
POWERHOUSE
Peter Bernhard
Senior consultant, Asplan Viak AS
12-24
POWERHOUSE

ASPLAN VIAK AS:

ARCHITECTURE AND CONSULTING COMPANY
Approx. 1000 employees with expertise in:

- Architecture
- City and Area Planning
- Building and Construction
- Energy and Environment
- Communication and Transport Engineering
- Landscape Architecture

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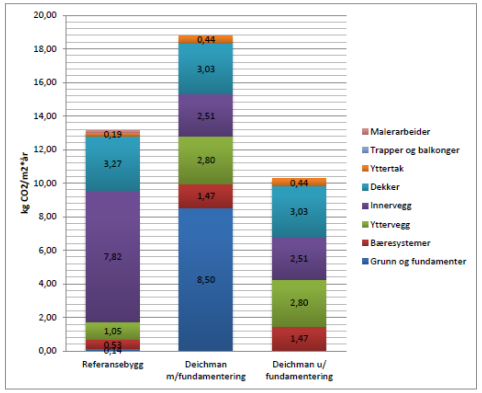
Asplan Viak - Department Energy and Environment

klimakost

LCC/LCA-analysis



The building industry´s responsibility

40%

Buildings account for approx. 40% of the global energy consumption and represent a major contribution to the global greenhouse gas emissions.

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The beginning - 2010

Zero Emission Conference November 2010

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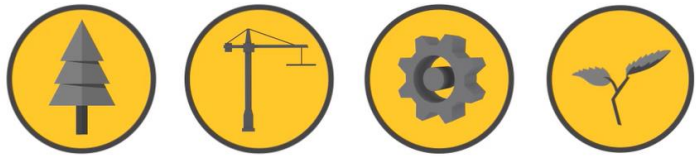
Definition of a Powerhouse

In its operational phase, an energy-positive Powerhouse should generate
more renewable energy than it consumes during its lifetime through the production of
building materials, construction, operation



as well as **deconstruction and disposal**

Research partner Powerhouse Kjørbo:

ZEB The Research Centre on Zero Emission Buildings

The Powerhouse collaboration:

Snøhetta entra SKANSKA asplan viak ZERO

Definition of a Powerhouse

Operational Energy Demand

+

Embodied Energy
(materials, construction, demolition)

<

Production of Renewable Energy
(on site)

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Powerhouse Kjørbo (Sandvika)

Trinn 1:

- Ca. 5200 m^2 BRA
- Byggestart: 2012
- Ferdigstillelse: 2014

Trinn 2:

- Ca. 10 000 m^2 BRA
- Byggestart: 2015
- Ferdigstillelse: 2018

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The first Powerhouse – Kjørbo, Sandvika

Renovation of two office buildings

- Originally built: 1980
- Heated floor area: 5,180 m^2
- Project start: January 2012
- Completed: April 2014

Objectives

- Renovate to an energy positive building
- Commercial market conditions
- BREEAM-NOR «Outstanding»
- Keep the expression of the building

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Building 4 and 5 before the refurbishment …

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Office landscape before …

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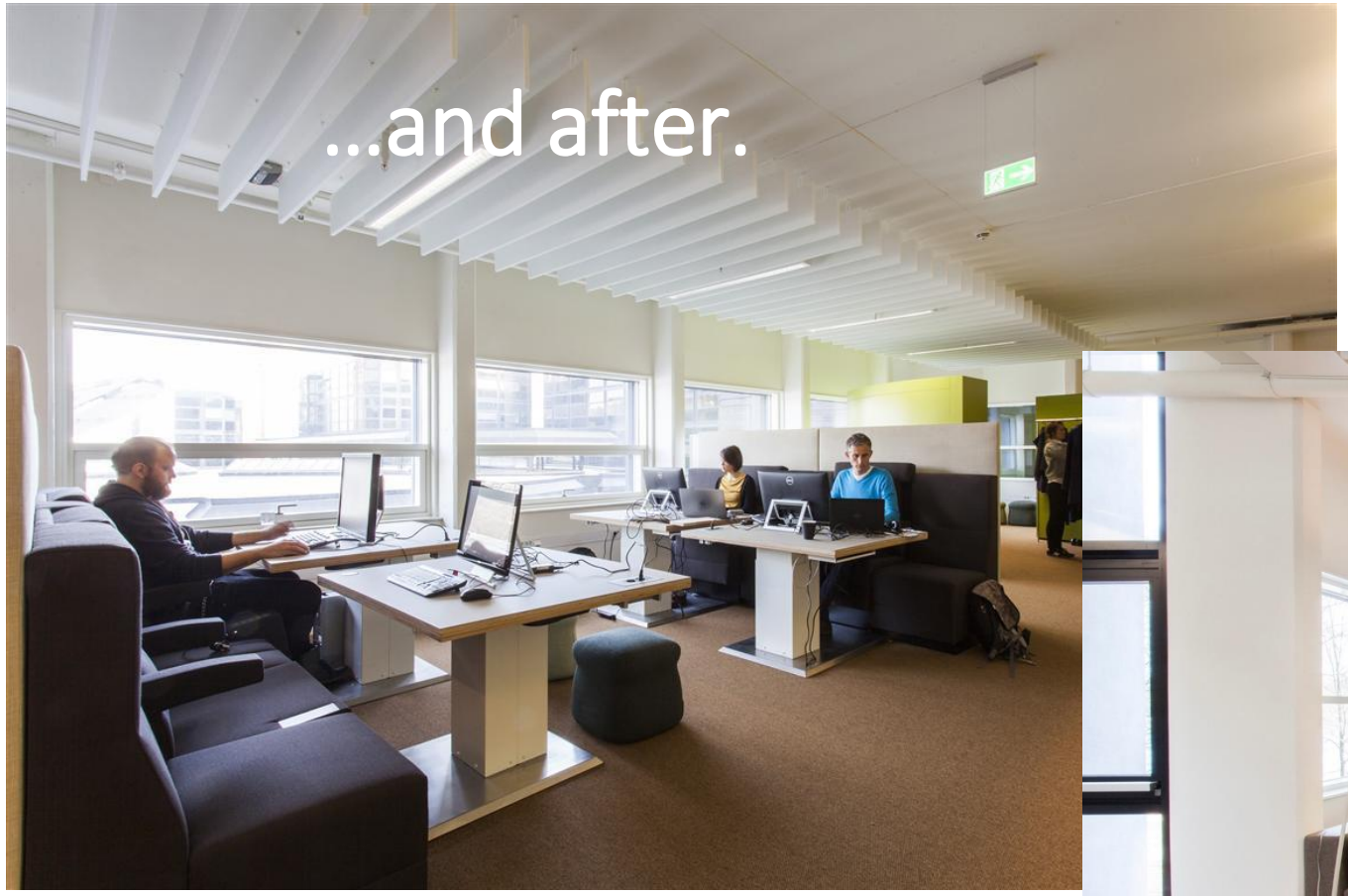

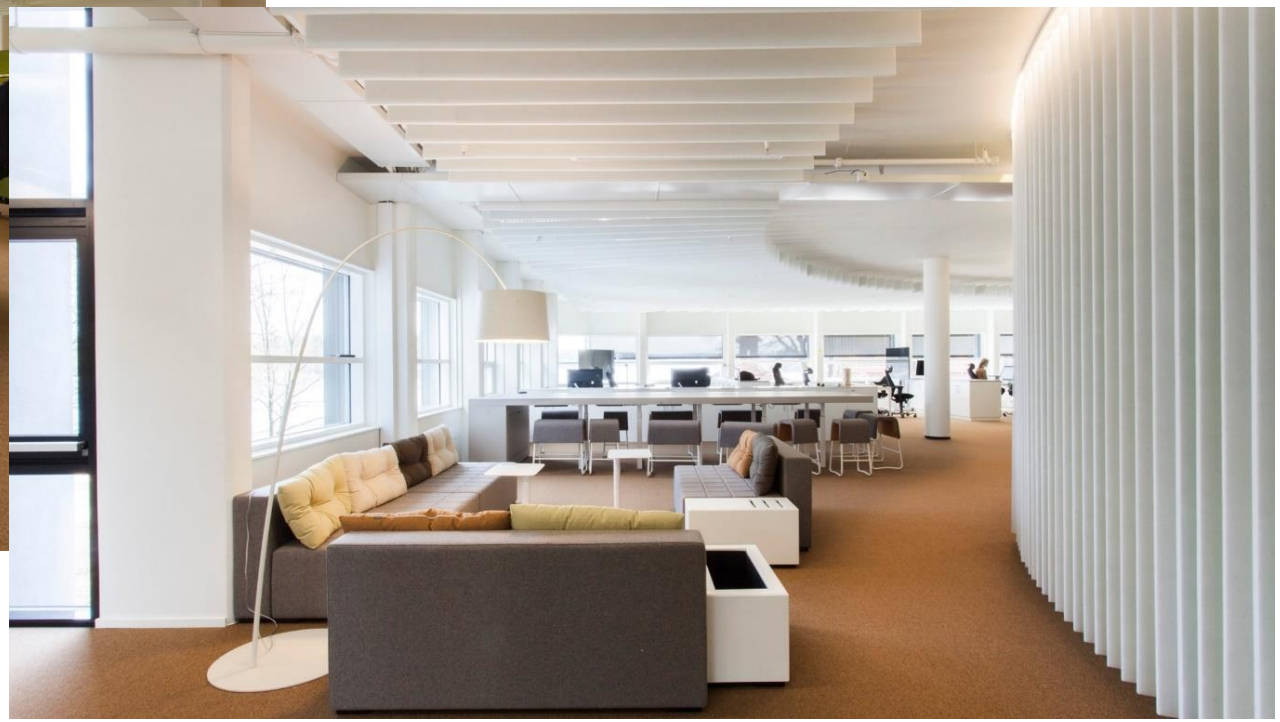

Activity Based Workspace (ABW)

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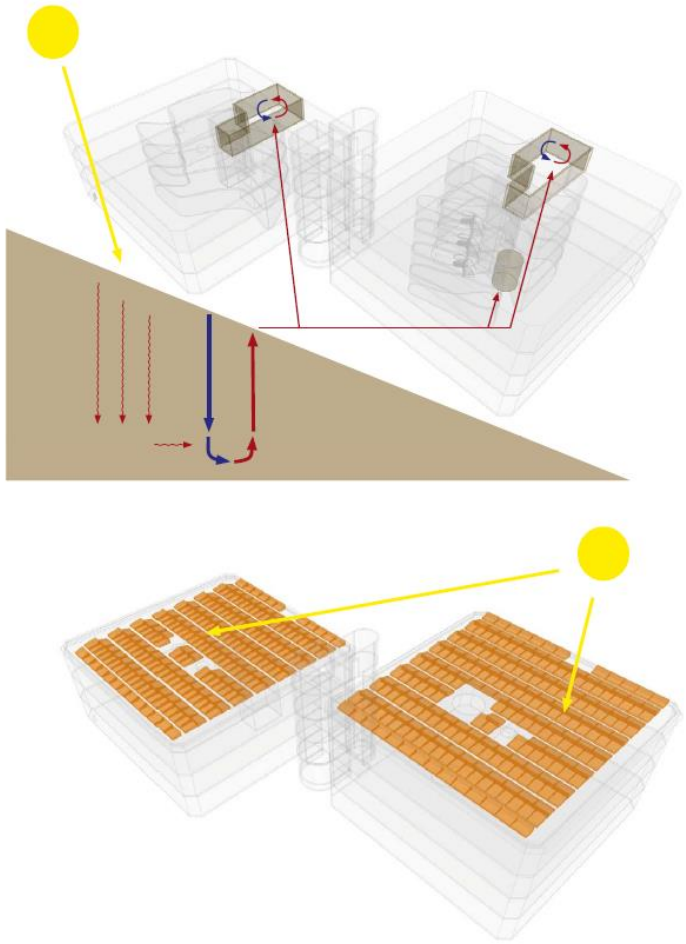
Energy concept



- Consequent reduction of energy demand
- Exposed concrete in ceiling for heat storage
- Energy wells supply heat and free cooling.
- Two heat pumps operating at different temperatures.
- Local production of electricity

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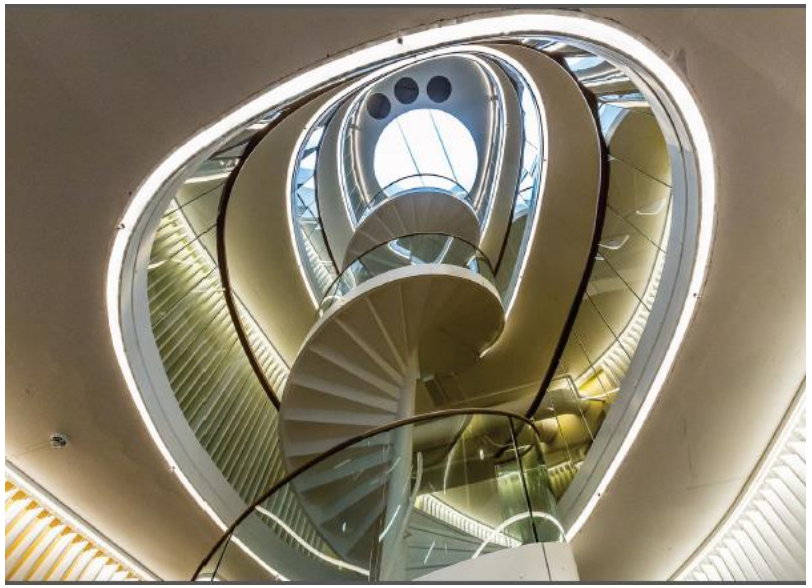
Energy efficient ventilation concept



- Efficient heat recovery (85%)
- Displacement ventilation
- Use of the building staircases, (reduced duct lengths, low speed)
- Demand controlled
- Very low pressure drop (SFP 0,10-0,25)
- Openable windows

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Energy efficient heating concept

Heat pump system

- 10 energy wells (200 meter)
- 2 heat pumps with different working temperatures (80 kW for space heating and 8 kW for DHW)
- Free cooling in summer
- COP better than expected (3,9 / 4,2 => 4,1)
- District heating only as reserve – not necessary for peak load

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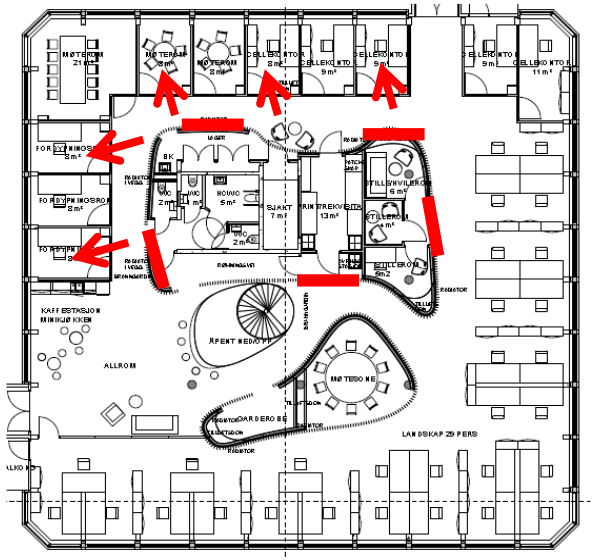
Heating and cooling concept

- No need for radiators along the outer wall.
- Just five radiators in the core of each floor.
- Free cooling in summer
- Exposed concrete.



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High efficient PV-system

Solar system

- 1550 m^2 on the roof of building 4, building 5 and the roof of the garage.
- Efficiency solar panels: 20,4 %
- Installed power: 312 kW_p
- Electricity production: 220 000 kWh/year

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Minimize embodied energy – reuse

- The buildings' structural systems remained
- Materials such as old glass façades have been reused
- All new materials were carefully chosen to ensure that the materials had low embodied energy.

Low carbon footprint

Reuse:

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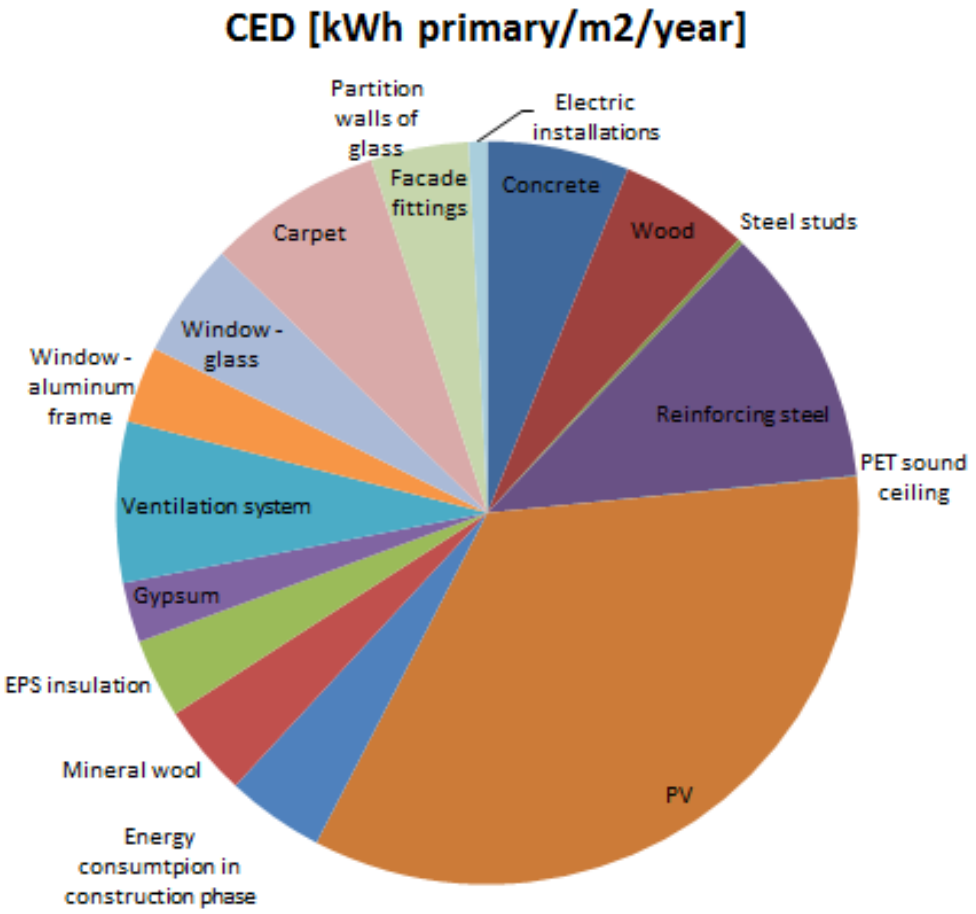
Embodied energy - Powerhouse Kjørbo



- The solar system => approx. 30%.

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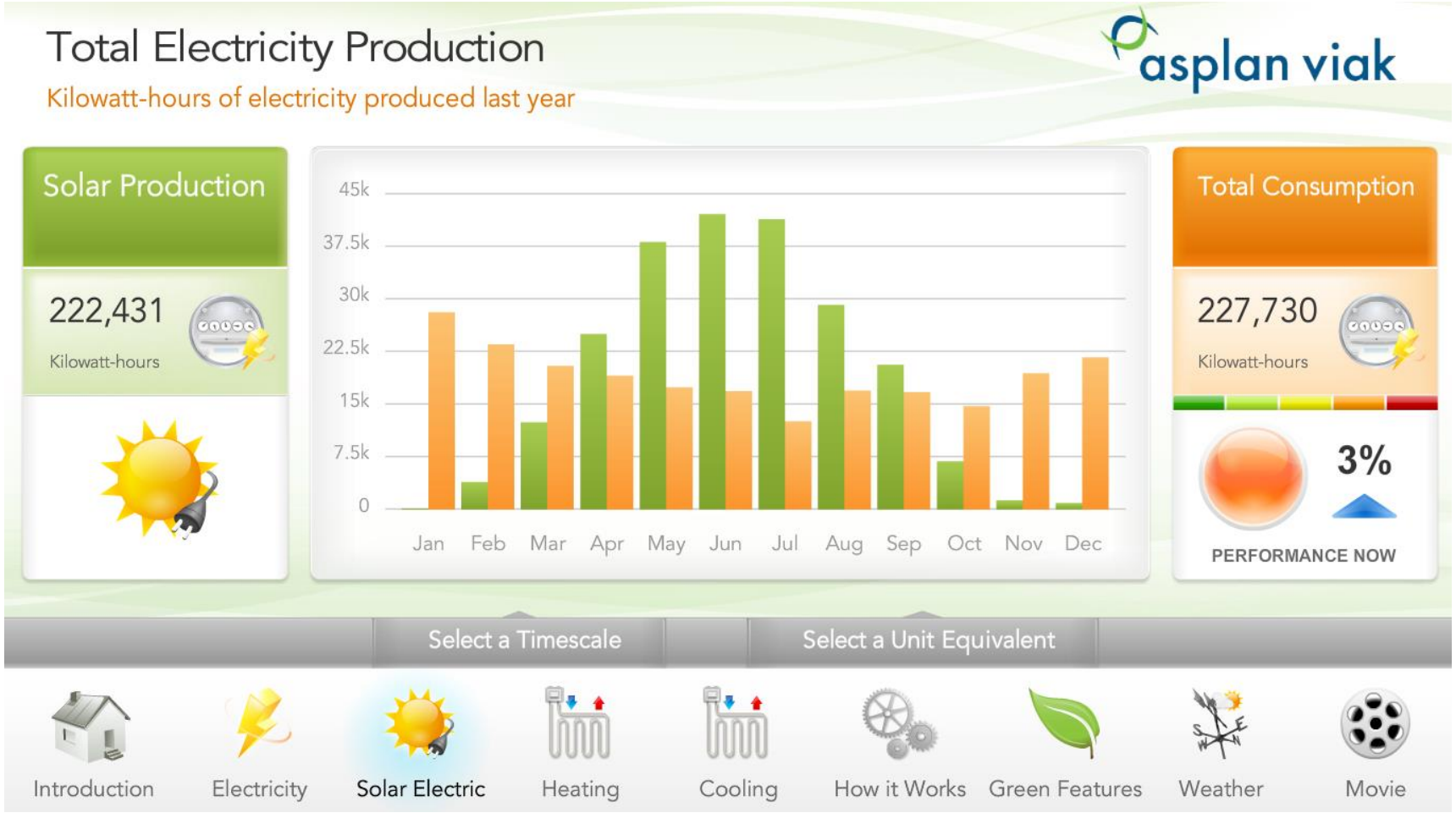
Energy Dashboard



http://buildingdashboard.com/clients/powerhouse/kjorbo/index.php?mode=&kioskName=

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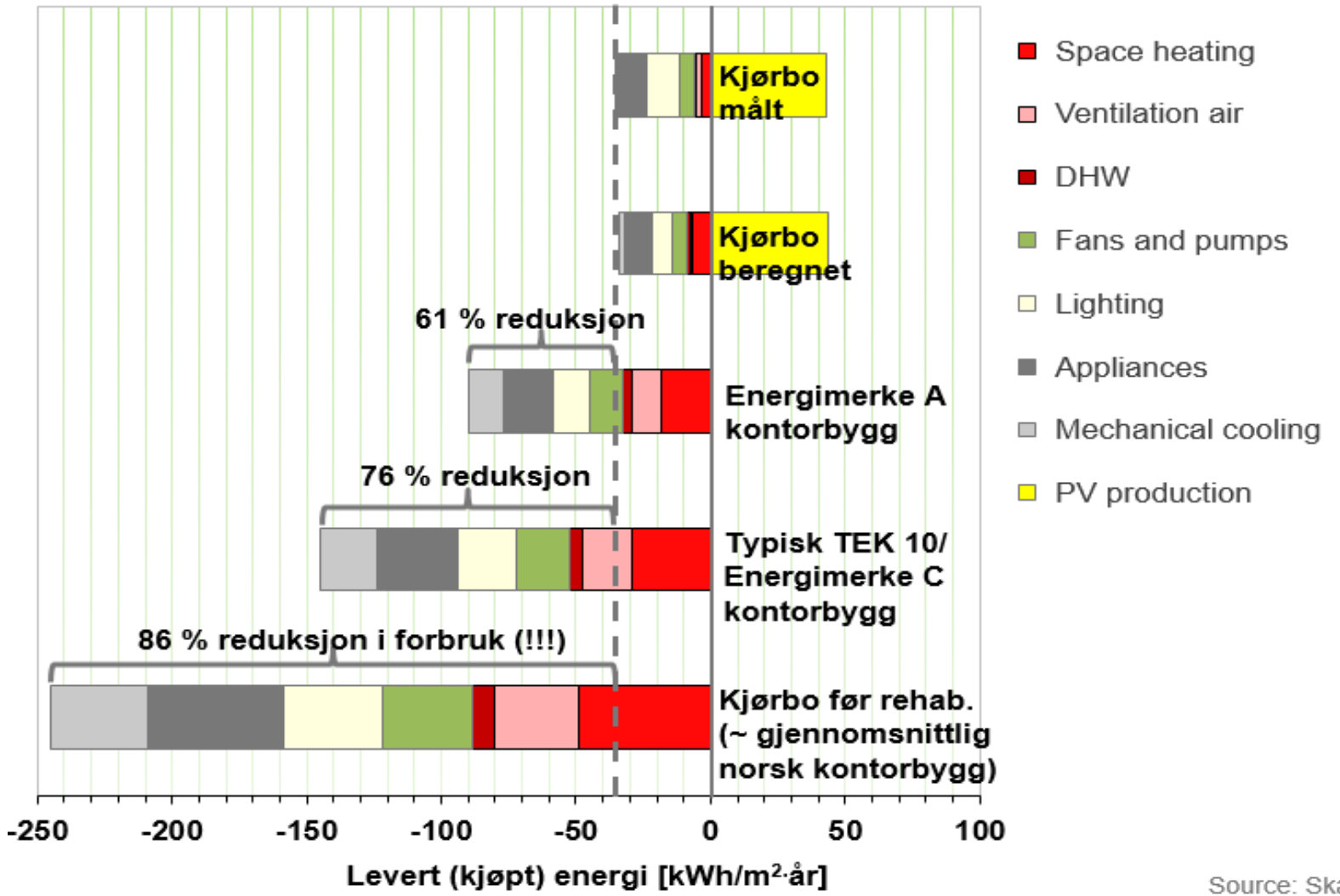
Energy performance



Source: Skanska

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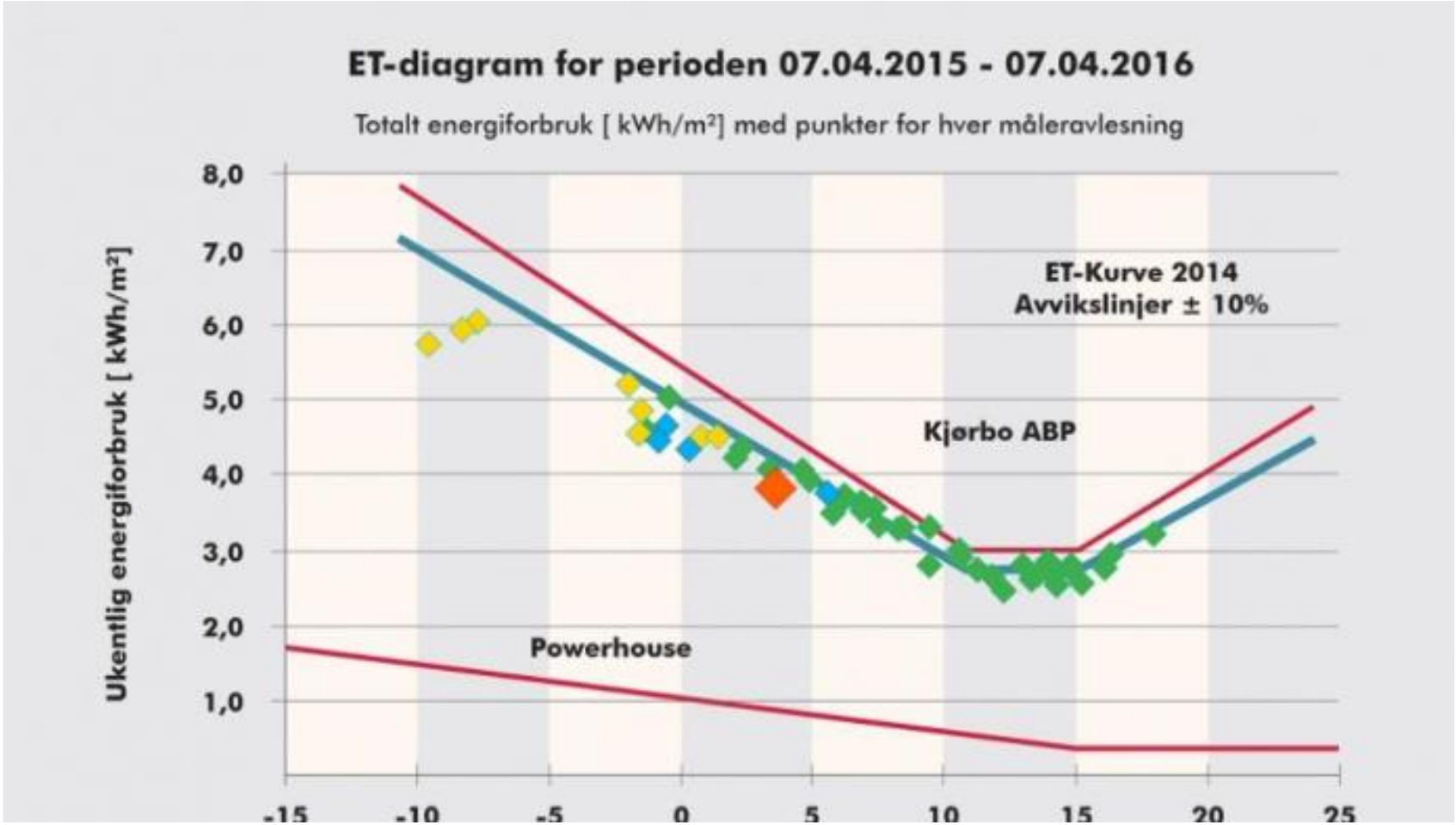
ET-diagram for perioden 07.04.2015 - 07.04.2016
Totalt energiforbruk [kWh/m²] med punkter for hver måleravlesning
Ukentlig energiforbruk [kWh/m²]
8,0
7,0
6,0
5,0
4,0
3,0
2,0
1,0
-15
-10
-5
0
5
10
15
20
25
ET-Kurve 2014
Avvikslinjer ± 10%
Kjørbo ABP
Powerhouse

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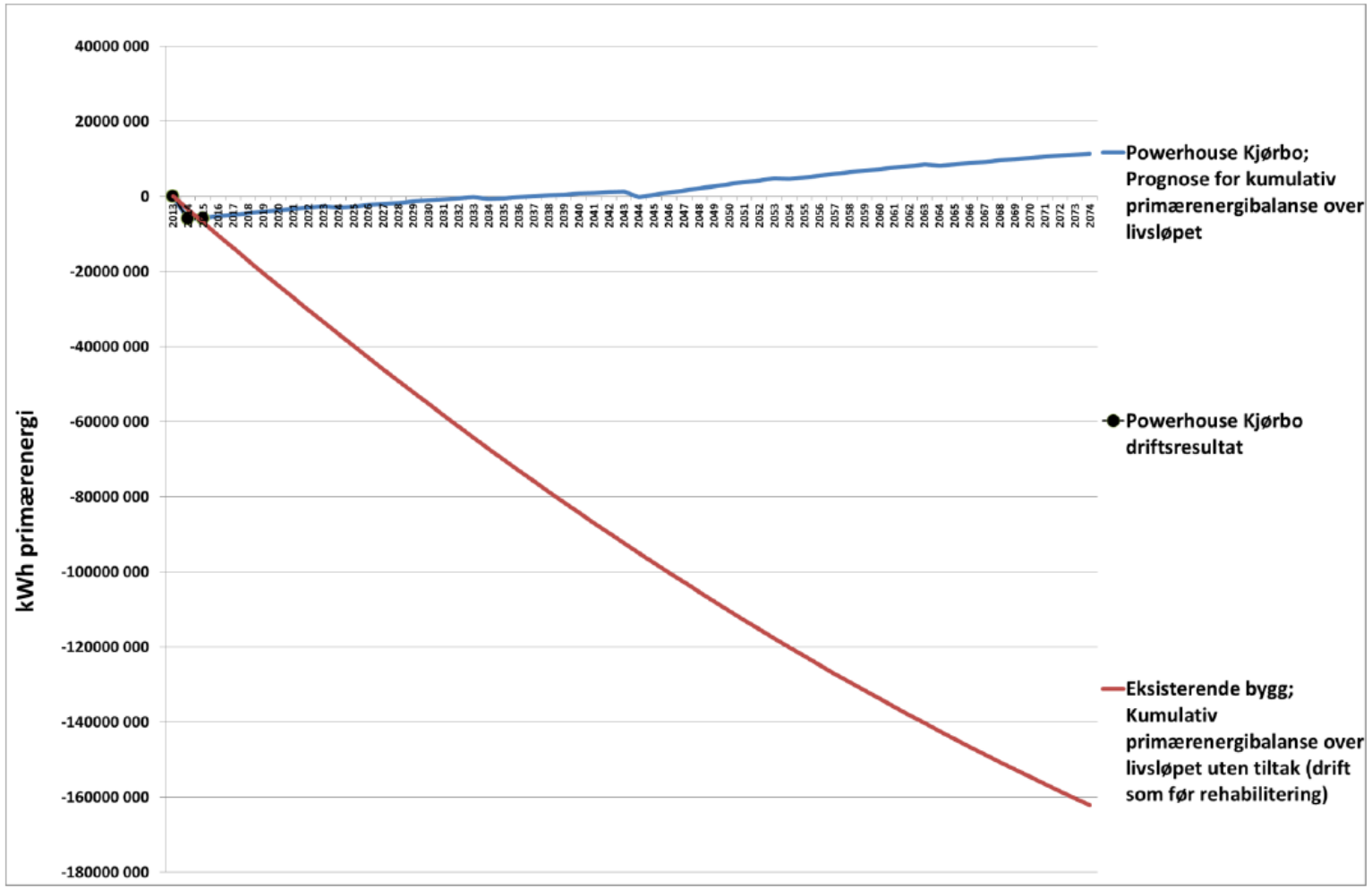
Energy balance during 60 years of operation



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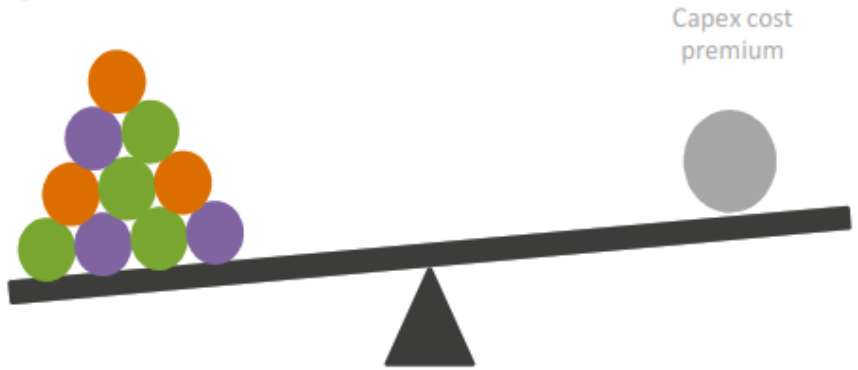
How is Powerhouse commercial?

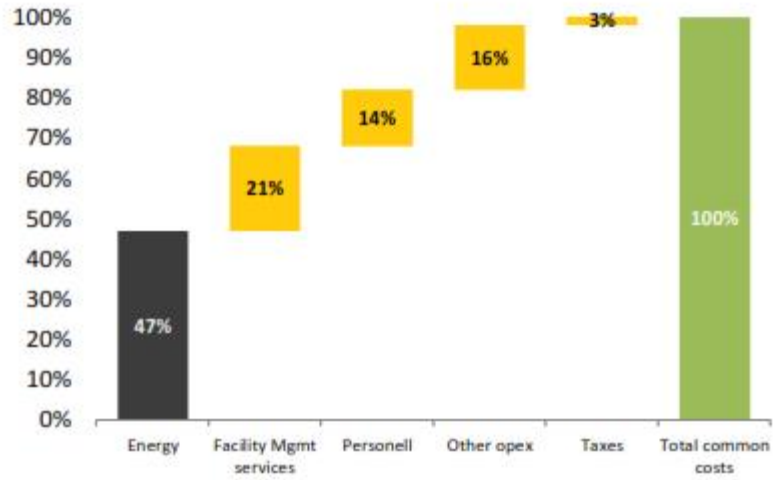
Owner
Higher rent
Higher valuation and exit value
Lower finance cost

Tenant
Lower sick leave
Increased productivity

Owner/tenant
Lower operating/common costs
Branding / CSR



Tenants common costs split (avg.)



➢Most important measure to reduce tenants common costs which in turn gives potential for higher rent

Source: Entra ASA

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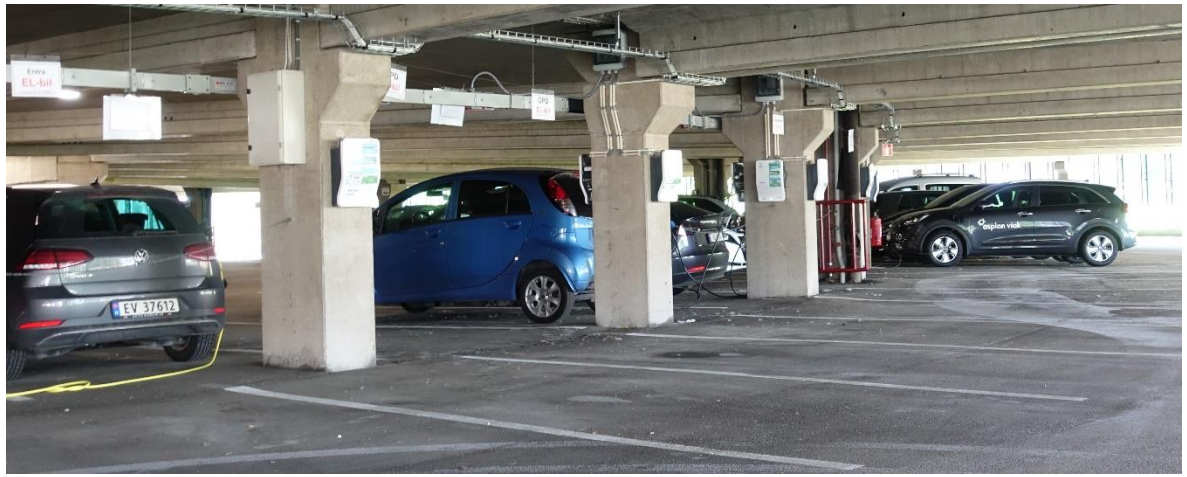
Sustainable Transport

Charging station for electric cars

- Dedicated parking for electric cars is available.
- Surplus energy from the solar system is used to charge electric cars.



Bicycle parking

- Safe and weather protected parking for bicycles.

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Energibalanse for Norge, 2014

Energibalansen følger energiflyten på norsk territorium.

Produksjon av primær energi

Primære energiprodukter utvinnes eller hentes rett ut fra naturen og har ikke vært gjennom en omvandlingsprosess fra annen energi.

Tilgang

Netto innenlands tilgang

Netto innenlands energibruk

Netto innenlands energibruk omfatter hovedsakelig forbruk av sekundære energiprodukter, samt biobrensel, naturgass, kull og NGL/etan som også går til sluttforbruk.

Etter forbrukergruppe

Naturgass 48,5 %
Råolje 37,9 %
Vann- og vindenergi 6,1 %
Annet 7,6 %
inkluderer NGL 4,2 %
kondensat 2,2 %
biobrensel og avfall 0,6 %
kull 0,6 %

2 285 TWh → **315 TWh**

Med råstoff **231 TWh**
Uten råstoff **209 TWh**

Industri og bergverk
67 TWh
(+ 0,4 % siste år)

Transport
56 TWh
(- 1,8 % siste år)

Andre aktiviteter
86 TWh
(- 8,4 % siste år)

10 TWh
Internasjonal bunkers (sjøfart og luftfart)

7 TWh
Lagerendringer nedgang (+) oppgang (-)

26 TWh
Svinn (10 TWh) og statistiske avvik (16 TWh)

68 TWh
Tap ved transformasjon (5 TWH) og forbruk i energiproduserende næringer (63 TWh)

Transformasjon: Prosess der primære energiprodukter omvandles til sekundære energiprodukter, som for eksempel at råolje omvandles til bensin.

22 TWh
Energi brukt som råstoff

Energi som ikke brukes som brensel, men som råvarer. Eksempler er oljeprodukter brukt i plastproduksjon og naturgass brukt i metanolproduksjon.

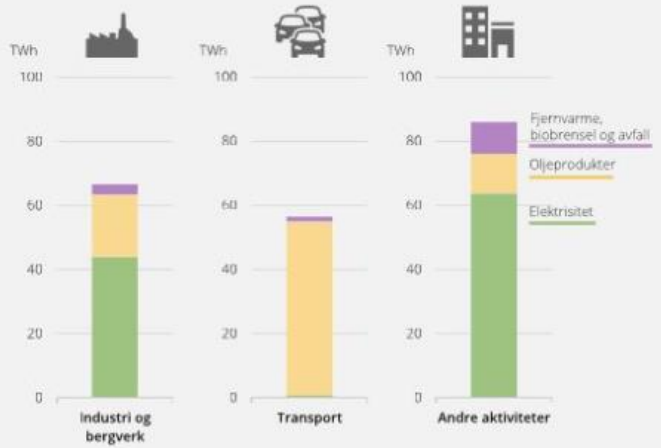
Eksport
2 042 TWh

De fire landene som Norge eksporterer mest til – Storbritannia, Tyskland, Nederland og Frankrike – står for 75 % av eksporten.

Import
76 TWh

Hvor mye er egentlig 1 TWh?
1 terrawattime (TWh) er en milliard kilowattimer (kWh). En gjennomsnittlig norsk husholdning bruker rundt 20 000 kWh per år. (2012).

Fordeling av energibruk på energiprodukter



Statistisk sentralbyrå
Statistics Norway

Kilde: http://www.ssb.no/energibalanse

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New Powerhouse Definisjon

-A Powerhouse definition based on global warming potential

New Powerhouse definition

This is defined by two criteria

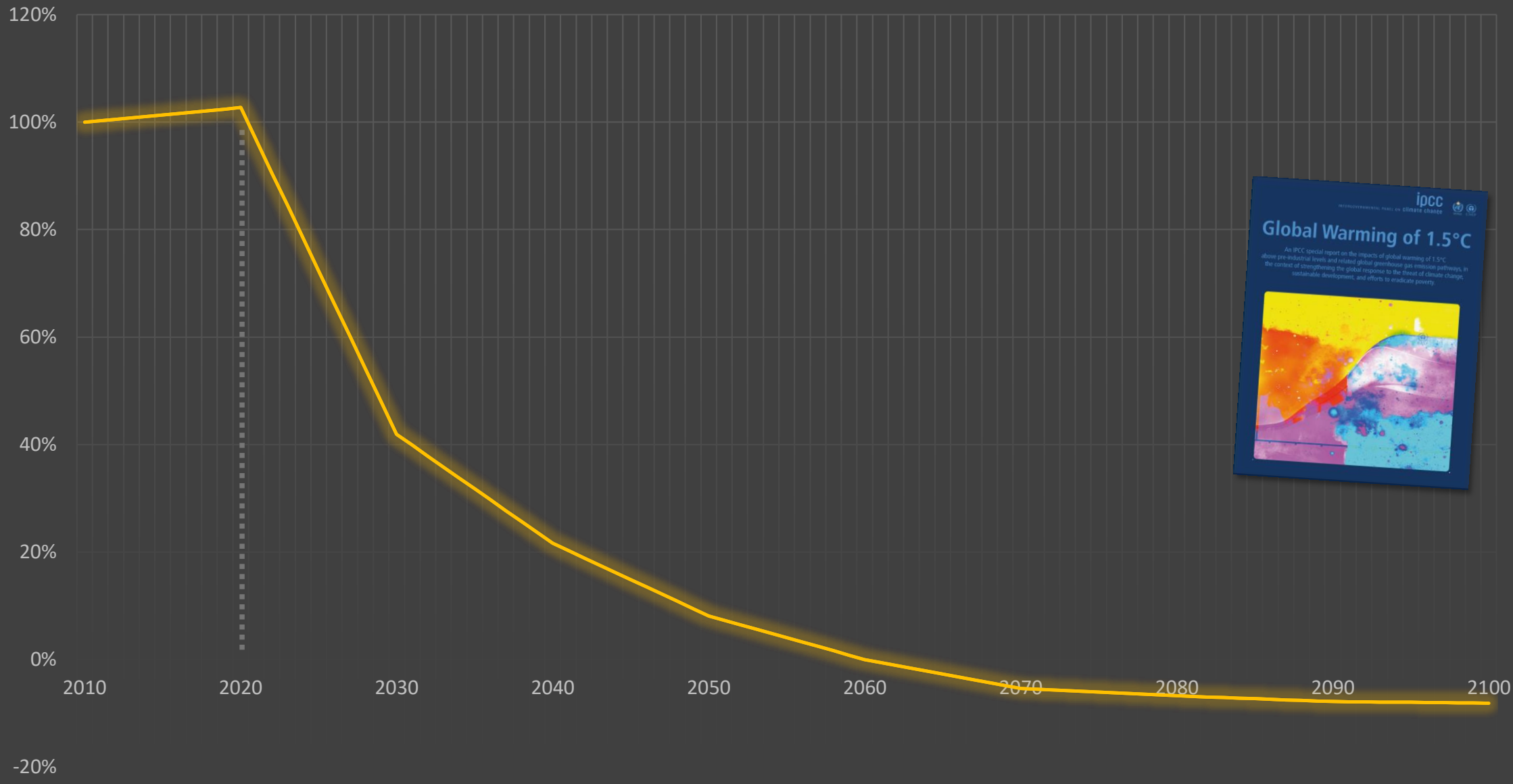
1. Plus energy building

   The building must comply with FutureBuilt plus house standard (2018) with project specific and documented values for ventilation air volumes, heated tap water and lighting. Project specific and documented values for plug loads shall be used if they are lower than the standard values in NS 3031. If the plug loads are higher than defined in NS 3031, the standard values will be used.

2. 1,5ºC-proof according to the IPCC SR 1.5 P1 Scenario

   The total greenhouse gas emissions over a 60 year lifecycle for the function of a m^2 of building space, should be lower than the budget defined as the sum of the annual emissions occurring from processes related to materials, construction processes, operational energy and end-of-life as it would have been in an equivalent 2010 building space multiplied by the factor for the given year defined by a reference scenario documented to be in line with the 1,5ºC-target.

To ensure communicability, the suggested label is: Powerhouse Paris-proof


120%
100%
80%
60%
40%
20%
0%
-20%
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
ipcc
Global Warming of 1.5°C

BY ALL MEANS NECESSARY

Paris-proof buildings:

- Reduce operational energy and plus energy buildings.
- Use low-carbon materials and construction processes.
- Refurbish existing buildings and reuse building materials.
- Design smart buildings and maximize use.

Powerhouse Telemark

Thank you for your attention

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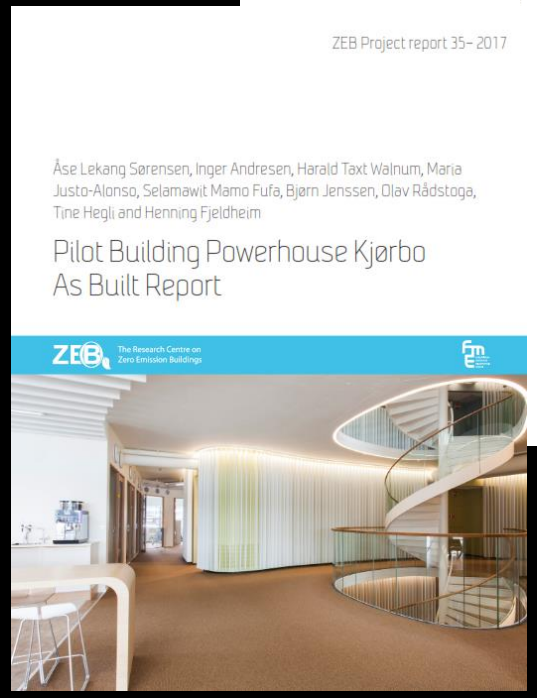

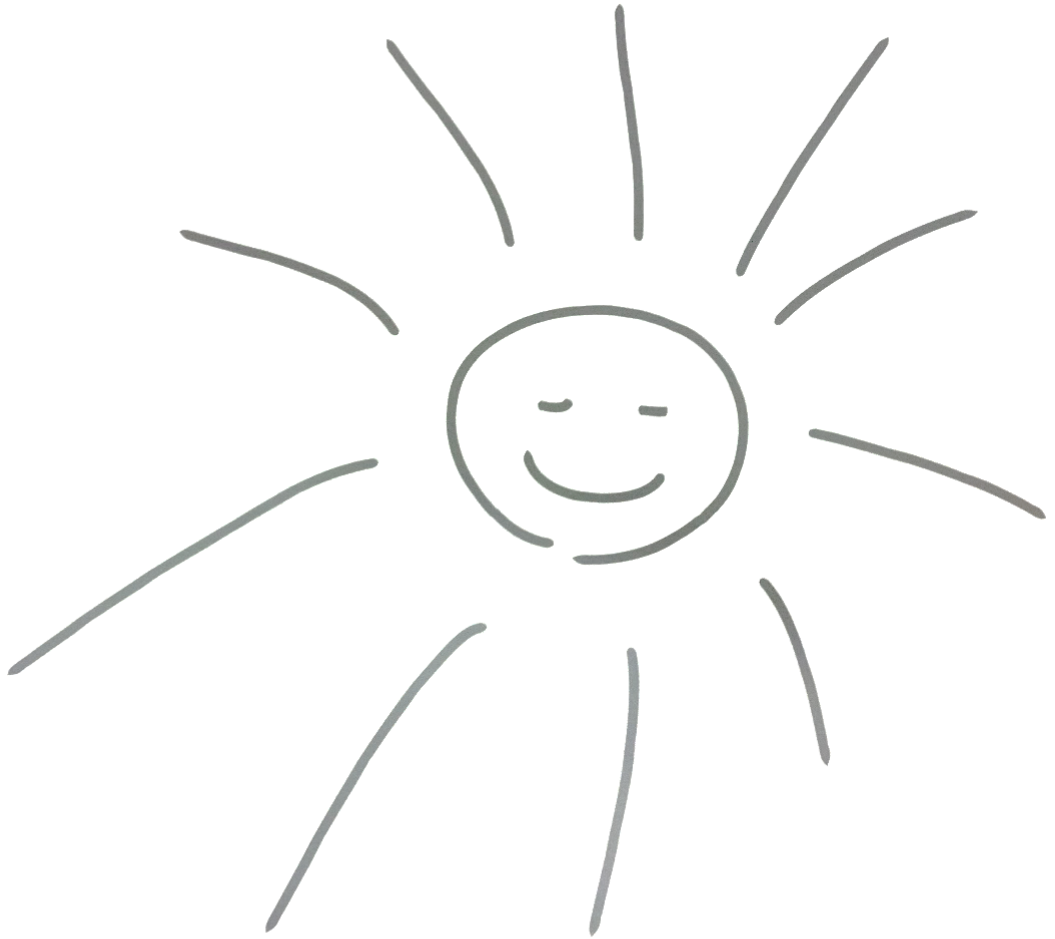

https://ntnuopen.ntnu.no/ntnu-xmlui/handle/11250/2486604

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