Passivhus Norden 2013

POWERHOUSE KJØRBO, a plus-energy renovation office building project in Norway

Authors: Marit K. Thyholt, Tor Helge Dokka, Bjørn Jenssen. Skanska Teknikk

The Powerhouse Alliance, established in 2010

HYDRO

entra

SKANSKA

SNØHETTA

ZERO

New partner from 2013:

asplan viak

The aim was to demonstrate that it is possible to build energy-positive buildings in cold climates

SKANSKA

Main definition of «Powerhouse»

Powerhouse is a building that *during its lifecycle produces more renewable energy than it consumes for production of building materials, construction, operation and demolition of the building*.

The building shall be built within commercial conditions.

SKANSKA

Additional criteria

- The energy quality of produced on-site energy shall not be lower than for imported energy
  - All electricity use for operation must be balanced by electricity production
- Minimum standard: Passive house standard according to NS 3701
- The energy production must be based on energy sources on site or nearby with access from the site
- Energy use for electrical appliances shall not be included in the balance account

Powerhouse Kjørbo

- Sandvika in Bærum, at 60 degrees north latitude
- Annual mean outdoor temperature of 5,9 °C, annual mean horizontal irradiation of 110 W/m² (955 kWh/m²a)
-

SKANSKA

Powerhouse Kjørbo

- Renovation of two office buildings at Kjørbo in Sandvika
- Building owner: Entra Eiendom
- Contractor (and responsible of the environmental and energy concept): Skanska Norway
- Architect: Snøhetta
- Heated floor area: ca. 5200 m2
- Start construction March 2013, completion February 2014
- Renter: Asplan Viak
- BREEAM-NOR Outstanding
- Due to architectural restrictions (9 similar blocks), there are limitations regarding energy solutions

Photo: Skanska. Illustrasjon: Snøhetta/MIR

SKANSKA

The energy concept - main measures (1)

- Holistic approach: integrating technical systems and architecture
- Very good insulated building envelope, according to NS 3701 (passive house standard)
- Ventilation solutions, minimizing the need for ducts and valves:
  - high-efficient heat recovery,
  - extremely low pressure drop,
  - building integrated air shafts (stairwells and existing shafts)
  - high ventilation efficiency (displacement ventilation),
  - demand control
  - building integrated system

Good thermal insulation and air tightness. Photo: Skanska

Exhaust air via open stairwells. Photo: Skanska

SKANSKA

The energy concept - main measures (1)

- 10 energy wells (200 meter) will be utilized for free cooling during the summer, and for production of heat during winter
- Heat from the server-room will be utilized for heating when needed
- Two heat pumps connected to energy wells and server-room: one for room heating and one for tap water heating
- Efficient exterior solar shading and exposed thermal mass in ceilings for reduction of cooling
- PV on roof will balance all energy use, incl. materials and construction phase
- Extensive measuring of energy use and production is planned

Exposed thermal mass in tceiling. Photo: Skanska

PV on roof (block 4). Photo: Skanska

SKANSKA

Energy demand (operation)

Embodied energy and electricity production not included

	Net specific demand kWh/m²/y	Specific demand for delivered energy kWh/m²/y
Space heating	15,5	4,9
Ventilation heating	3,1	1,0
Tap water heating	4,3	1,4
Fans and pumps	3,9	3,9
Lighting	7,7	7,7
Equipment	12,0	12,0
Equipment – data room (server inst.)	16,9	16,9
Space cooling	0,0	0,0
Cooling data room	16,9	1,1
Ventilation cooling	3,4	0,2
Total	83,7	49,0
Total excluding data server installation	67,0	32,0
Total excluding equipment	54,8	20,1

SKANSKA

Primary energy factors for electricity

- Based on the assumption that Norway will be fully integrated in the European power grid
- Based on simulations for an ultra-green scenaro, i.e. EUs goal for reduction of GHG-emissions from the electricity production towards 2050 (85 – 95 %)

- * I. Graabak, N. Feilberg, “CO2 emissions in different scenarios of electricity generation in Europe.” TR A7058, SINTEF Energy Research, January 2011. *Preliminary report.*

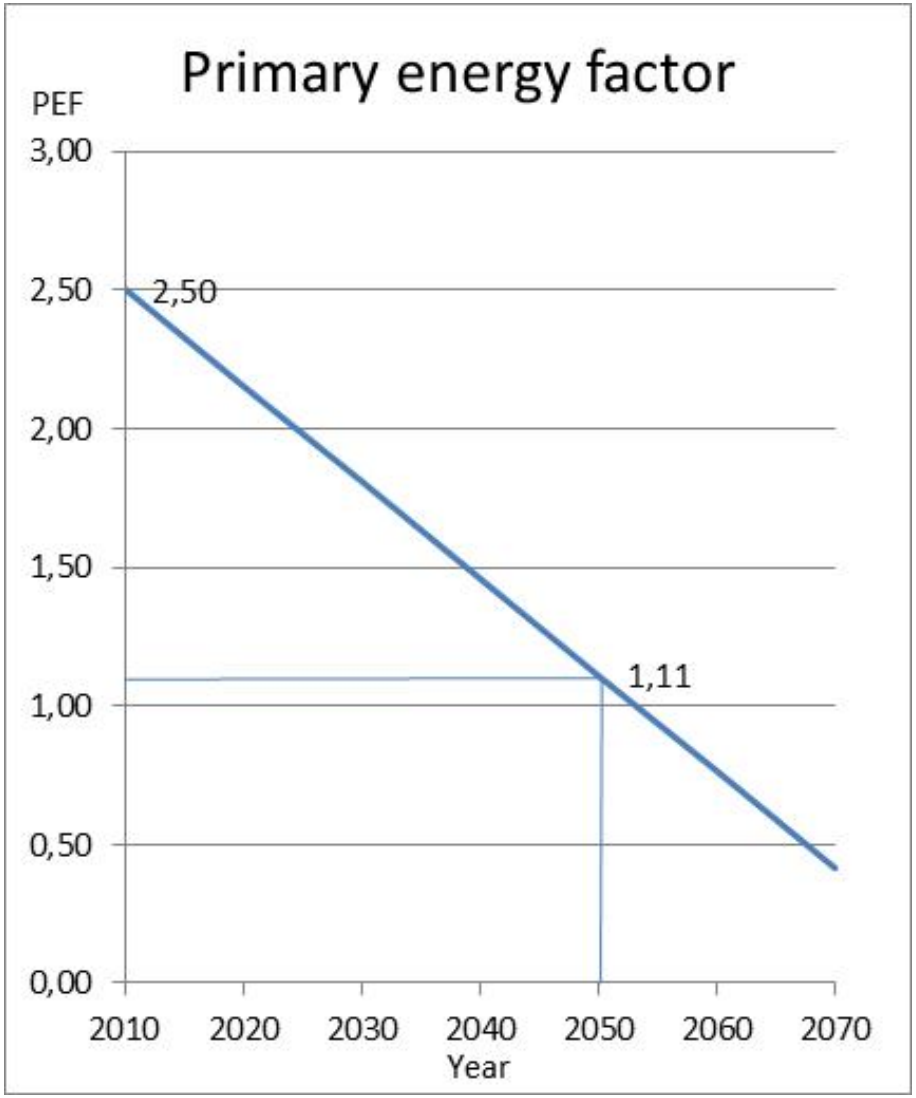
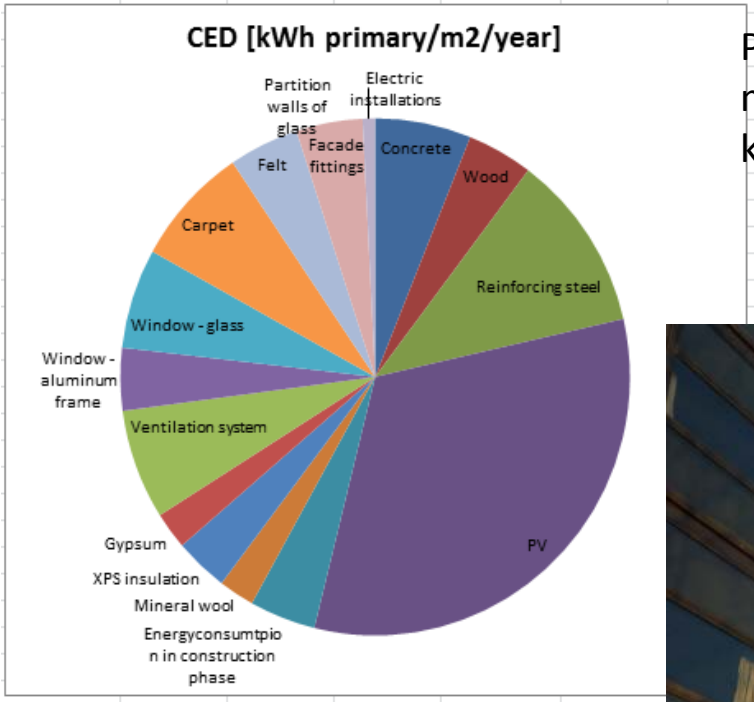


Figure: Skanska

SKANSKA

Materials: primary energy demand (CED)



Primary energy (new materials): 23,7 kWh/m2 per år

New cladding of burned wood/aspen (giving black surface), Photo: Skanska

Reuse of glass sheets from the facades to interior partition walls. Photos: Skanska

Keeping the existing structure reduces the environmental loads. Photo: Skanska

SKANSKA

The energy balance

Energy demand/production	Delivered/ produced energy (kWh/m²year)	Primary energy factor	Primary energy (kWh/m²year)
PV-production, first 30 years	37,7	1,98	74,7
PV-production, last 30 years	54,7	0,93	50,9
PV-production, average 60 years			**62,8**
Operational energy use	-20,1	1,46	**-29,2**
Embodied energy			**-23,7**
Energy consumption in the construction phase			**-1,4**
SUM			**+8,5**

SKANSKA

Conclusions

- Plus-energy (according to Powerhouse definition), including materials and construction phase, is obtainable
- Necessary for obtaining plus-energy is a holistic approach:
  - integrating technical systems and architecture;
  - high level of energy efficiency (passive house standard, innovative ventilation strategies/solutions etc.),
  - high focus on embodied energy
  - optimized energy supply system for production of thermal energy and electricity on-site.
- A professional operation of the technical systems will be crucial

SKANSKA

POWERHOUSE

www.powerhouse.no