Lia Kindergarten – A plus energy building: First year experience with regard to energy use

Tor Helge Dokka[1], Maria Myrup[1], Morten Solsem[2]

1 Skanska Technology , 2 ABK AS

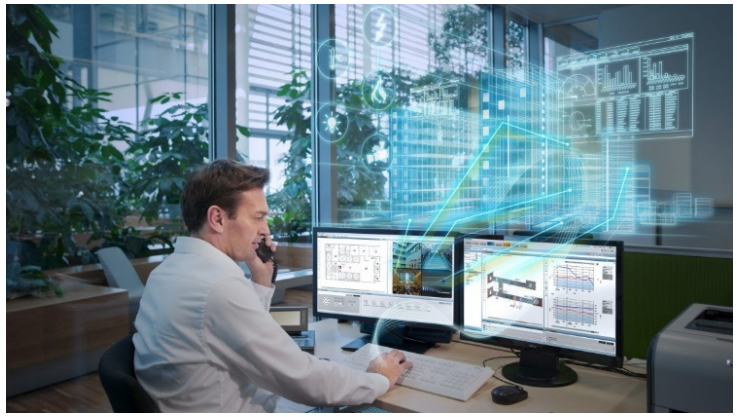
Design intent

- Building owner: Omsorgsbygg
- Ten department kindergarden with a heated floor area of 1580 sqm
- Situated Ellingsrud, Oslo.
- A highly insulated building envelope
- High performance demand controlled ventilation system
- Lighting is provided by a modern LED-lighting system with presence- and daylight control system
- “Lowex-system” with low temperature heating and high temperature cooling is done with an embedded floor system.
- Geothermal wells together with a heat pump provide heating and DHW.
- Free cooling via the geothermal wells
- A flat roof PV-system with modules facing East and West with an angle of 10^{o}
- Designed to reach the plus energy ambition.

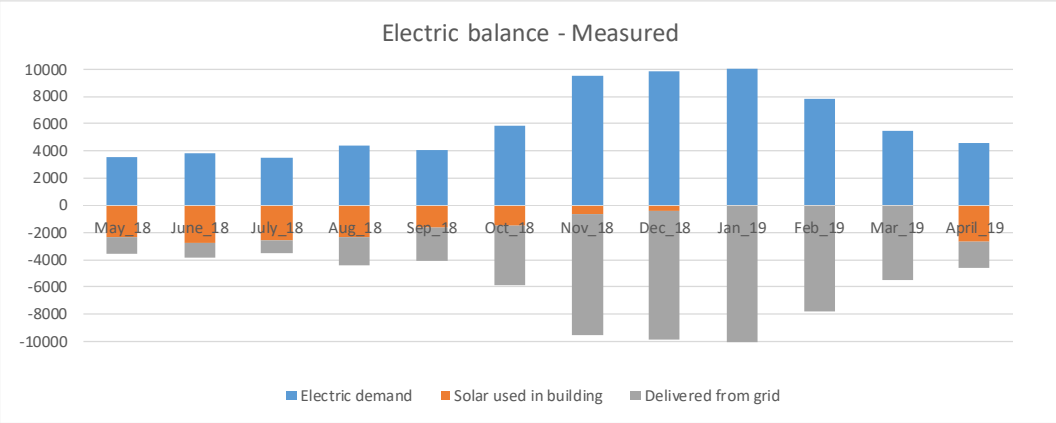
Component	Value
U-value external wall	0.17 W/m^{2}K
U-value roof	0.19 W/m^{2}K
U-value external wall	0.10 W/m^{2}K
U-value windows and doors	0.79 W/m^{2}K
Air leakage number	0.50 ach
Specific fan power	0.70 kW/(m^3/s)
Annual energy use lighting*	6.1 kWh/m^2
Annual energy use plug loads	5.2 kWh/m^2
SCOP heat pump DHW	3,0
SCOP heat pump heating	5,7
SEER free cooling system	60
Geothermal wells	3 wells a’ 280 m
Peak power PV-system	47,2 kWp

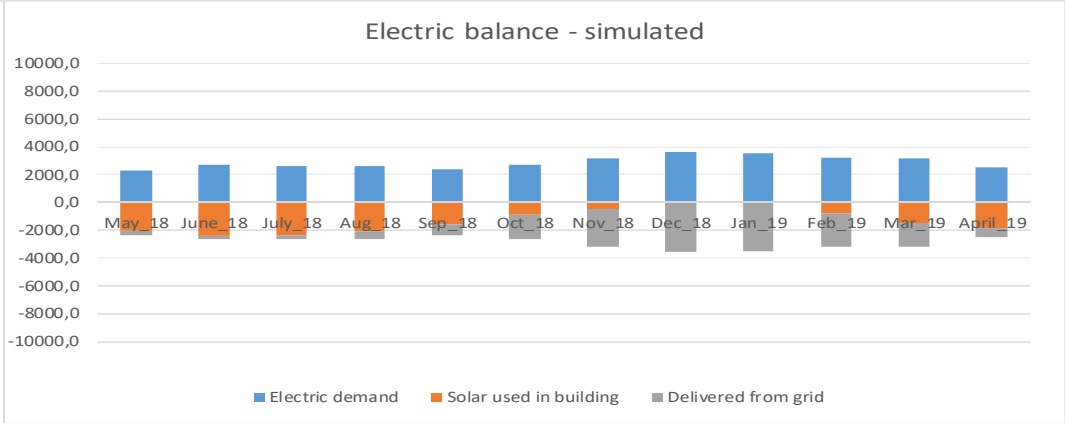
Methods and data gathering

- **Design:**
  - SIMIEN 6.0 simulation of energy performance
  - Excel-based simulation models used for the embedded floor system based on ISO 11855
  - Pvsol simulation of the PV-system
- **Monitoring:**
  - Siemens Desigo CC
  - Entro Optima
  - Sungrove Inverter
  - Nibe Uplink



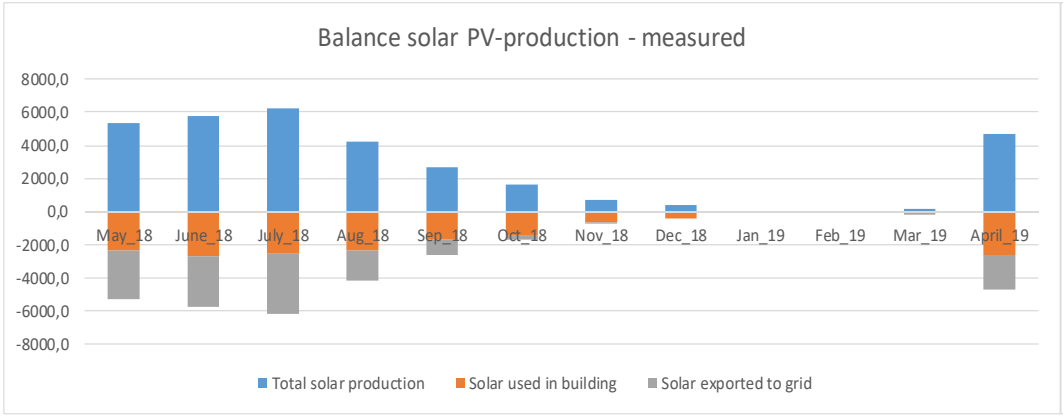
Simulated vs. measured electric balance

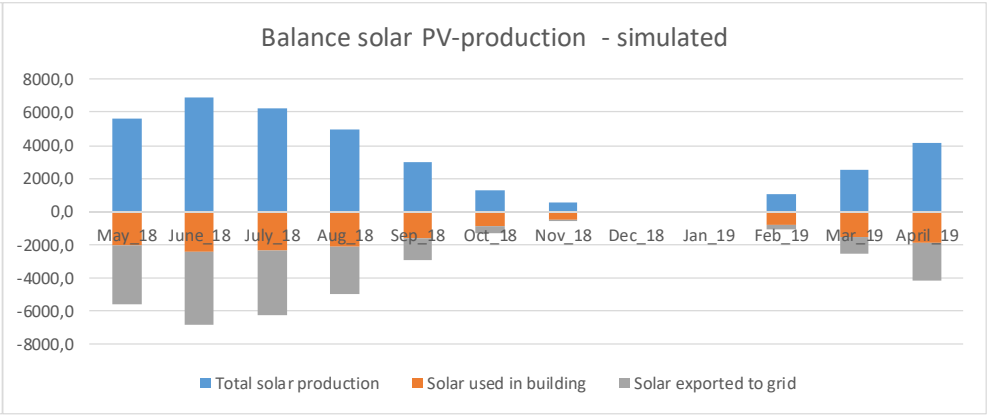




The building is an «all-electric-building».

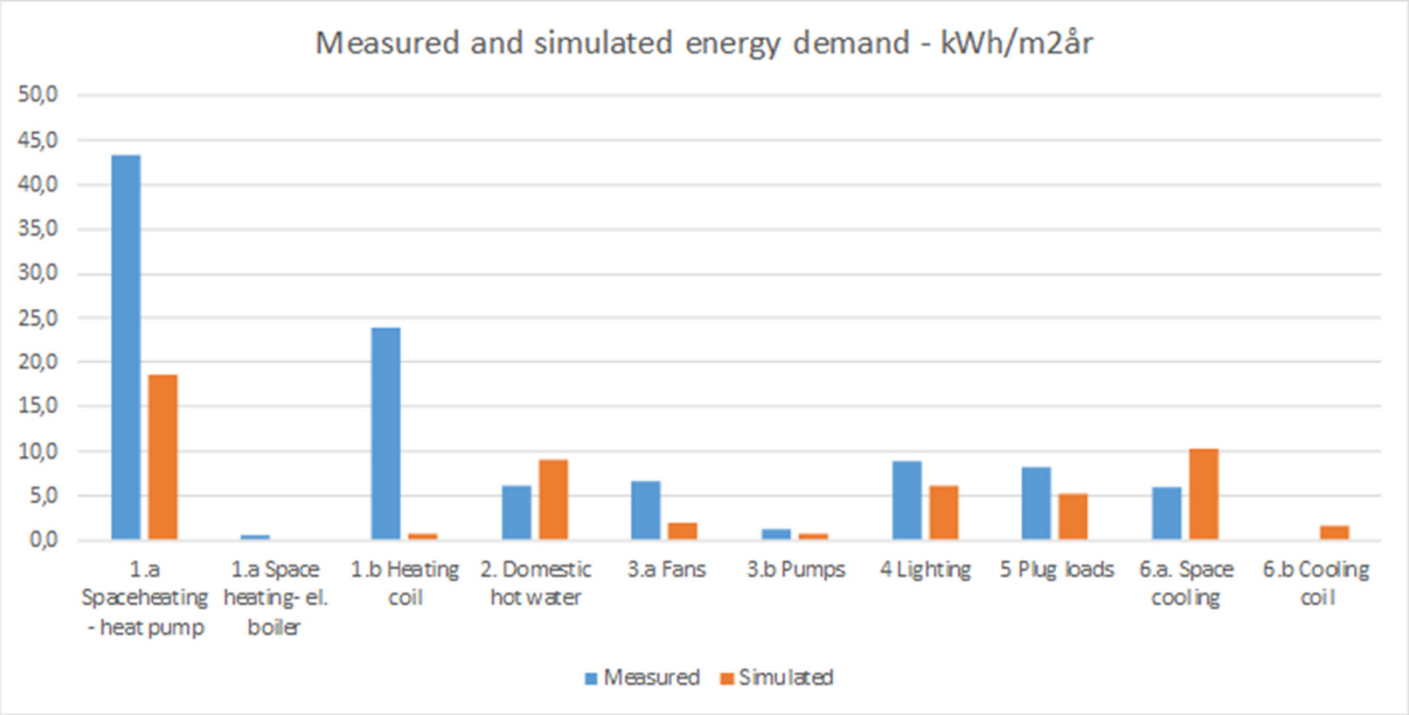
Simulated vs. measured solar production-balance





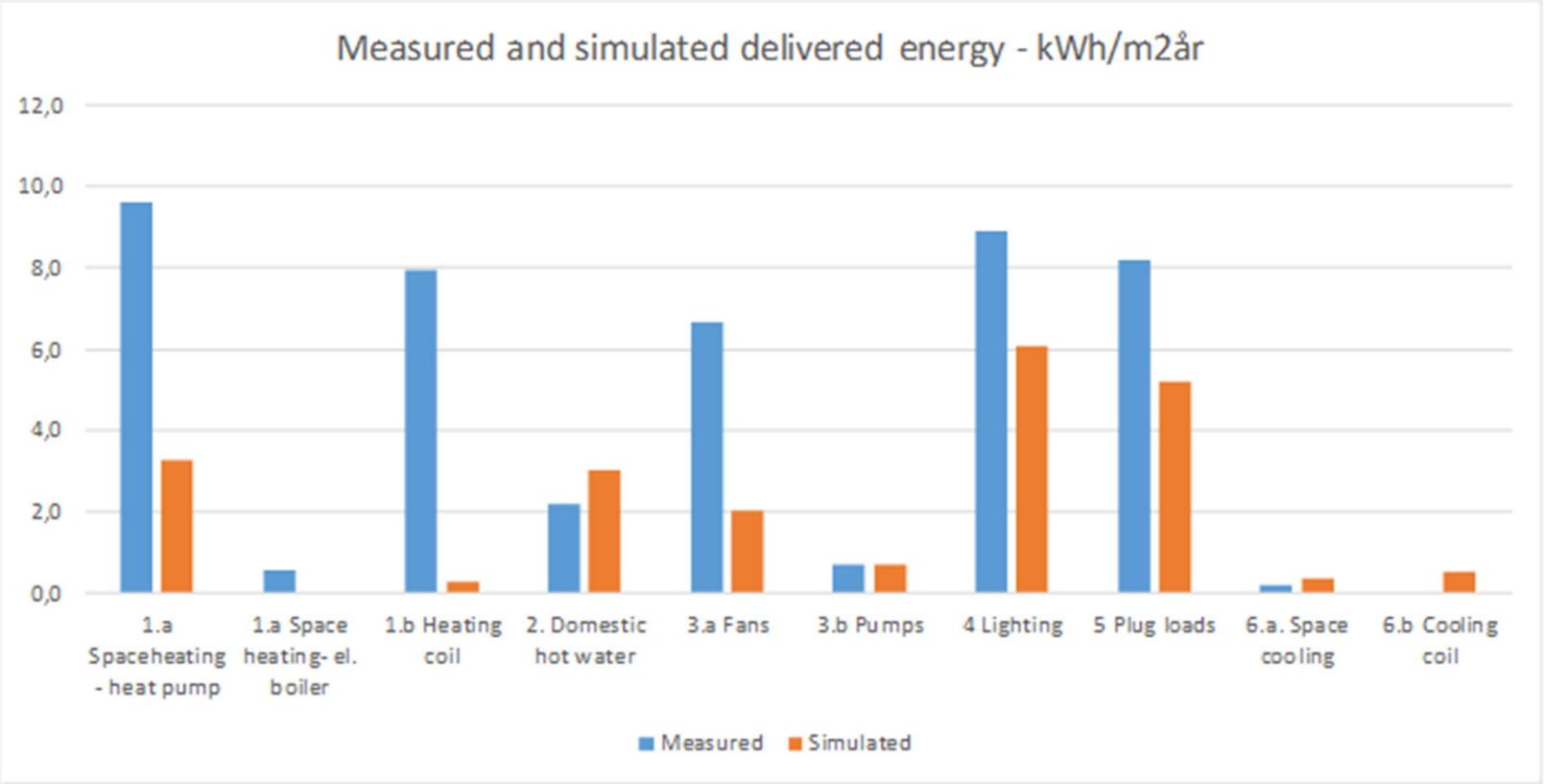
Quite good compliance between simulation an the measured solar PV-production, but the winter was harsh and the PV was snow covered into April.

Simulated vs. measured net energy demand



The high net energy use for space heating, ventilation heating and fans is mainly due to a fault after a fire rehearsel, so the ventilation system was running 24/7 a large part of the heating season. Also the integrated heat pump in the AHU is not working according to the intention.

Simulated vs. measured delivered energy



Conclusion

- By far the most energy efficient kindergarden Omsorgsbygg have
- Still the energy use is higher than simulated performance
- Main reasons:
  - The ventilation system was running 24/7 a large part of the heating season
  - The internal heat pump in the AHU in not working according to intent
  - The control system of the lighting system outside occupied hours is not working properly
  - The snow cover on the PV was much longer this year than anticipated in the simulations.
- The users is satisfied with the indoor climate, especially during summer condition where the «lowex» floor system works very good.

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