

LECO sluttkonferanse

Oslo, 4.11.2011

LECO - Energibruk i fem kontorbygg i Norge

Prosjektrapport 48

2009



CATHERINE GRINI, HANS-MARTIN MATHISEN, IGOR SARTORI, MATTHIAS HAASE,
HELLE WØHLK JÆGER SØRENSEN, ARNKELL PETERSEN, IDA BRYN OG
TORE WIGENSTAD

Presented by: Igor Sartori

LECO – Energibruk i fem kontorbygg i Norge

- **5 office buildings overview**
- Analysis results
- Lessons learned

Aibel-bygget – Sandnes



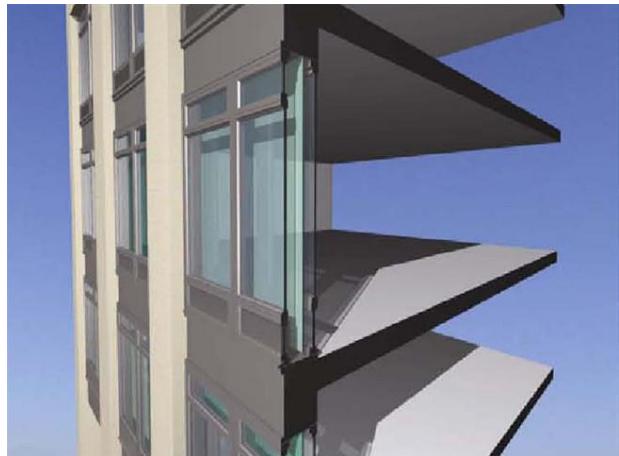
- District heating/cooling
- Heating with waterborne radiator
- Ventilation/cooling with klimatak
- Atrium serves as exhaust air plenum
- Demand controlled ventilation: motion sensor / CO₂ sensors

Bravida-bygget – Fredrikstad



- Geothermal heat pump, solar collectors
- Heating, cooling, ventilation & lighting combined in ceiling elements
- Demand controlled ventilation & lighting

FN-bygget – Arendal



- Renovated building (1965 – 2004), box-windows
- Seawater heat pump, solar collectors
- Heating with waterborne radiators
- Ventilation/cooling with ceiling elements
- Demand controlled ventilation & lighting

Bassengbakken 1 – Trondheim



- District heating/cooling
- Heating with waterborne radiators
- Ventilation/cooling with klimatak
- CAV ventilation
- Manual control

Strandveien 18 – Bærum

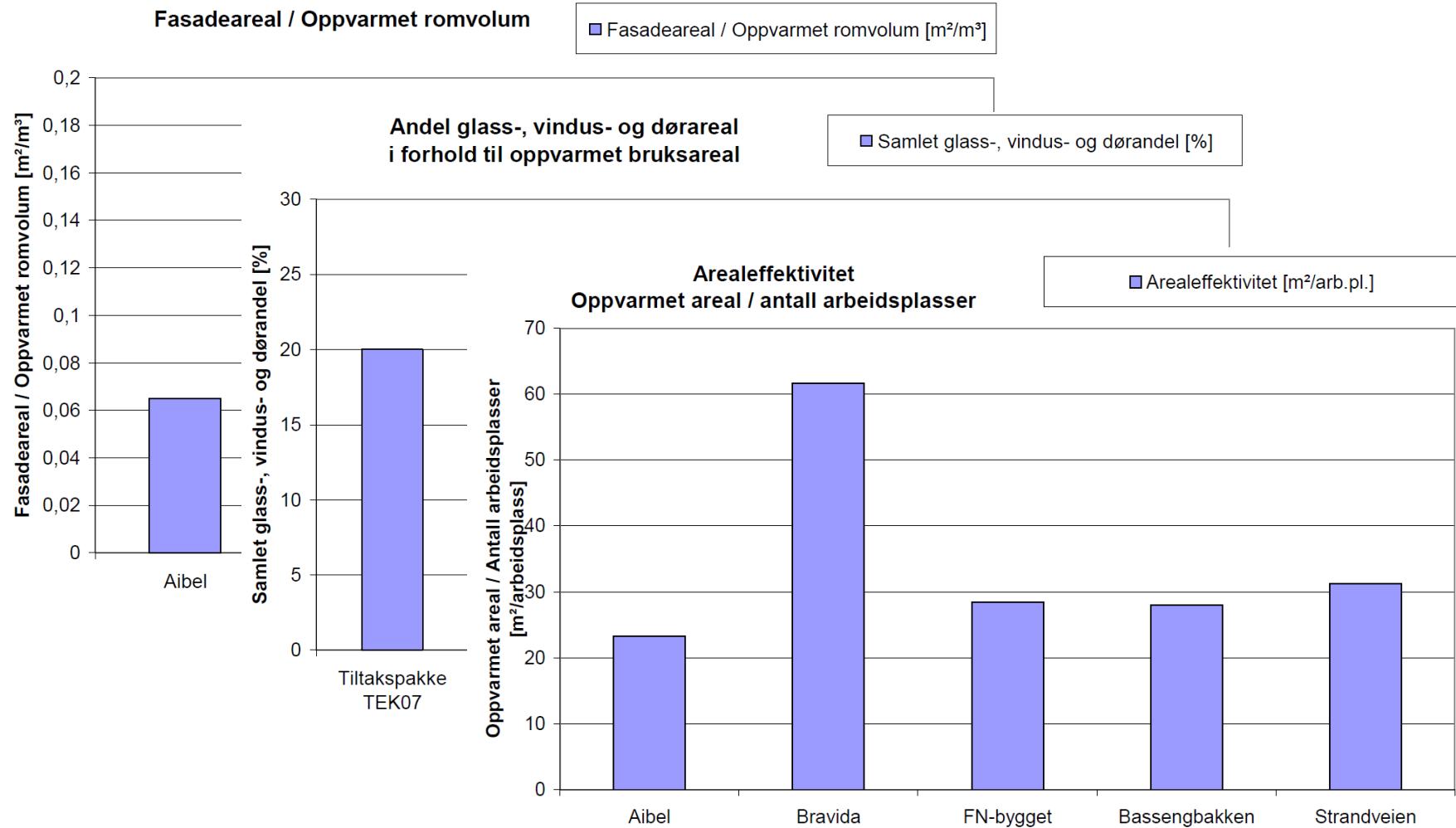


- District heating/cooling
- Heating with waterborne radiators / floor heating
- CAV ventilation
- Lighting control with motion sensor, after office hours
- Temp. control conflict in open spaces

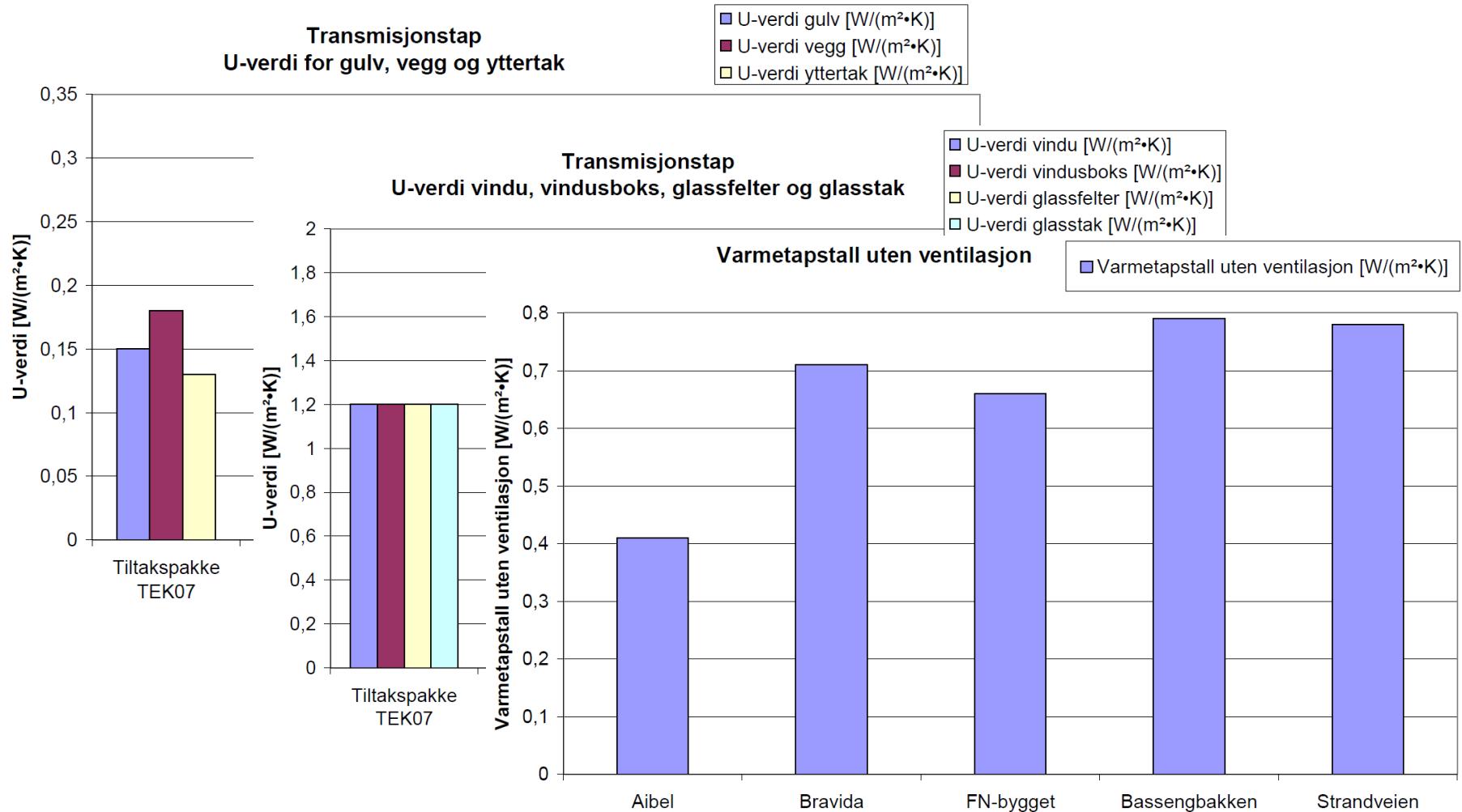
LECO – Energibruk i fem kontorbygg i Norge

- 5 office buildings overview
- **Analysis results**
- Lessons learned

Building form

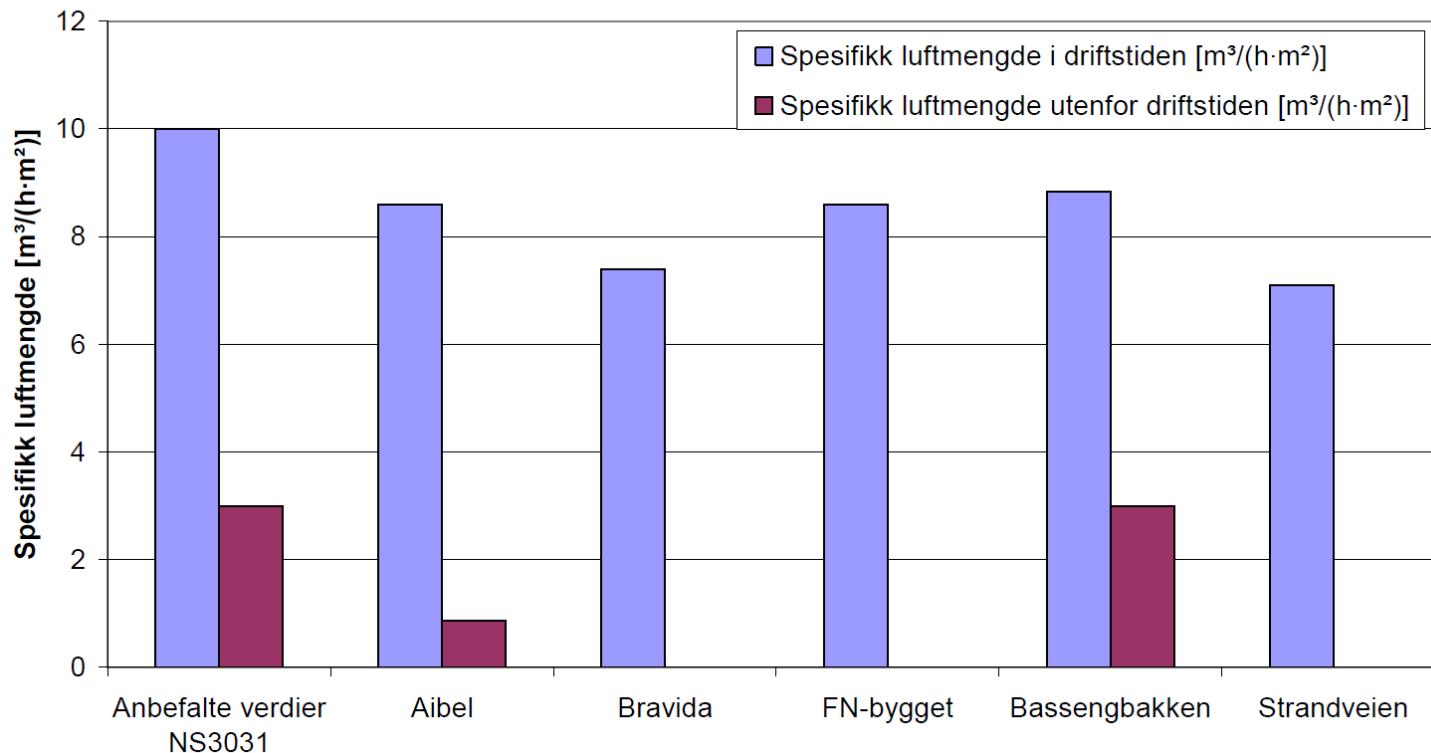


Envelope



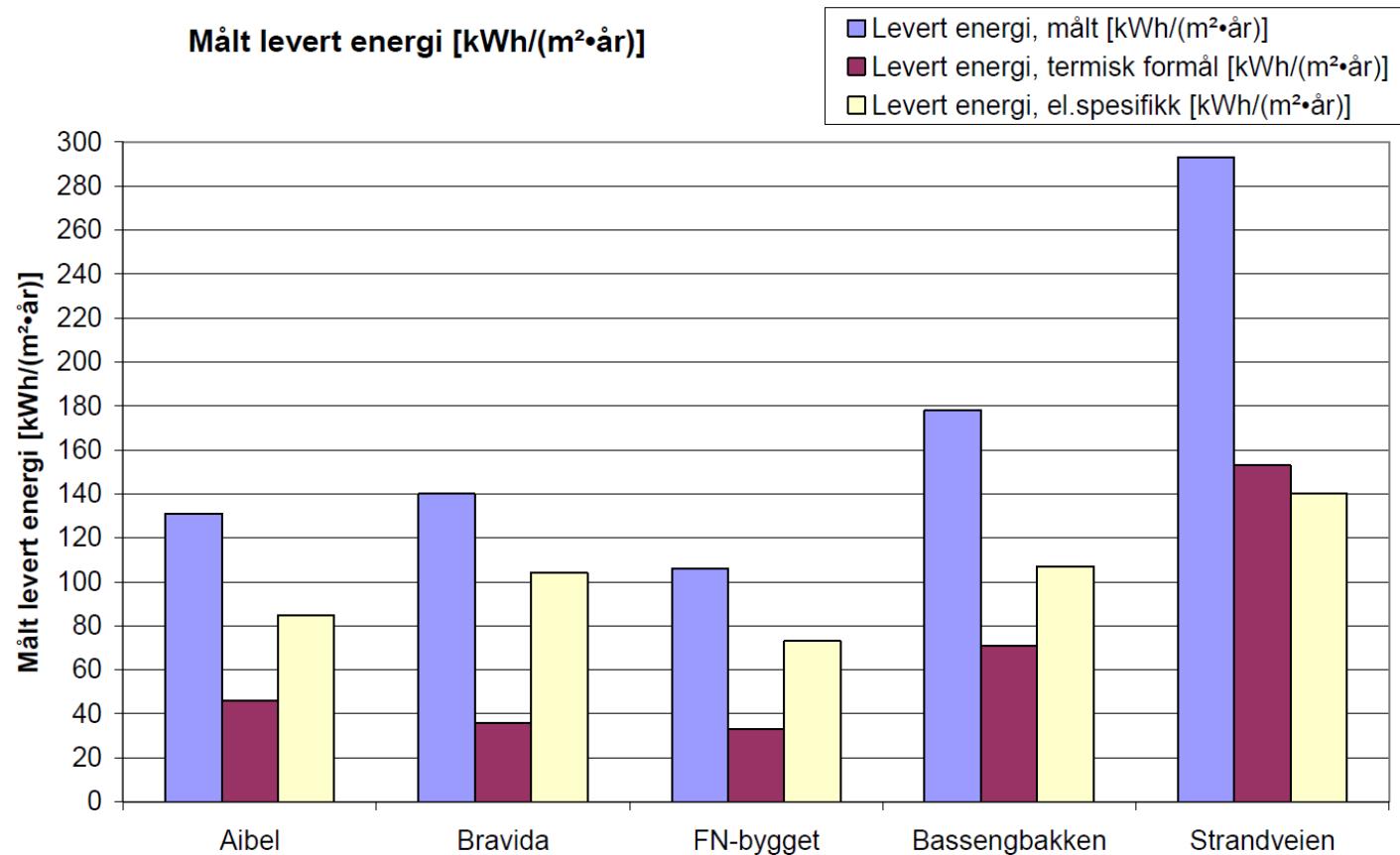
Ventilation

Spesifikk luftmengde i og utenfor driftstiden [$\text{m}^3/(\text{h}\cdot\text{m}^2)$]

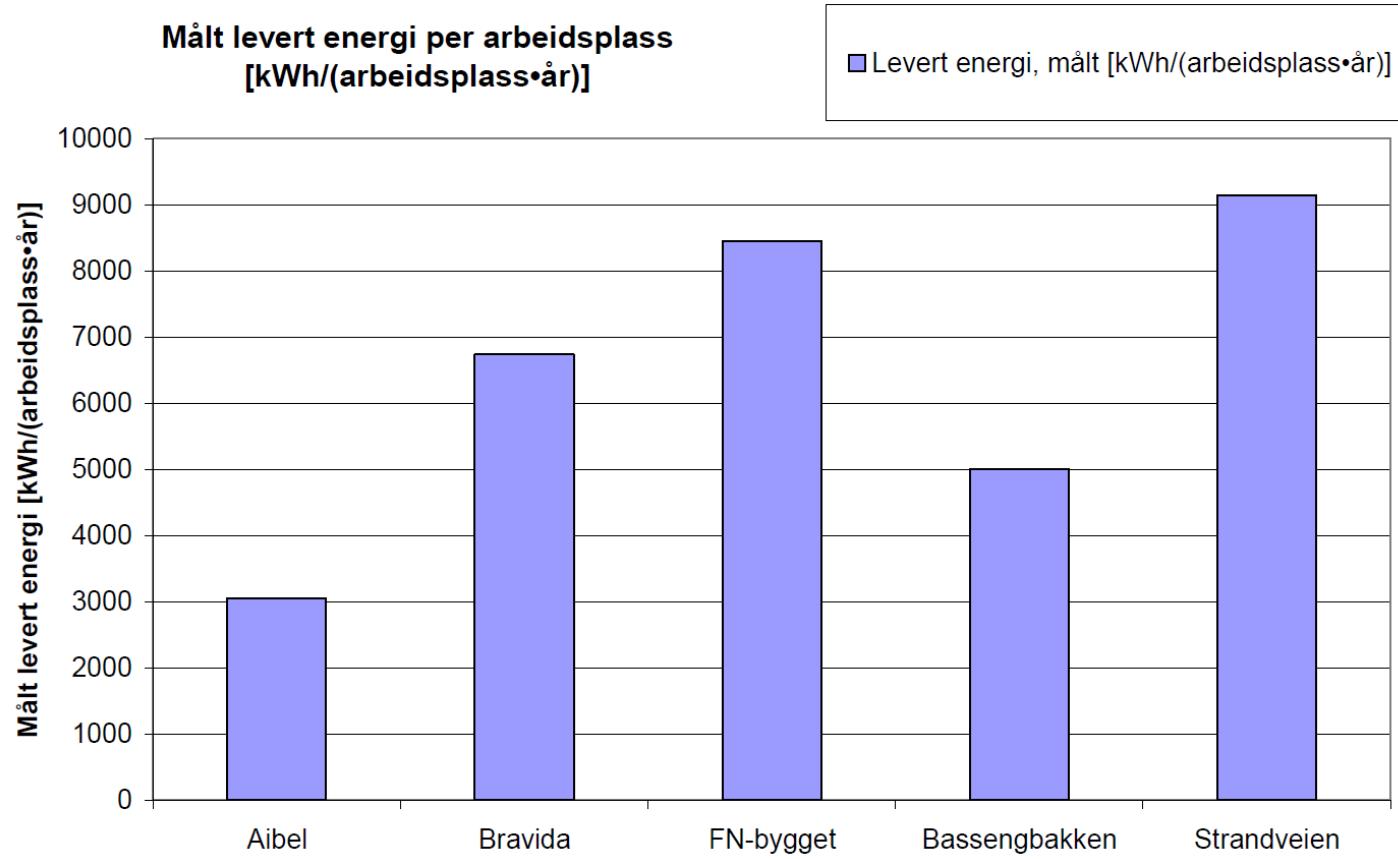


Temperatur-virkningsgrad på varmegjenvinner, gjennomsnitt	[%]	64 (nominell verdi)	61 (registrert ved SD-anlegg)	65 (antatt)	51	50 (nominell verdi)
Antatt SFP	[$\text{kW}/(\text{m}^3/\text{s})$]	2,0	2,0	2,9	2,98	3,0

Metered energy use, per square metre



Metered energy use, per working place



LECO – Energibruk i fem kontorbygg i Norge

- 5 office buildings overview
- Analysis results
- **Lessons learned**

Lessons learned – The way to energy efficient offices

- *Aibel-bygget* achieves a low energy use thanks to:
 - "Optimal" building envelope: compact, well insulated, less glazed area
 - Efficient ventilation: demand controlled, heat recovery 64%, SPF 2.0 kW/(m³/s), cooling with ventilation (klimatak)
 - Is also the newest; good use of existing and well-proven technologies
- *FN-bygget* almost achieves the design energy target: 100 kWh/m²a delivered:
 - Good building envelope, especially windows
 - Efficient ventilation, demand controlled
 - Heat pump coupled with seawater
 - Metering and monitoring of energy use

Lessons learned – Higher energy use than planned, why?

- *Bravida-bygget* shows higher energy use than planned; operation is not optimal:
 - Solar collectors are not used
 - Circulation pump for heating and cooling runs 24h year round
 - No follow-up of energy use; the vaktmester went to pension and was never replaced
- *Strandveien 18-bygget* has the highest energy use:
 - Server room/UPS use 80 kWh/m², 29% of the total
 - Ventilation is poorly regulated
 - Temp. regulators not calibrated and not changed after cell-offices became open space

Lessons learned - The role of operation control

- *Bassengbakken-bygget* does not reach low energy levels, BUT:
 - Similar envelope and HVAC characteristics as in *Strandveien 18*
 - Even with more glazed area, higher ventilation rate, longer occupation, colder climate. Yet...
 - Thermal demand is half!
 - *Bassengbakken* is the only building to have a manual control of teh most important parameters affecting energy use (vaktmester regulating from a central room)
- ...shall on conclude that the best automatization cannot make up for human brains?

Lessons learned - Further consideration

- Ingen av byggene har etablert en økonomisk incentivordning for å motivere brukerne til energisparing. Myndighetene ønsker å redusere kraftig energibruk i bygningsmassen [...] Følgelig kan det reises spørsmål om tiden er inne for å kreve at kontorbyggene utstyres med **en strømmåler per leietaker**, på lik linje med boligblokker, der hver leilighetsbeboer betaler for sitt eget strømforbruk, utenom husleie.
- Elektrisk spesifikk forbruk knyttet til serverrom / UPS (Uninterruptible Power Systems) oppfattes som ikke godt nok kartlagd. Installert effekt til serverrom er lik 107 kW for bygget i Strandveien 18. Bravidahuset har et høyt elektrisk forbruk døgnet rundt. Det er registrert et effektuttak på 35 kW nattestid over hele året, uten at en kan tydelig si hva elektrisiteten brukes til. Det er **behov for egne strømmåler** som gir mulighet til å overvåke den leverte elektrisiteten til serverrom. I enkelte bygg oppfattes denne posten som "ute av kontroll".

After all: "If you cannot measure it, you cannot improve it"
Sir William Thomson, Lord Kelvin