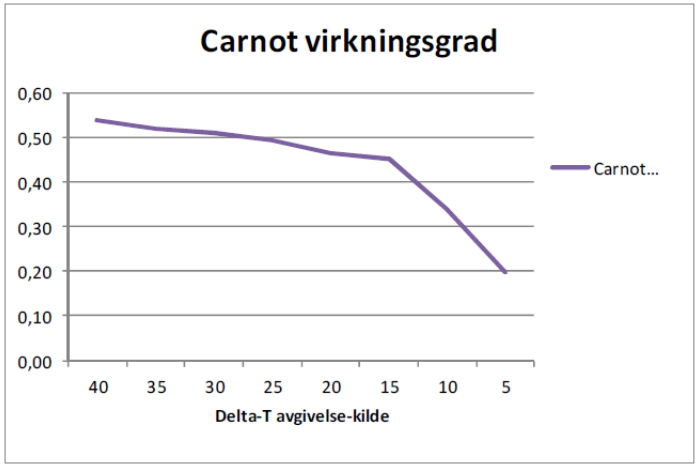
International: EU-project GEOTABS

		A (2010)	B (2009)	C (2011)	D (2011)	E (2010-11)
$SCOP_1$	[-]	5,15	3,94	3,76	3,56	ND
$SCOP_2$	[-]	4,71	ND		1,96	ND
$SCOP_3$	[-]	-	ND		1,59	ND
$SCOP_4$	[-]	4,38	ND		1,23	ND
$SEER_1$	[-]	-	7,54	10,74	-	ND
$SEER_2$	[-]	49,70	ND		3,72	ND
$SEER_3$	[-]	20,95	ND		2,89	ND
$SEER_4$	[-]	-	ND		2,08	ND

Theoretical background for LowEx

- Carnot COP
  - Ideal compression cycle without losses in the system
  - In practice, lot of parameters have a negative influence on the efficiency
- Real COP
  - Product of the Carnot COP and the system efficiency (η_{ex})





$$COP_{CARNOT} = \frac{T_{cond}}{T_{cond} - T_{evap}}$$

$$\eta_{ex} = \frac{COP}{COP_{CARNOT}}$$

Estimated SCOP

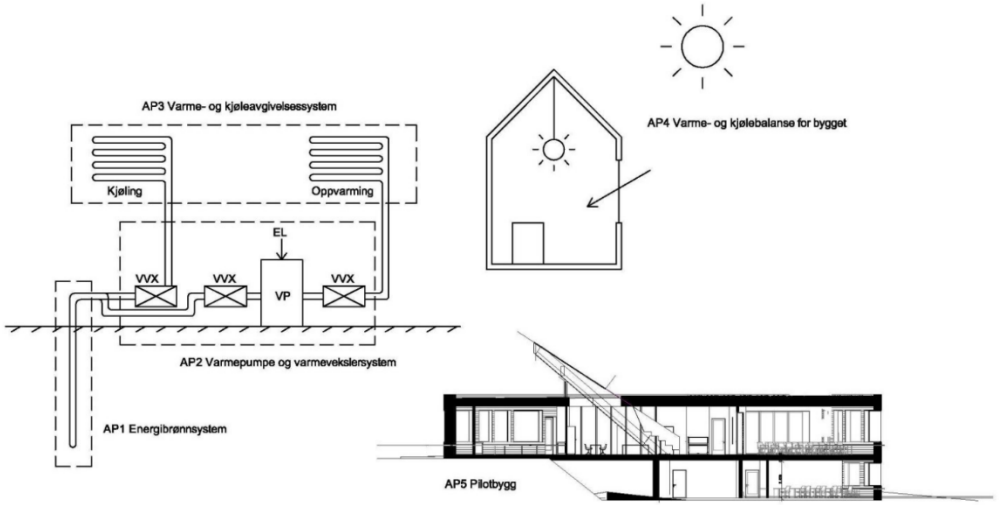
Estimated real COP for a heat pump calculated in the heating season

Outside temperature	-20 °C	-15 °C	-10 °C	-5 °C	0 °C	5 °C	10 °C
Desired flow temperature	29,3 °C	27,8 °C	26,4 °C	25,0 °C	23,5 °C	22,0 °C	20,4 °C
Estimated brine temperature	0,0 °C	1,0 °C	2,0 °C	4,0 °C	6,0 °C	7,0 °C	8,0 °C
Theoretical COP, COP_{carnot}	10,3	11,2	12,3	14,2	16,9	19,7	23,6
Calculated «real» COP	5,2	5,7	6,2	7,2	8,5	9,9	11,9

- What if it is possible with an average brine temperature of 8 °C and 24 °C flow temperature in the heating season?
  - COP_{carnot} = 18,6
  - With η_{ex} of 0,5 => COP = 9,3

Work packages

- WP1: Energy well system
- WP2: Heat pump and heat exchanger system
- WP3: Heating and cooling delivery system
- WP4: Heating and cooling balance for the building
- WP5: Pilot buildings



Partners

- Skanska Norway – KEB
- Omsorgsbygg KF
- Avantor
- Lund University (Chalmers)
- ABK
- NIBE