



POWERHOUSE

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- Powerhouse – the unique and the ingenious
 - Powerhouse Kjørbo – facts and figures
 - Powerhouse – economy and motivation
 - Q & A

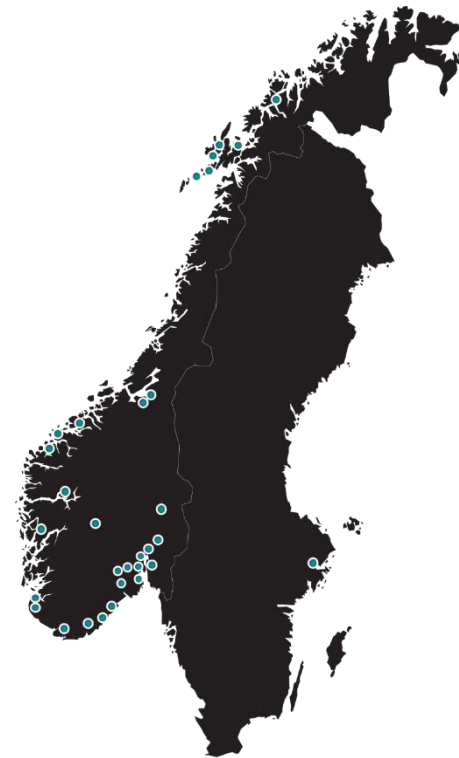


ASPLAN VIAK AS:

ARCHITECTURE AND CONSULTING COMPANY

Approx. 900 employees with expertise in:

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



The beginning - 2010



Zero Emission Conference November 2010



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.



Powerhouse – the alliance



Snøhetta 



entra

SKANSKA

 **asplan viak**

«No one can develop Powerhouse energy-positive buildings alone –
but with the right partners we can do it»

 **asplan viak**



The unique - Definition of a Powerhouse

- **A 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.**

Additional criterias:

- *The quality of produced energy should not be lower than bought energy*
- *Minimum passivehouse standard (NS 3701)*
- *Appliances (PC, printers etc.) not included in the energy balance*
- *Embodied energy over the buildings lifecycle to be calculated in primary energy*
- *Shall be built within commercial market conditions*



The unique - Definition of a Powerhouse

Operational Energy Demand



Embodied Energy
(materials, construction, demolition)



Production of Renewable Energy
(on site)



The first Powerhouse (concept) - Trondheim

New office building

Heated floor area: 13.000 m²

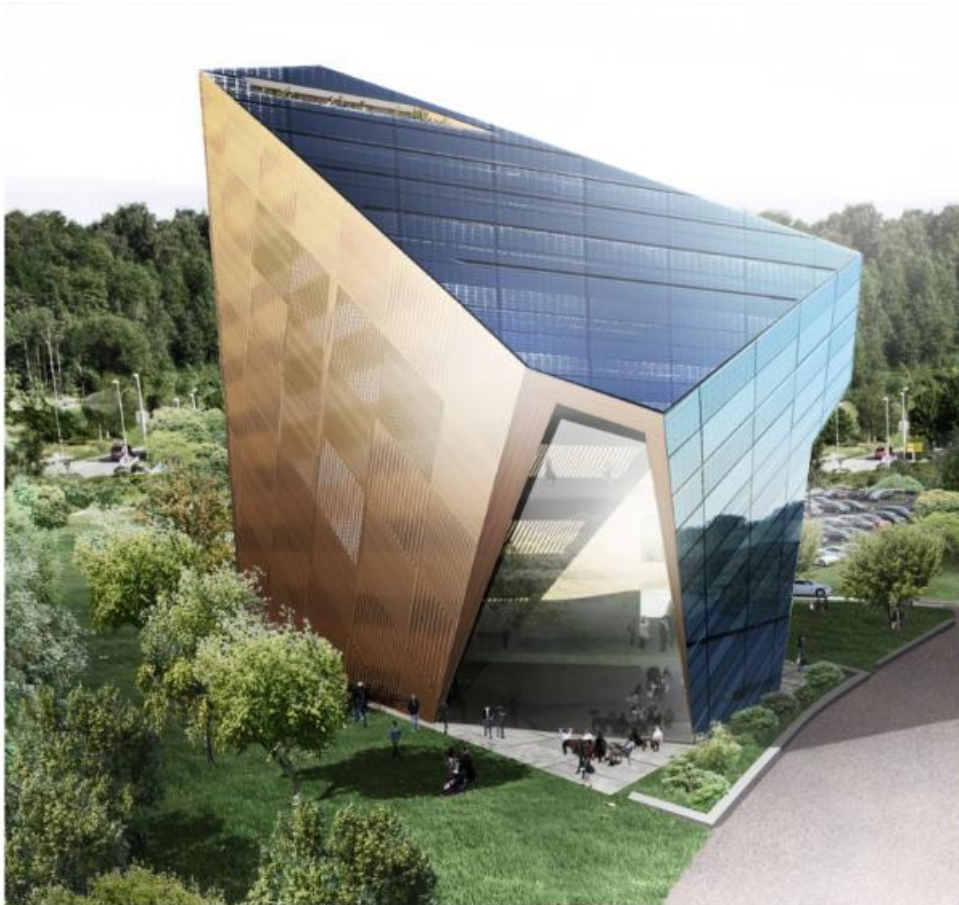
Approx. 500 workplaces



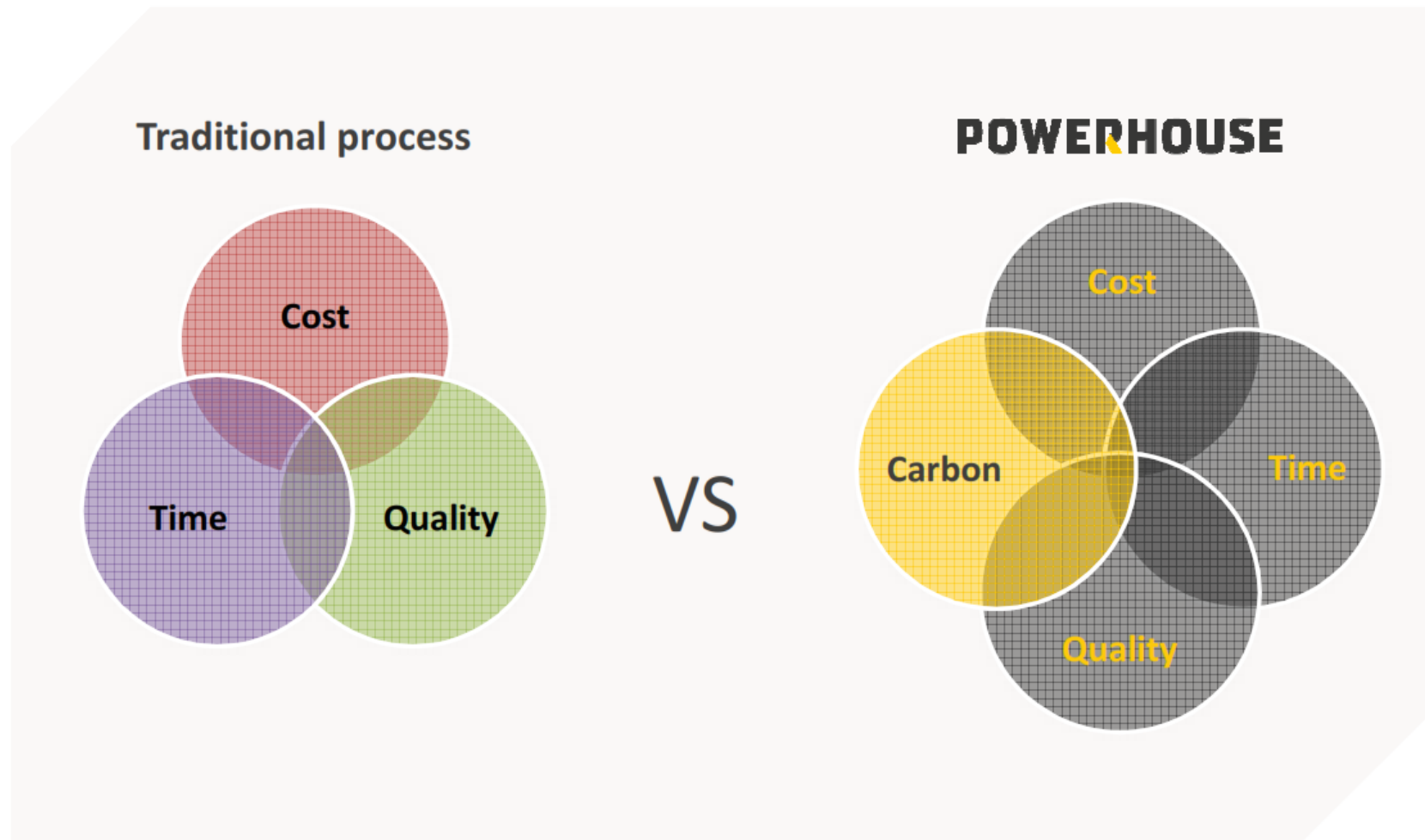
Powerhouse Montessori – Kindergarten



Powerhouse Telemark – Office building



The unique – complexity





The ingenious – the process

- New collaboration models and cooperation from day one
- Interaction and interdisciplinary design processes
- Holistic thinking where form follows environment



The first Powerhouse – Kjørbo, Sandvika



Renovation of two office buildings

- Originally built: 1980
- Heated floor area: 5,180 m²
- Project start: January 2012
- Completed: April 2014

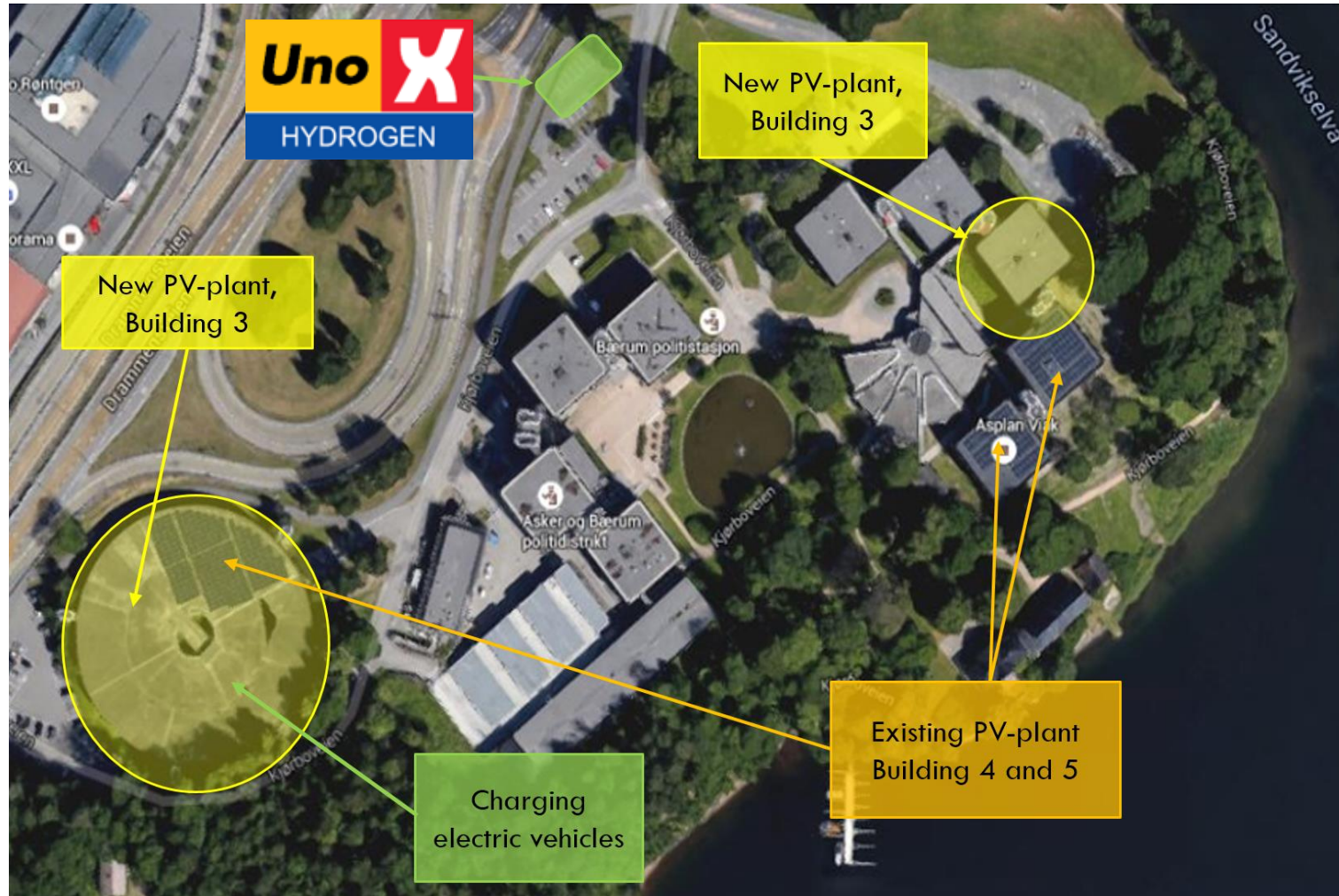
Objectives

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

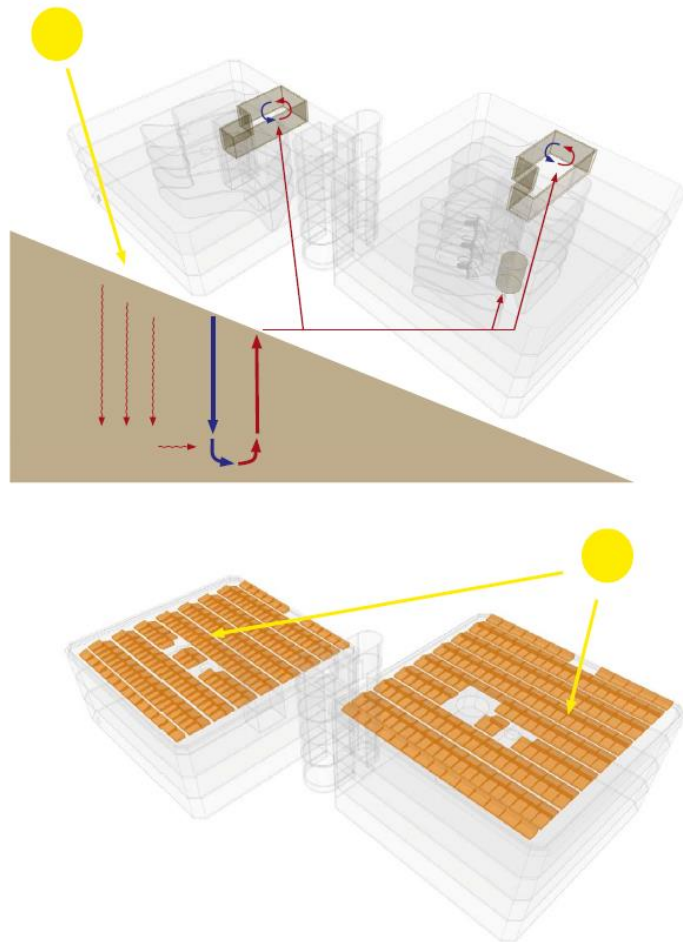




Powerhouse Kjørbo - location



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

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

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

High efficient PV-system



Solar system

- 1550 m² 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



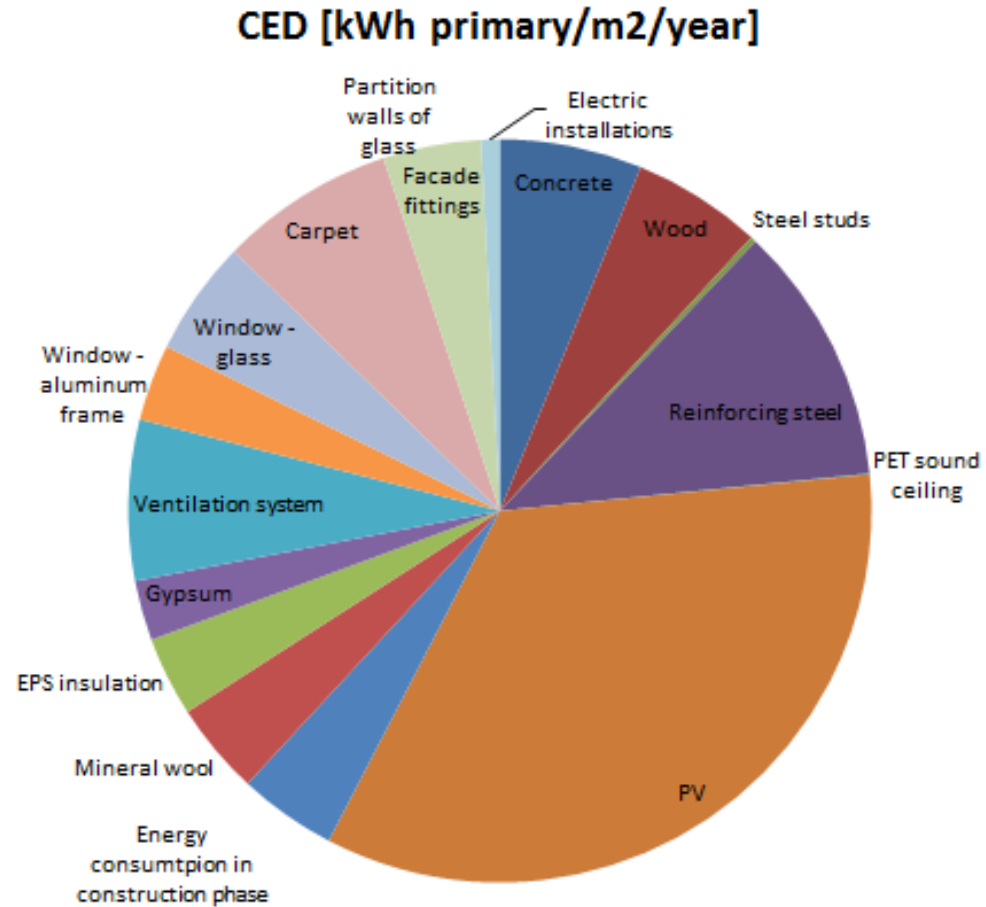
Minimize embodied energy – reuse

- 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.





Embodied energy - Powerhouse Kjørbo



➤ The solar system counts for approx. 30%.

Building 4 and 5 before the refurbishment ...



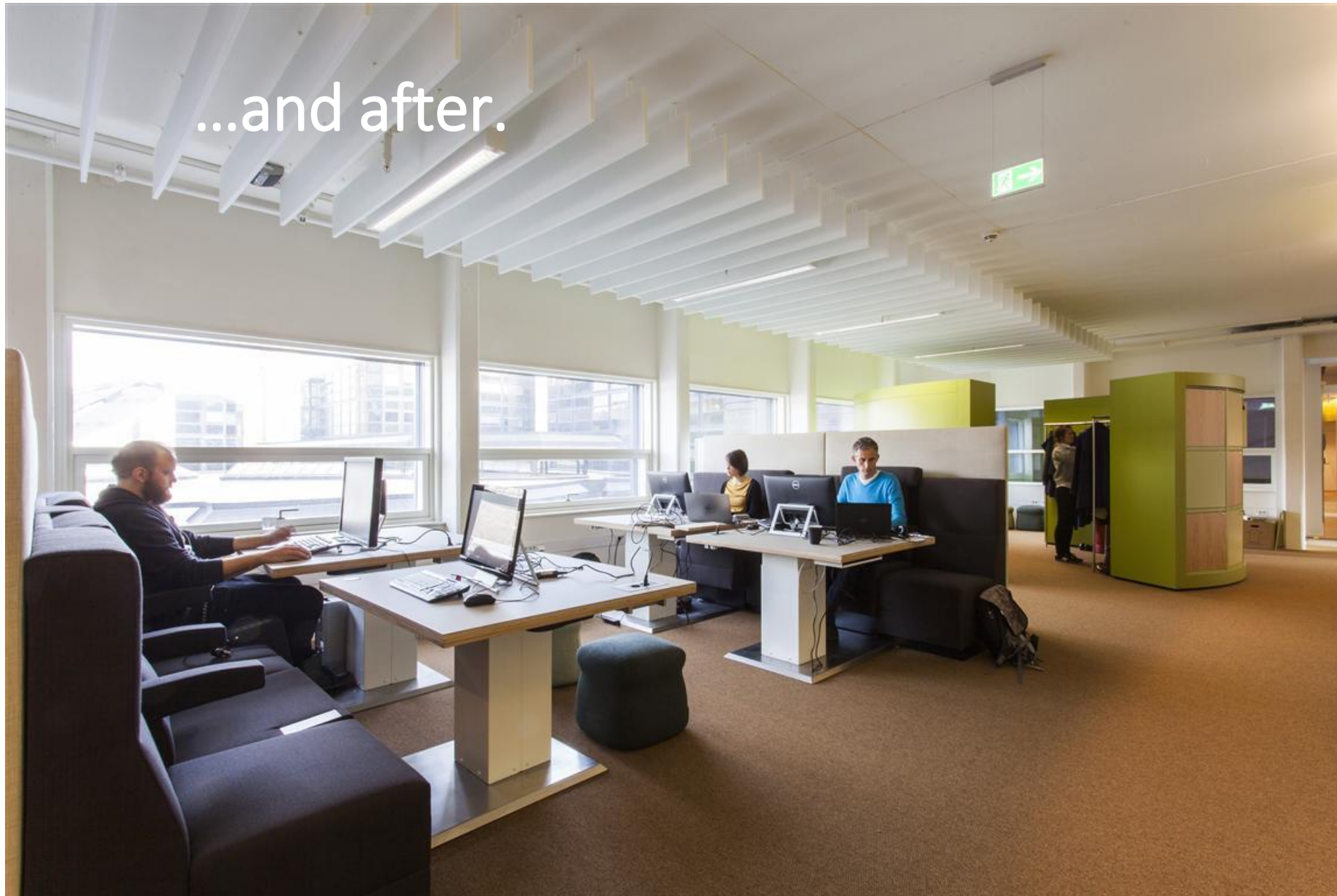
.... and after.



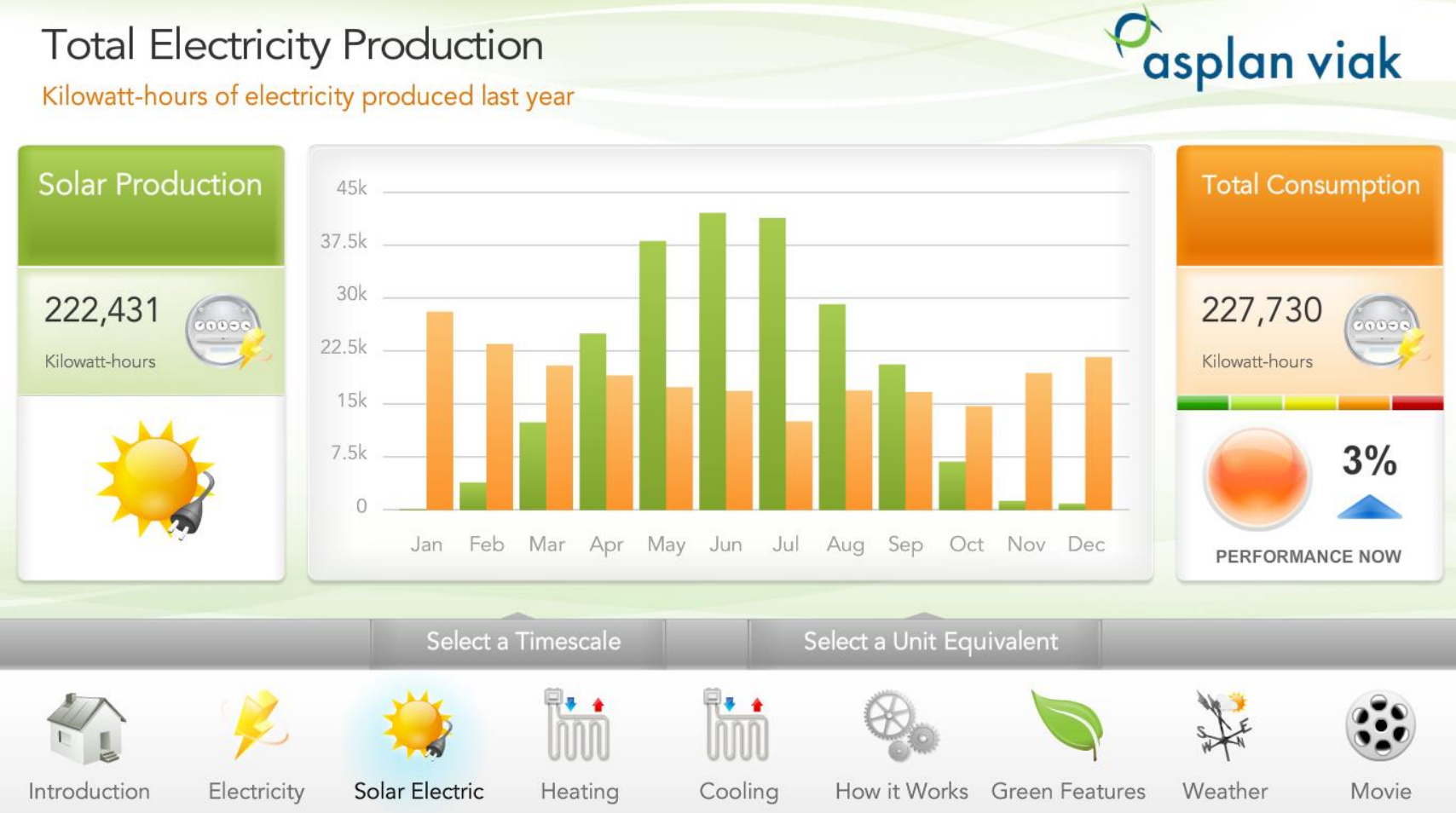
Office landscape before ...



...and after.



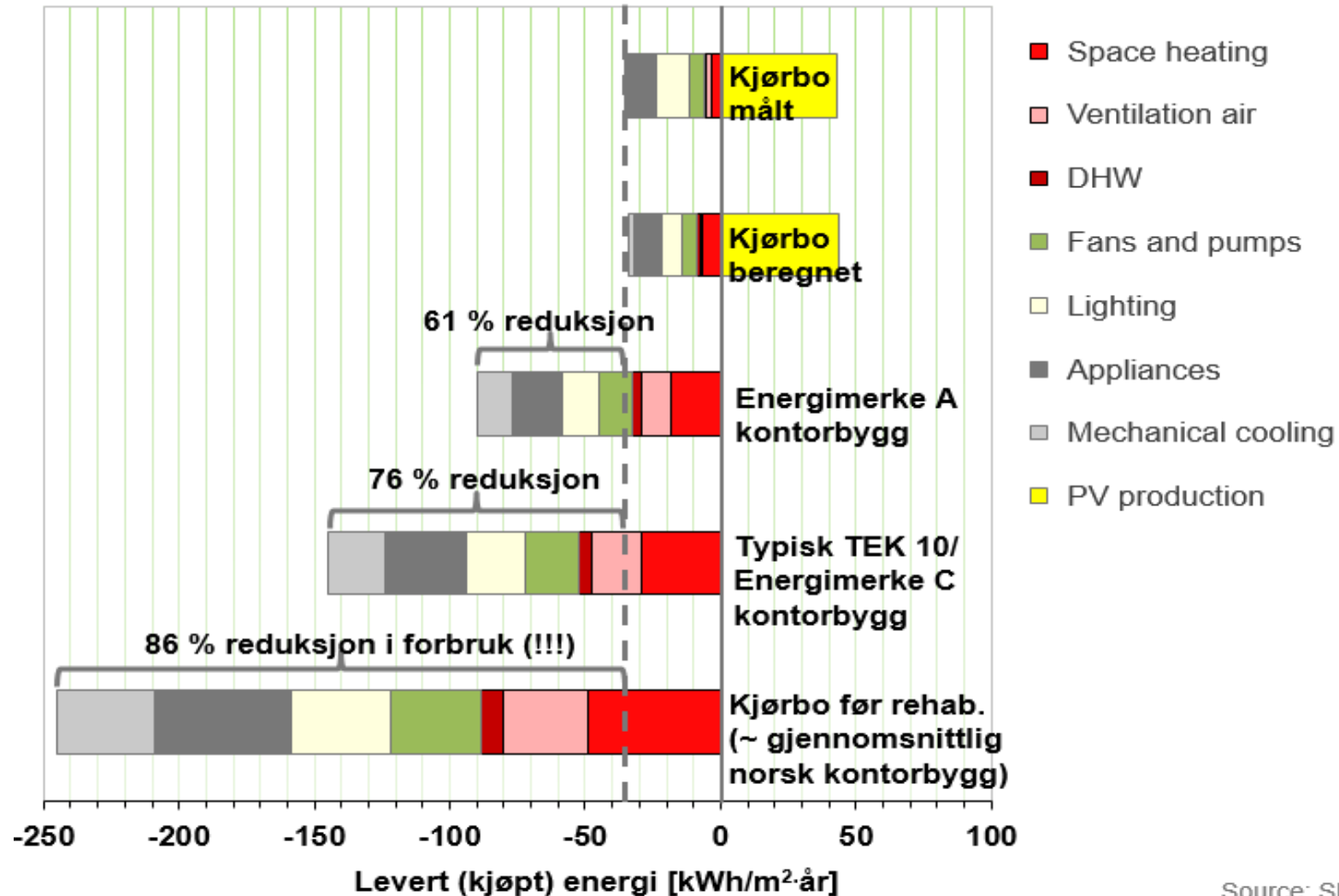
Energy Dashboard



<http://buildingdashboard.com/clients/powerhouse/kj-orbo/index.php?mode=&kioskName=>

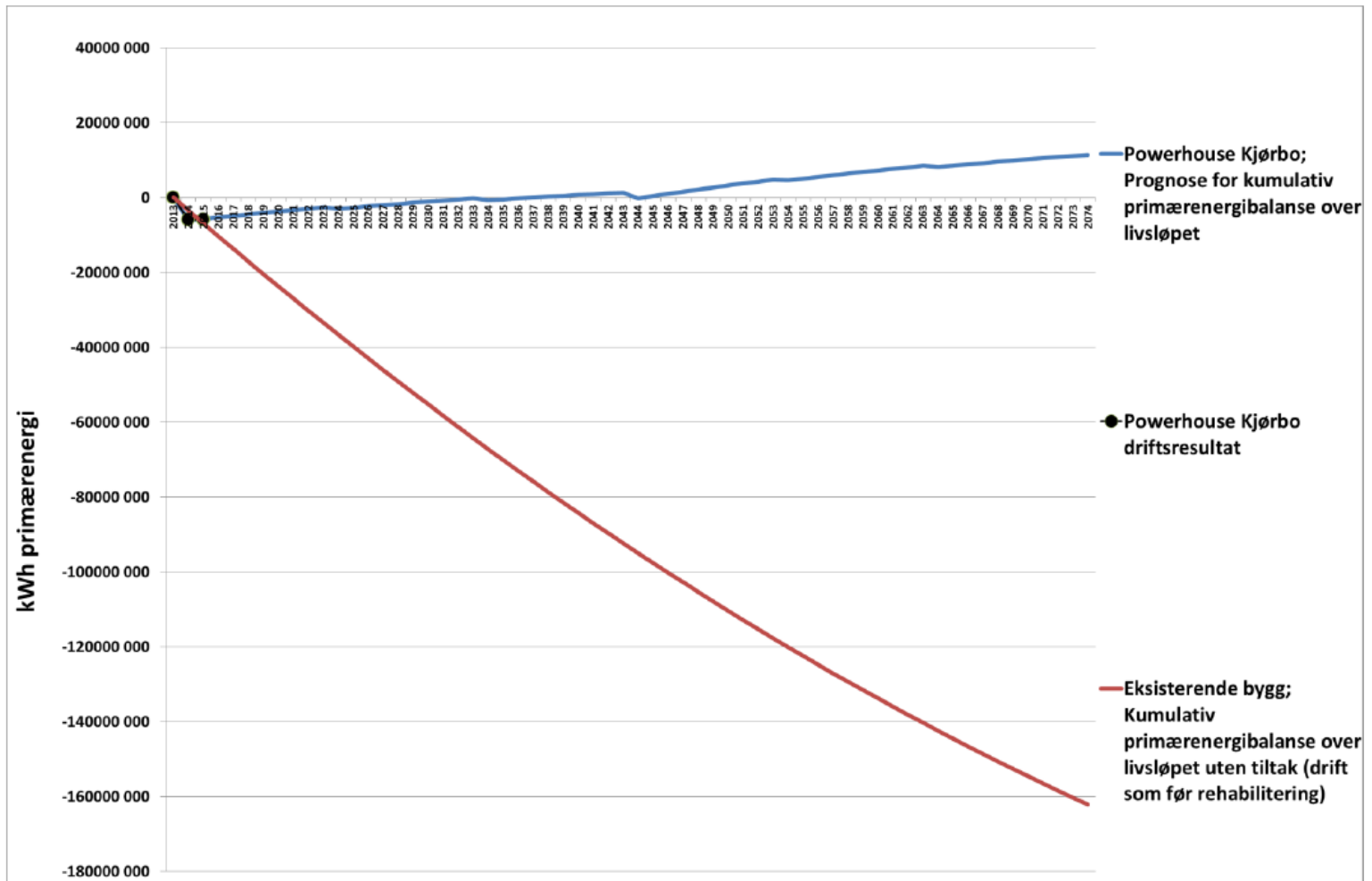


Energy performance

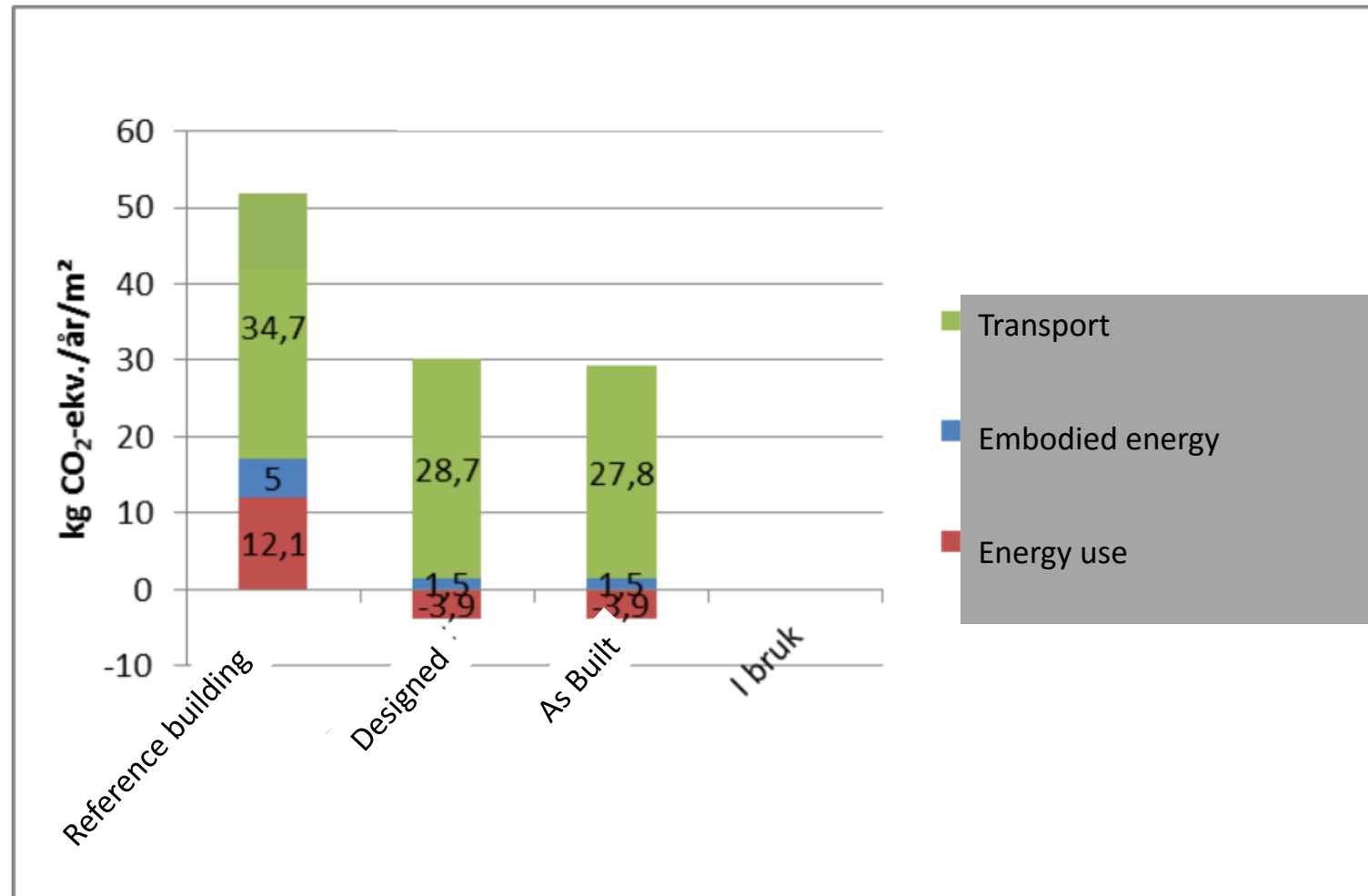


Source: Skanska

Energy balance during 60 years of operation



Climate gas emission Asplan Viak Sandvika



Sustainable Transport



Electric cars

- Dedicated parking for electric cars is available.
- Surplus energy from the solar system can be used during summer.



Bicycle parking

- Safe and weather protected parking for bicycles.
- E-bikes can be charged.
- Access with the office key card.



Sustainable Transport



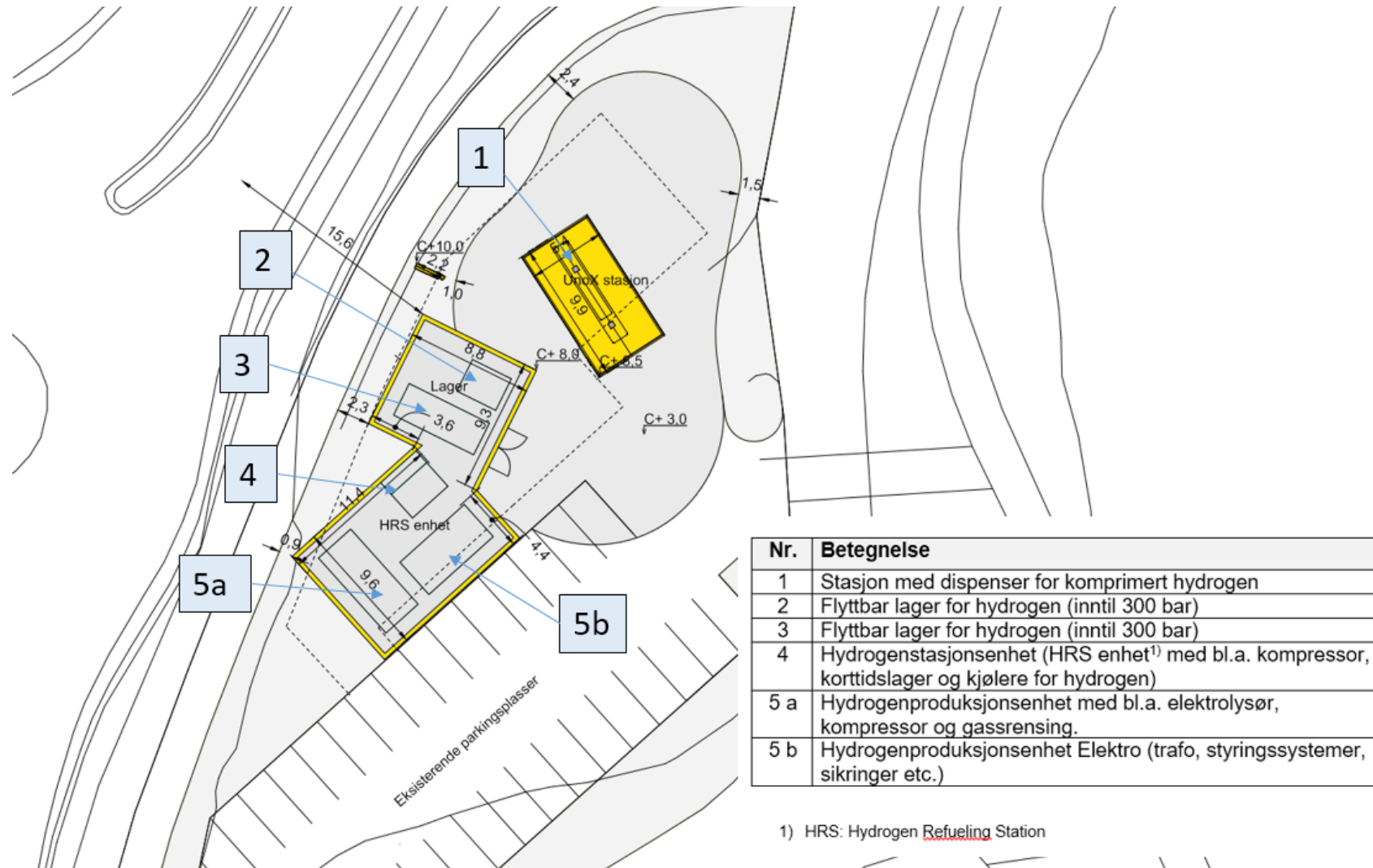
Solar Hydrogen Fuel Station



- Surplus solar power from the Powerhouse can be used to produce hydrogen.
- Electricity from the public grid can be used in periods without surplus of solar power.
- Truck delivery, if necessary.



Solar Hydrogen Fuel Station



How is Powerhouse commercial?



Owner

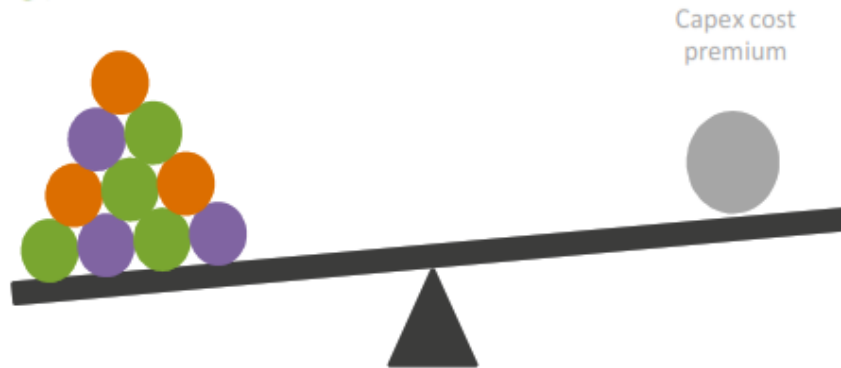
- Higher rent
- Higher valuation and exit value
- Lower finance cost

Tenant

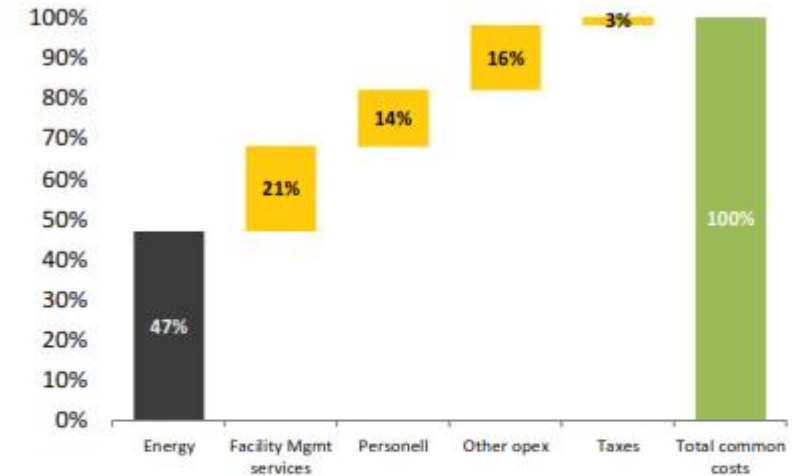
- Lower sick leave
- Increased productivity

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

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.



2 285 TWh

315 TWh

Tilgang

Netto innenlands tilgang

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

Med råstoff 231 TWh

Uten råstoff 209 TWh

Netto innenlands energibruk

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

Transport
56 TWh
(- 1,8 % siste år)

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



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.

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 energiprodukerende næringer (63 TWh)

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

↓ Eksport
2 042 TWh

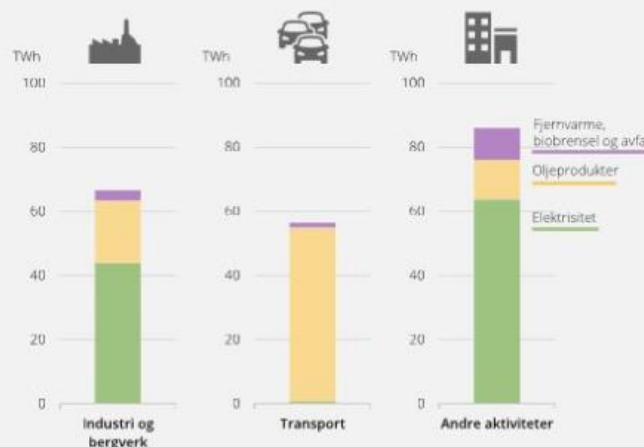
↑ Import
76 TWh

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

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



Thank you for your attention



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