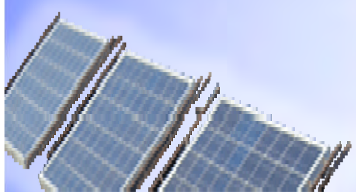
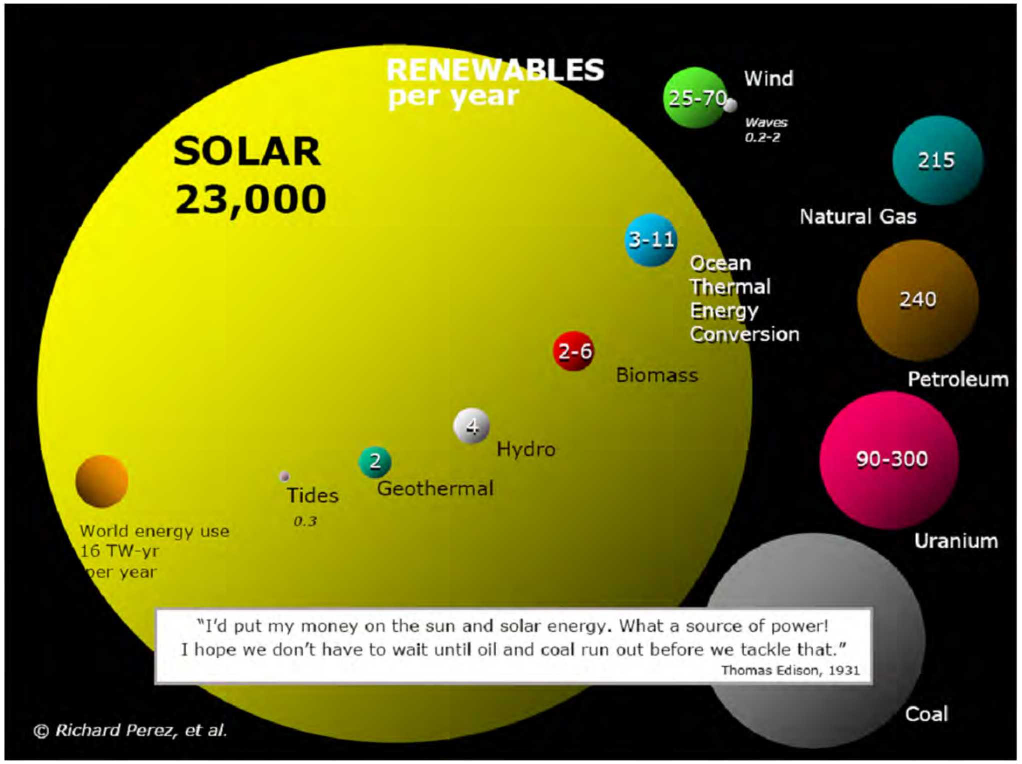


Smart Active House Building

By Peder Vejsig Pedersen, Cenergia (from 1. Oct. 2016, Kuben Management)



Presentation on how to integrate solar energy systems into buildings, which at the same time has a low energy use and an optimised energy supply. Based on experiences of almost a whole engineering career equal to the last 30 years.

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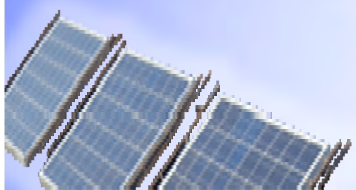

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By Peder Vejsig Pedersen, Cenergia (from 1. Oct. 2016, Kuben Management)

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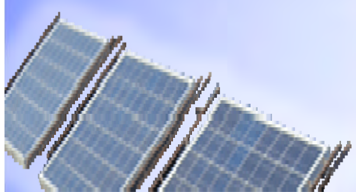

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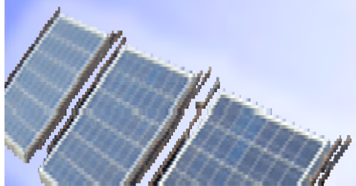

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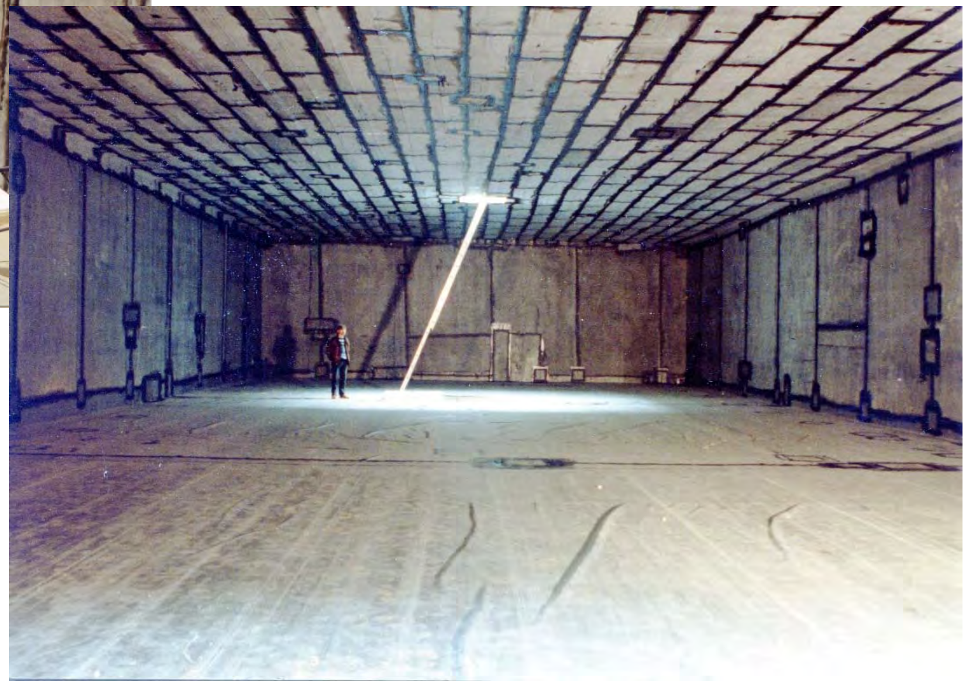
In 1990 it was, with EU and Danish Energy Agency funding, possible to realise the first large scale solar thermal installation in Denmark in combination with a seasonal storage.



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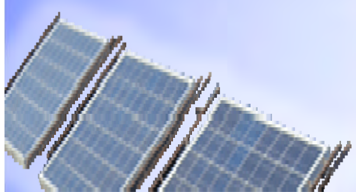

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By Peder Vejsig Pedersen, Cenergia (from 1. Oct. 2016, Kuben Management)

This was the Tubberupvænge II project in Herlev near Copenhagen with 100 housing units utilising 400 m² local solar thermal collectors together with a 1.000 m² Arcon Solar Heating collector field in combination with a 3.000 m³ well insulated seasonal storage, and with a small gas driven CHP and heat pump system as backup.

Tubberupvænge, DK
Solar low energy housing with seasonal storage.

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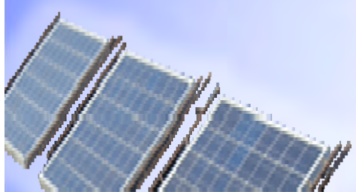

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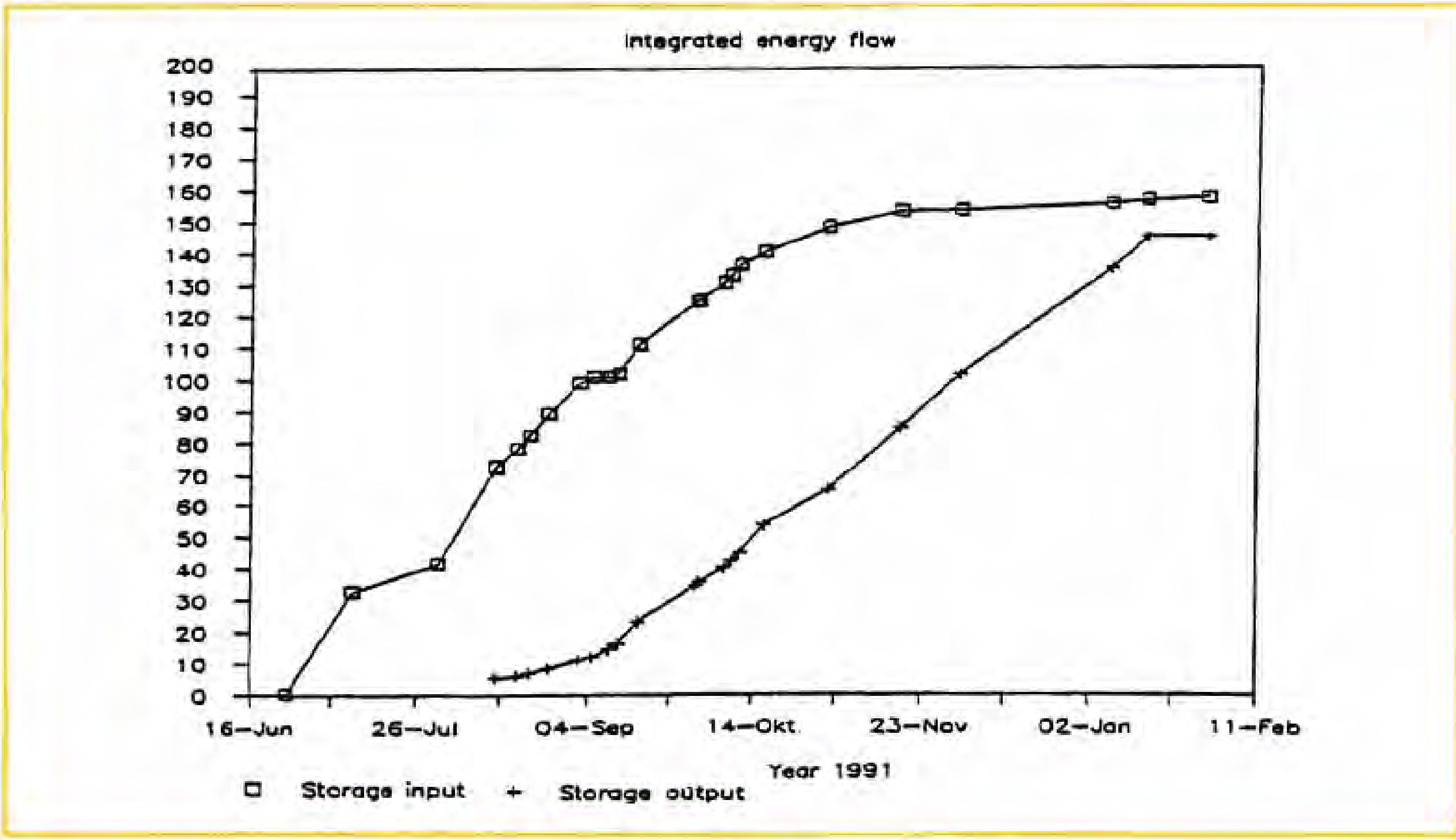

First year of operation led to 95 °C in the storage. In the second year a leakage was found, and only after 5 years a repair with a stainless steel liner was made.

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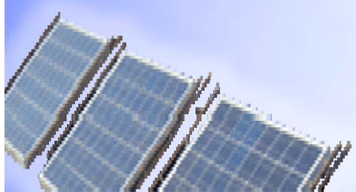

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Example of solar thermal collector integration by Danish BPS Standard.

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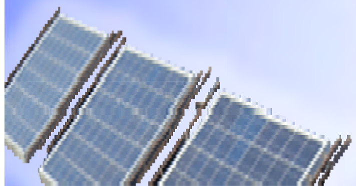

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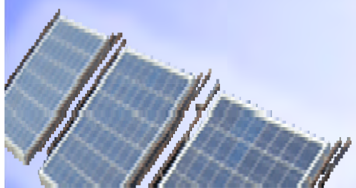

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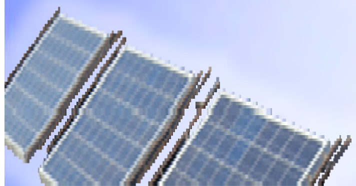

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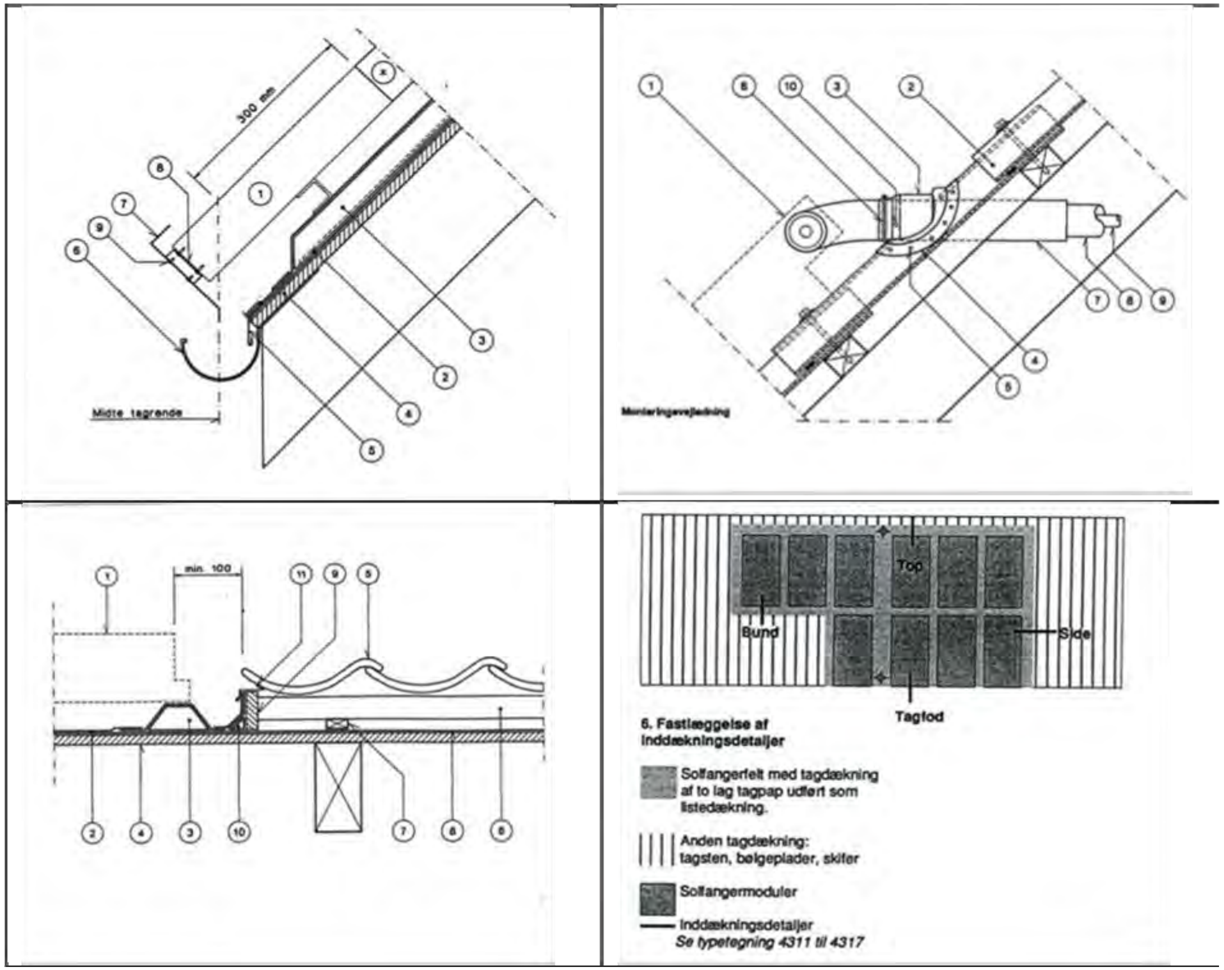

Illustrations of integration of solar thermal collectors according to the BPS rules from 1990s, leading to a very secure and nice integration in practice. The same approach can be used for BIPV in e.g. tile roofs.

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Nordic Solar heating demonstration in Ballerup and Roskilde

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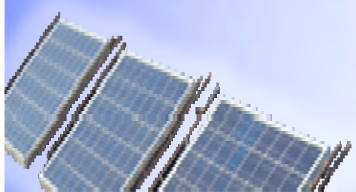

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By Peder Vejsig Pedersen, Cenergia (from 1. Oct. 2016, Kuben Management)

In 1992 it was possible to realise a new EU-funded project also with 100 low energy designed housing units. On these 700 m² roof integrated solar thermal collectors was combined with a smart pulse operation of a CHP based district heating supply and considerable reduced losses for the network was obtained during the summer.

Skotteparken solar low energy housing project at
Egebjerggaard in Ballerup near Copenhagen

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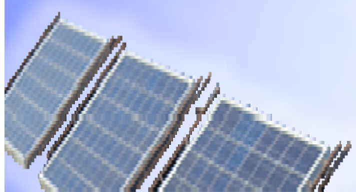

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The Skotteparken project received the World Habitat Award in 1993 and received a lot of positive attention

Heat Demand Halved in Danish Buildings

Ecological Building with 50% Lower Energy Consumption

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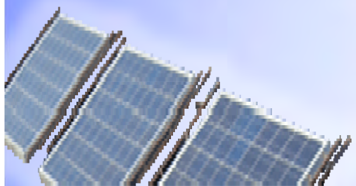

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The Skotteparken project also led to an EU-Target project with 9 demonstration projects in 7 EU countries, here the UK

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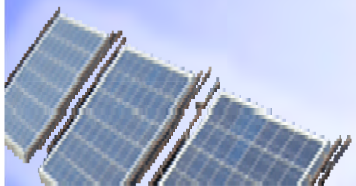

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JRC Ispra experimental hall 45 in Italy, with new solar low-energy retrofit including a 550 m² Canadian solar wall installed on the south facade of the building (1998)

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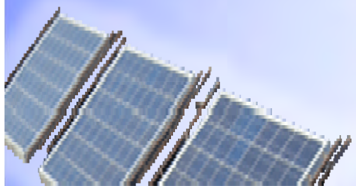

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The result from the first Danish PV architectural competition in Denmark from 1998 utilising PV assisted ventilation. (1998)

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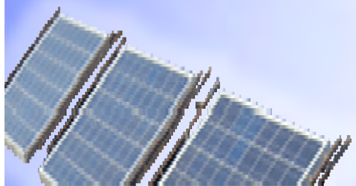

Smart Active House Building

By Peder Vejsig Pedersen, Cenergia (from 1. Oct. 2016, Kuben Management)

In 2005, it was possible, again with EU funding, to realise the first passive house building project in Denmark, Rønnebækhave II in Næstved with a small housing block with a CO_2 neutral heating solution based on combined use of solar thermal heating, PV panels and a ground coupled heat pump system. And as a special thing, the yearly energy savings obtained was exactly equal to the calculations, something which is not often the case.

Rønnebækhave II in Næstved.

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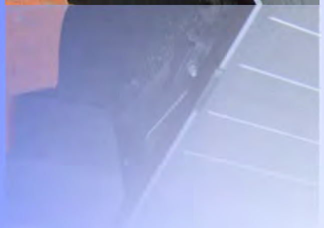
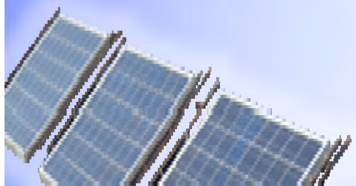
Shared IVT ground coupled heat pump
(COP of 3.2 -3.4)





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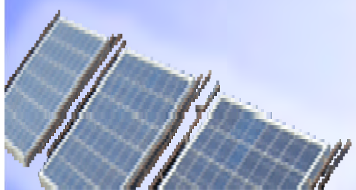

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Buffer tank for shared heat pump

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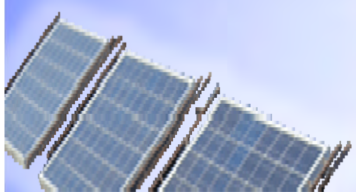

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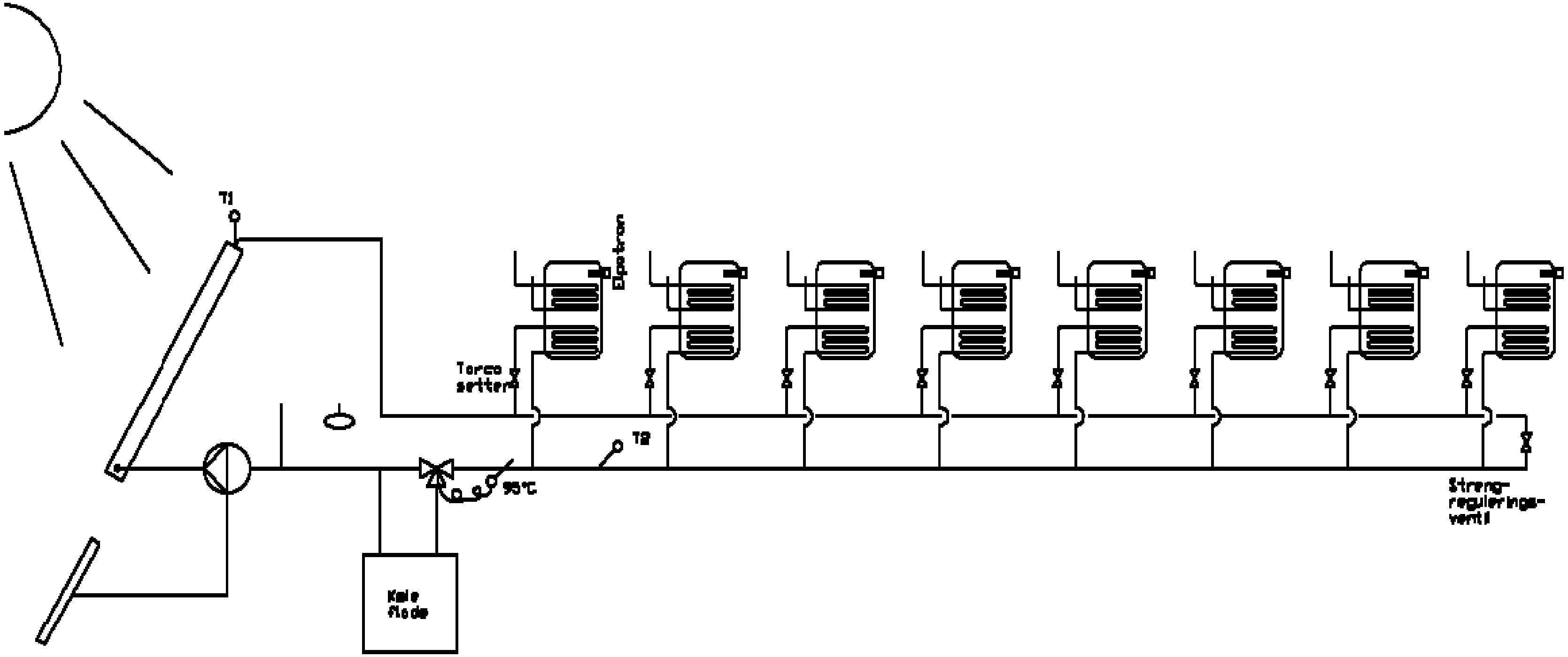

The apartments utilise a 28 m² shared solar DHW system from Arcon Solar Heating and individual 240 litre DHW tanks.

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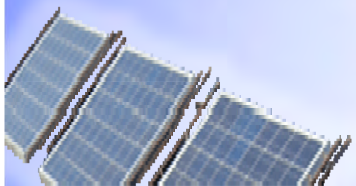

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50 m² PV-modules in Rønnebækhave II is mounted in the roof facing south in connection to a solar collector area of 28 m².

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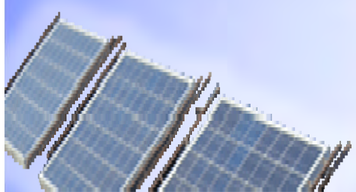

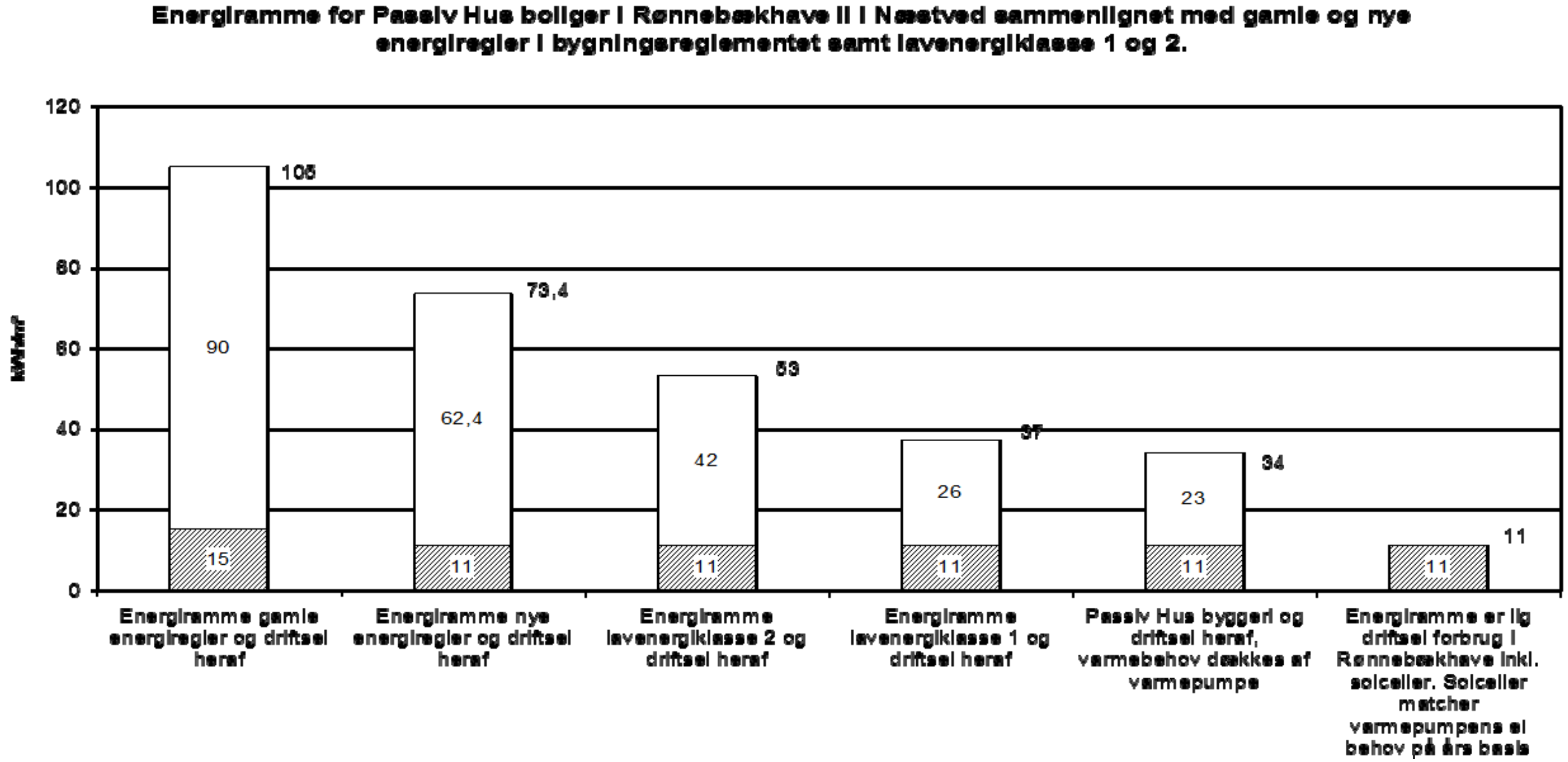

Here is illustrated the energy frame value for the project.
The energy use for the heat pump is the same as the yearly
PV production of the PV-modules which is 4000 kWh
or 6.3 kWh/m², year.

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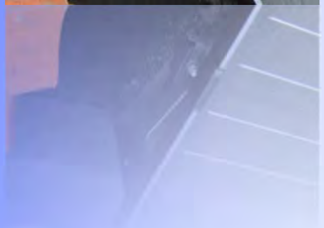

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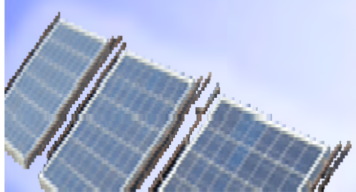
SOLTAG

A Prefabricated CO_2 neutral rooftop apartment was exhibited in 2005 at Ørestad Nord in Copenhagen.

It was developed in a co-operation between Cenergia and the Velux Group, Kuben Urban Renewal Denmark and Rubow Architects. Homepage : www.soltag.net



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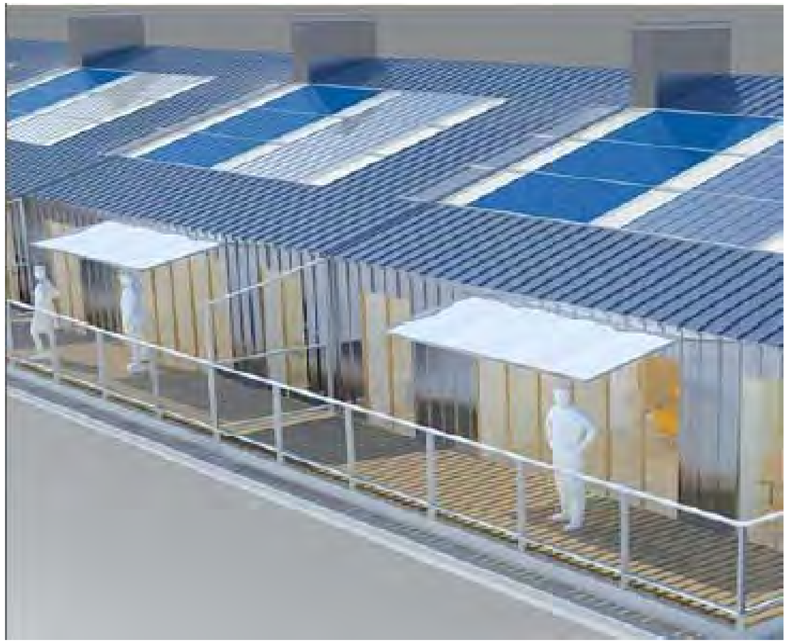
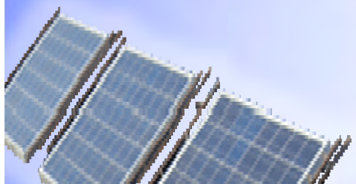
SOLTAG – In 2006 the prefabricated roof top apartment SOLTAG was moved to the headquarters of VELUX



In the drawing is shown a 2. generation SOLTAG zero energy housing unit developed in cooperation with MTHøjgaard Contractors



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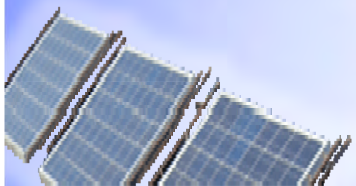

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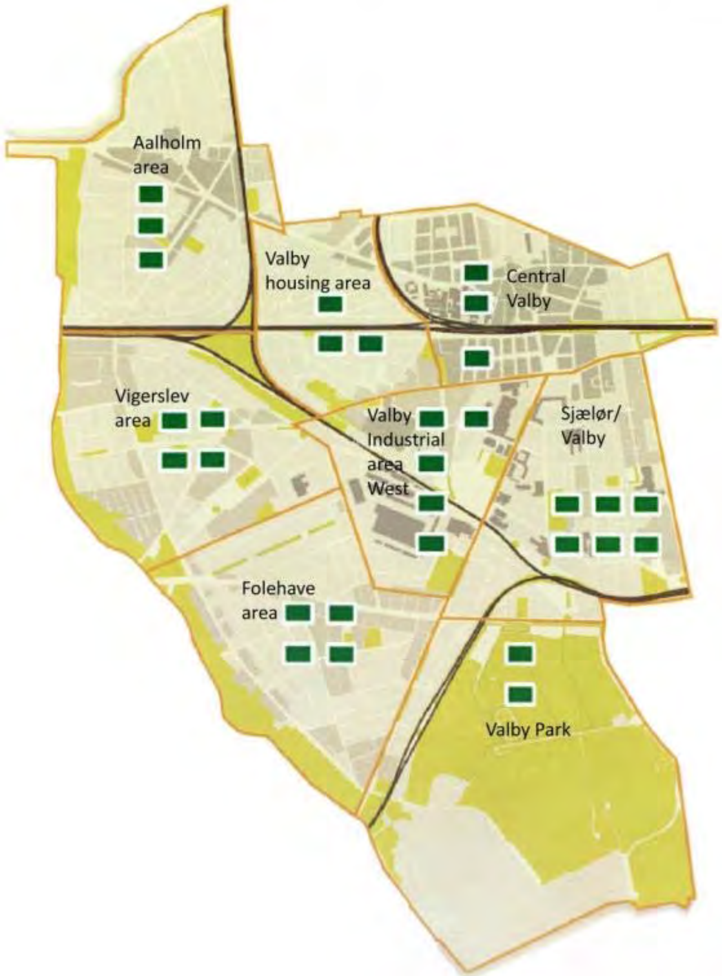

In the EU-Concerto project, Green Solar Cities (2007 – 2013) (www.greensolarcities.com) EU funding gave a strong support for the large scale PV implementation plan in Valby of Copenhagen. It was launched in year 2000 and aimed at supplying 15% of all electricity use in Valby by 30 MWp PV electricity established by year 2025. By 2013 around 4 MWp PV had been established but only 600 m² solar thermal installations.

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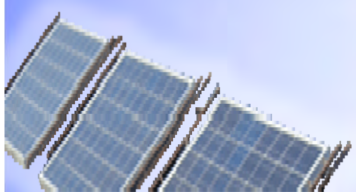

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PV art at “Prøvehallen” gable in Valby, Copenhagen,
which can be seen from the railway, is a symbol of the Valby PV plan.
In 2004 the Solar City Copenhagen organisation was established to support a similar development in the whole of Copenhagen

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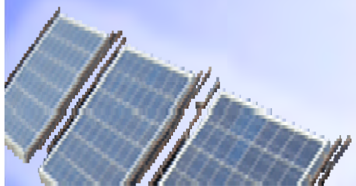
In relation to the EU Resurgence project, Erik Christiansen from EBO Consult and Peder Vejsig Pedersen from Cenergia established the first PV Coop in Copenhagen and in Denmark in 2004, where people bought shares in a 40 kWp system on top of a municipal owned building.



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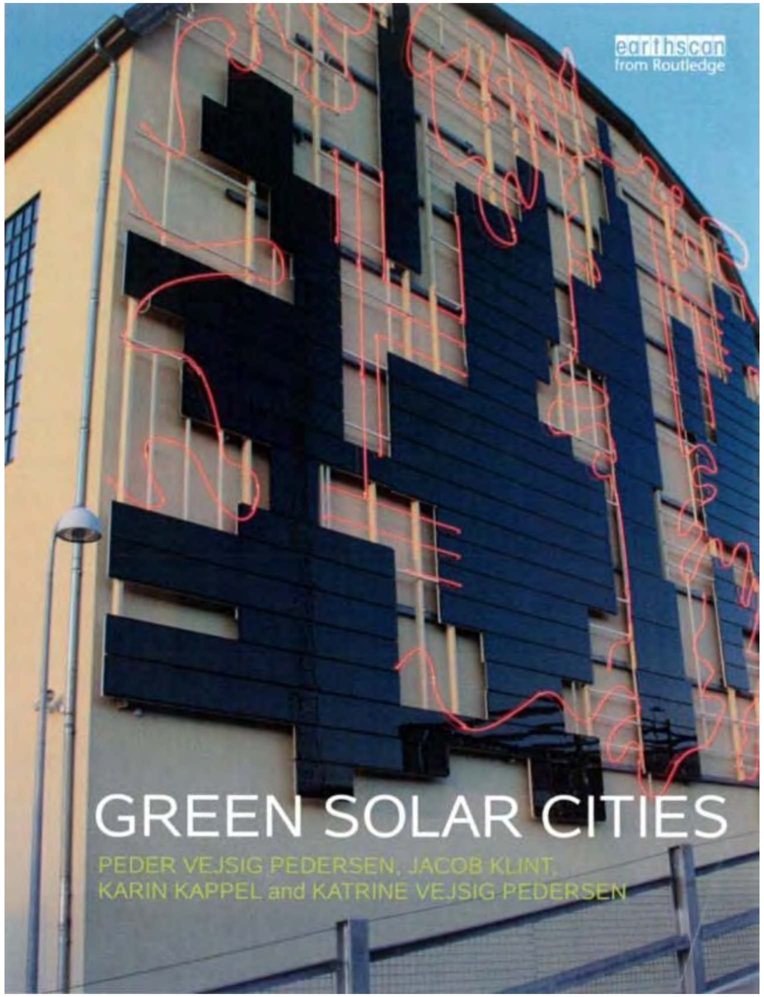
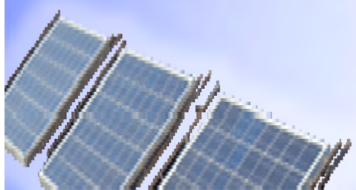


Green Solar Cities book from Routledge.

EU-Concerto project (2007-2013) in Valby, Copenhagen and Salzburg, Austria



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Solar collectors and buffer tank is part of a low temperature microgrid with 2,000 m² solar thermal collectors in Salzburg

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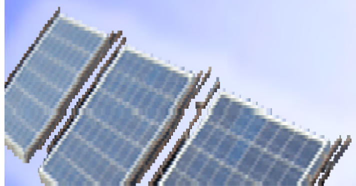

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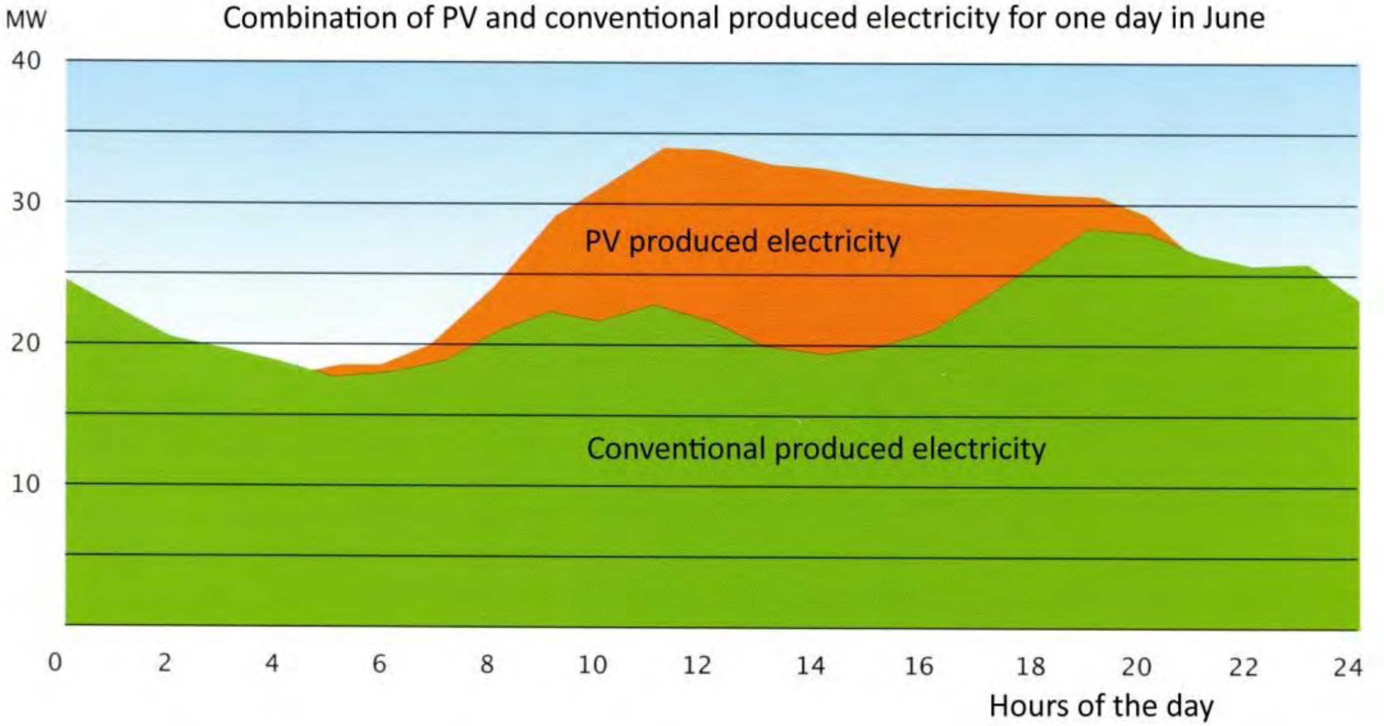

Illustration of electricity peak shaving in Valby when the PV plan is realised

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Smart Active House Building

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Photo from a large housing retrofit project in Valby at Hornemanns Vænge housing estate. 14 kWp PV (100 m²) and 100 m² solar thermal is used for each of six renovated housing blocks, as a solar energy combined heat and power solution.

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An experience here was however, that the local solar thermal systems were nearly 3 times more expensive per m² than ground based large solar thermal collector fields like this 20.000 m² solar thermal collectors for Nykøbing Sjælland district heating covering 16 % of the yearly district heating demand here.

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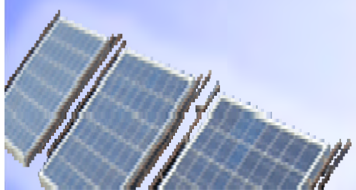

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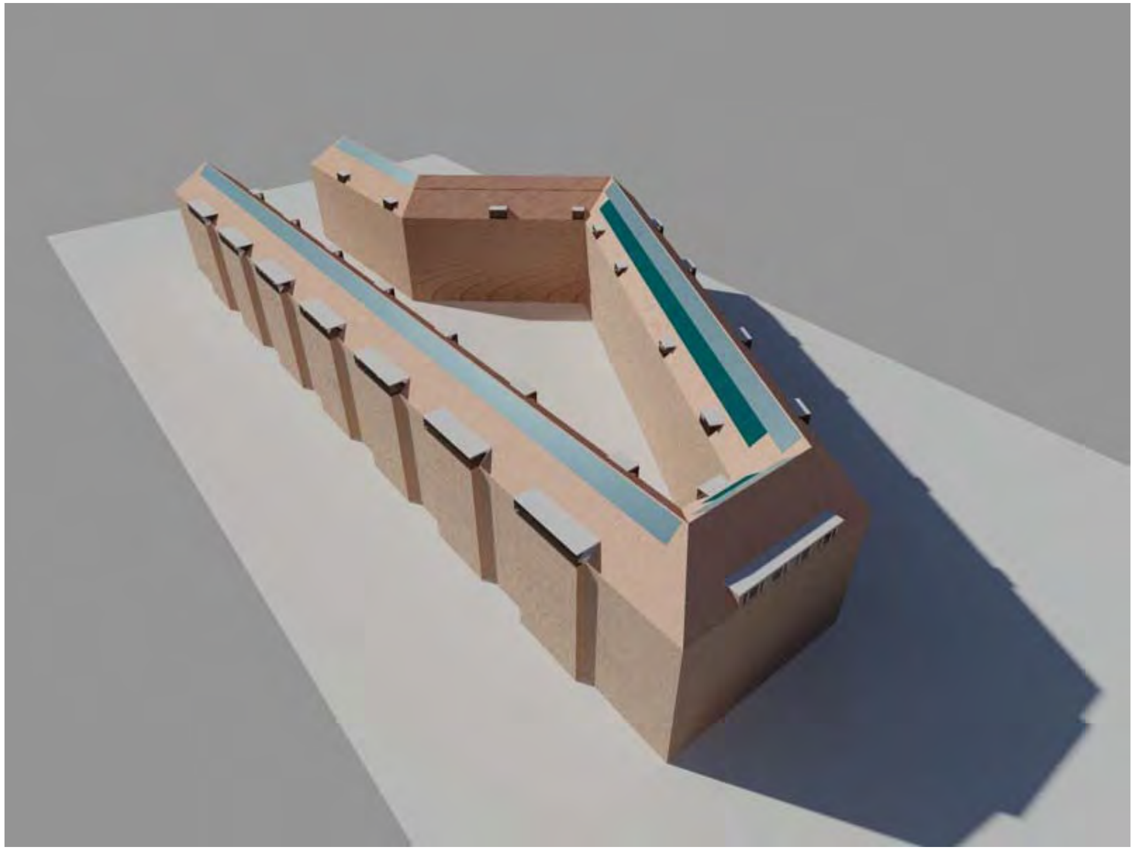

An example of solar energy combined heat and power from Copenhagen
(75 % PV area and 25 % solar thermal area).
Unfortunately the solar thermal part proved to be very costly

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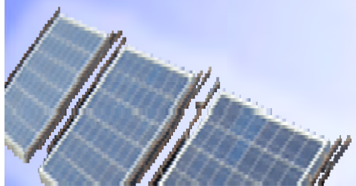

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For solar thermal building integrated solutions can still be of interest, like these low cost Norwegian Aventa façade and roof panels, that is also aimed to demonstrate in a small CO2 neutral test house in Denmark.

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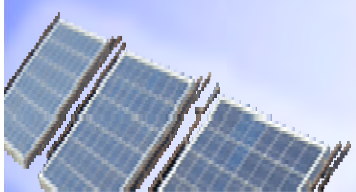

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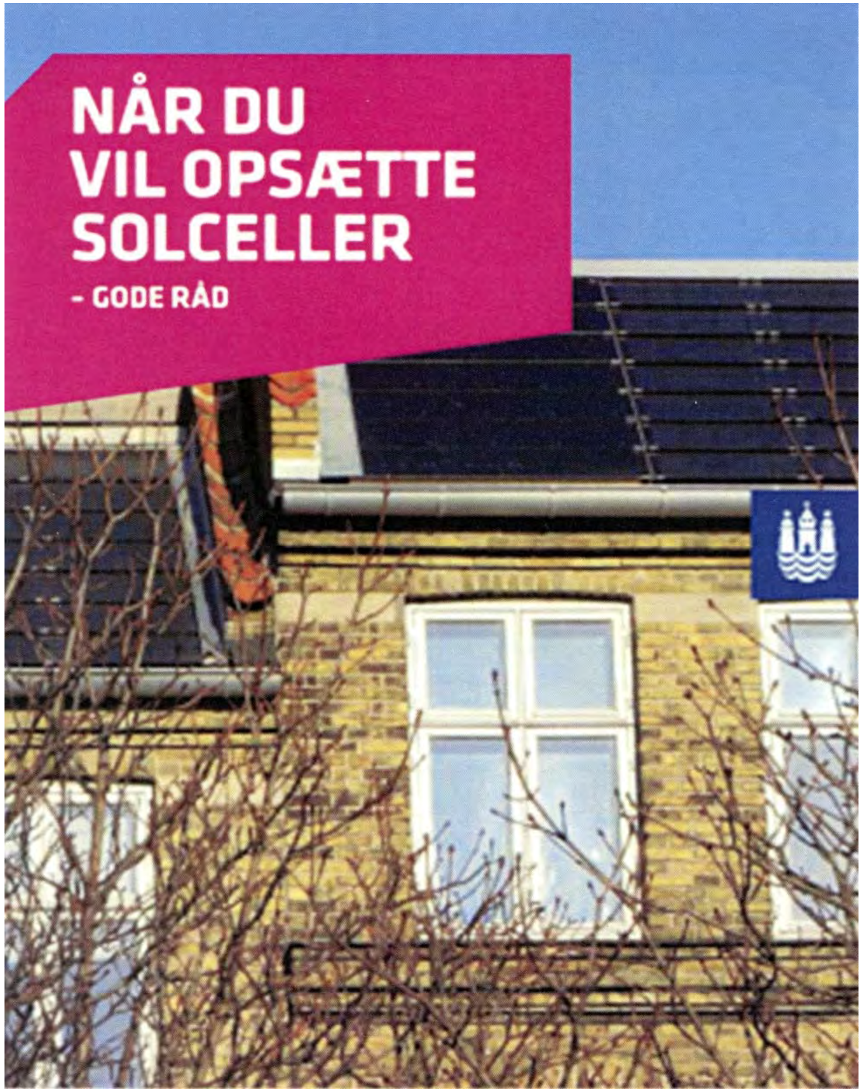

Due to the Copenhagen Climate plan to be CO2 neutral in year 2025 it is now accepted that aesthetically integrated PV solutions are allowed to be seen from street areas. Here you can view a small guideline from Copenhagen municipality showing the very successful PV-integration project Søpassagen in the centre of Copenhagen. (www.kk.dk/solceller)

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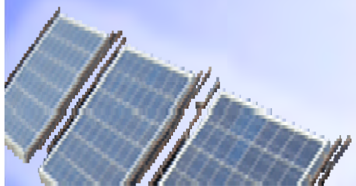

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Søpassagen housing block before integration of PV modules

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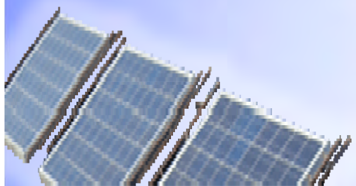
The so-called ”Copenhagen” roof consists of a flat roof part and a sloping roof part. PV panels on the top of the flat roof part are placed so they cannot be seen from the street area



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PV panels integrated in the sloping roof part
Søpassagen is chosen as an official PV example project by the Copenhagen Municipality

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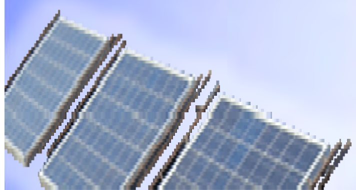
At the same time as the cost of PV panels and related technologies is still clearly reduced every year, ongoing work is still taking place in Denmark to develop new low cost mounting and integration systems for both roofs and facades



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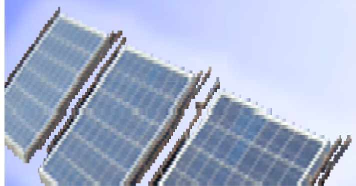

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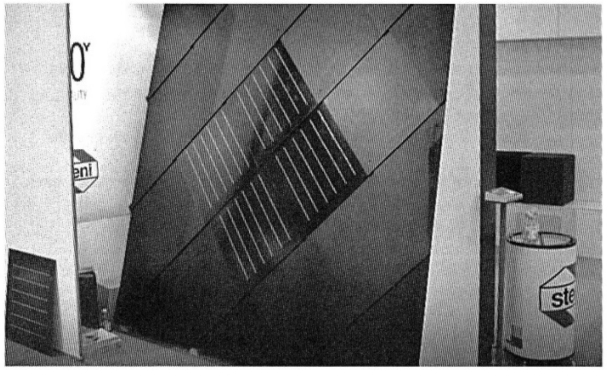
40 QUALITY SUPPORT FLEXIBILITY ENVIRONMENT

WWW.STENI.DK

Solpaneler er ved at vokse helt ind i tagpladerne

Nyt dansk erhvervssamarbejde præsenterer et bud på tagplader med indbyggede solceller.

ARTIKEL FRA DANMARS RADIO'S HJEMMESIDE: VIDEN DEN. 30.OKTOBER 2014



Løsningen med at integrere solceller i tagpladerne er helt ny og findes endnu ikke på nogen tage. Her ses princippet på de to virksomheders stand ved Building Green messen i Forum, hvor visse tagplader erstattes af solceller i nøjagtig samme dimensioner og farveskala. Foto: Bjørn Grubbe Rasmussen © Gaia Solar

Af **Martin Kunzendorf**

To danske virksomheder har slået deres respektive ekspertiser sammen og har netop præsenteret et system, hvor solceller er indbygget direkte i tagpladerne.
Det fortæller bygherrerådgiver Poul Elmegaard fra den norske virksomhed Steni, der har specialiseret sig i facader til byggeriet. Herunder tagplader.

Steni Danmark A/S

Brogade 3, 3. sal,
4600 Køge
Tlf.: (+45) 70 27 01 22
E-mail: steni@steni.dk

steni
Building knowledge

In the ongoing ForskVE projects, BIPV Quality Cities, PV Active Roofs and Facades and Low Cost Active House BIPV, Gate 21, Cenergia and other partners with Kuben Management, Technological Institute, AAU, EnergiMidt, Solar City Copenhagen and FBBB is working respectively with cities and housing associations to support the development of good BIPV solutions. Here also relying on the international Active House standard.
This will also include a BIPV demosite at Technological Institute in Tåstrup

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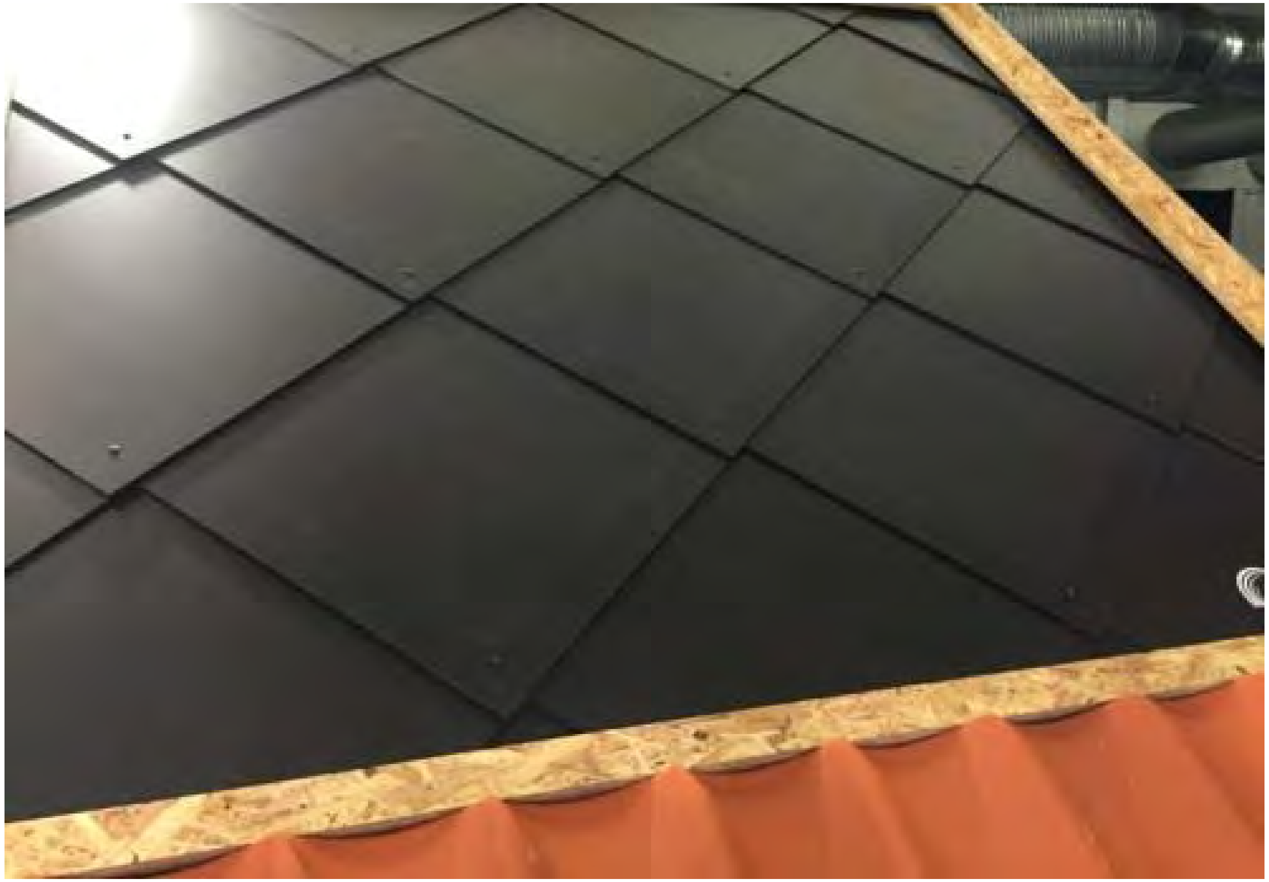

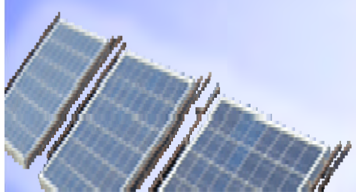

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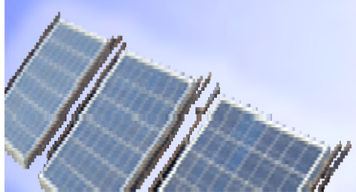

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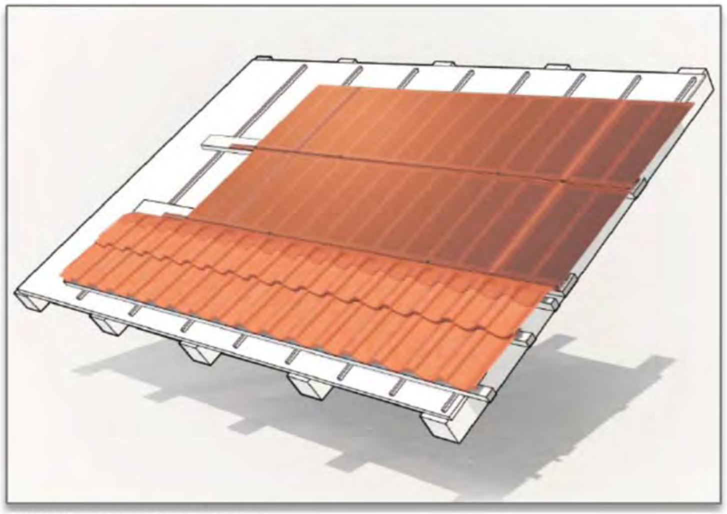

Visualisering af konstruktion

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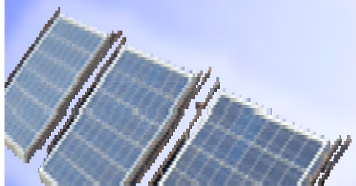

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Smart Energy Systems and 4th Generation District Heating, 26 – 29 September 2016, Aalborg

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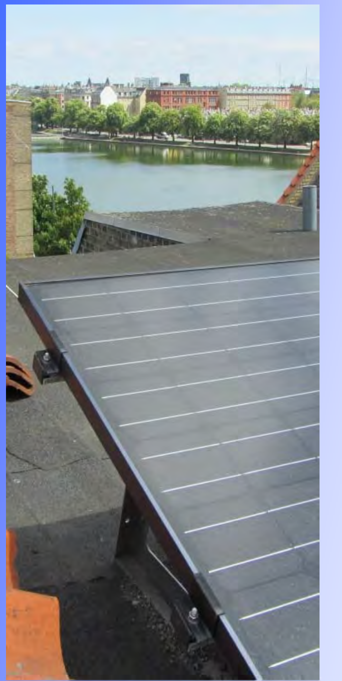

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Results are being disseminated through the national data base for sustainable and energy efficient building in Denmark, which is administrated by the Danish Association of Sustainable Cities and Buildings, FBBB (www.fbbb.dk and www.bæredygtigebygninger.dk)

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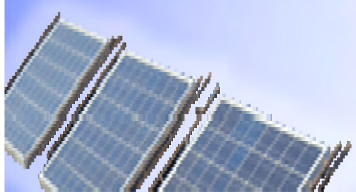

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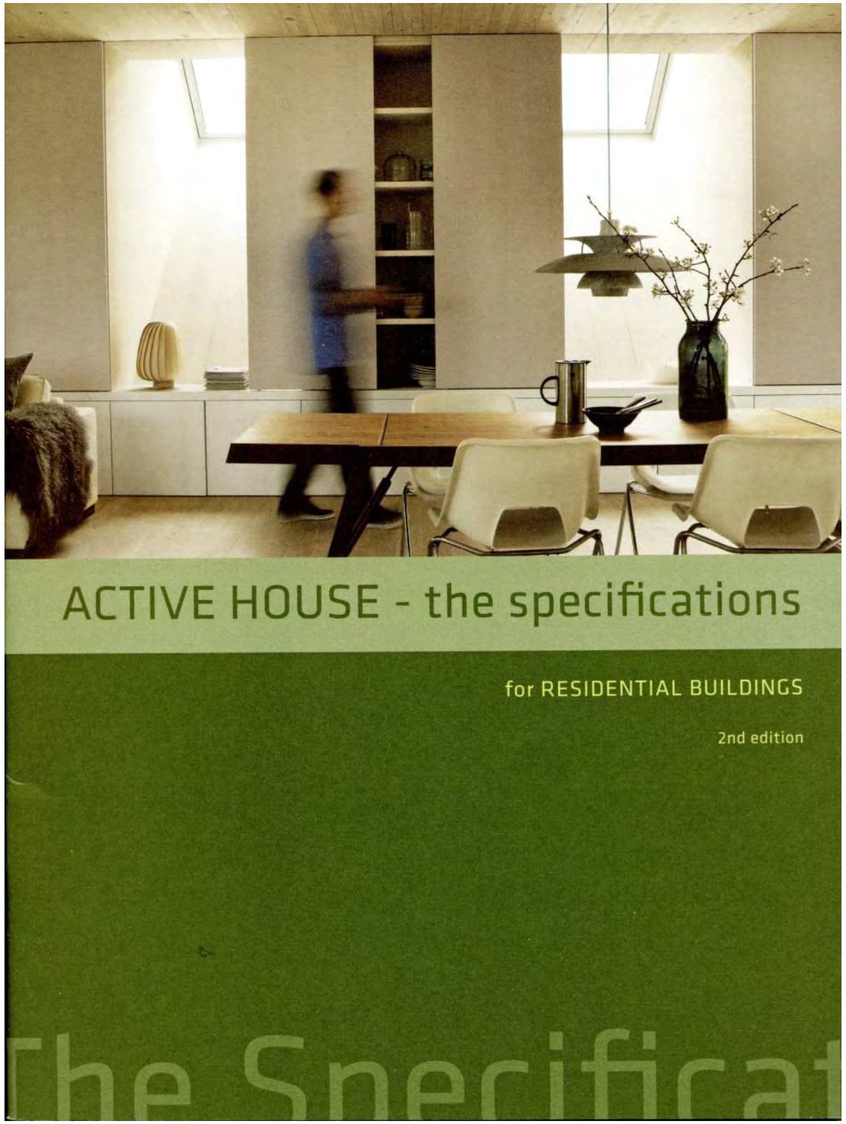

Active House Specifications can be used as a labelling tool for qualities concerning energy, comfort and sustainability.

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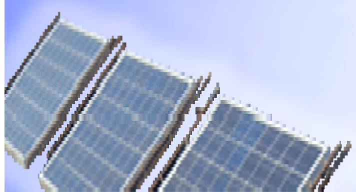

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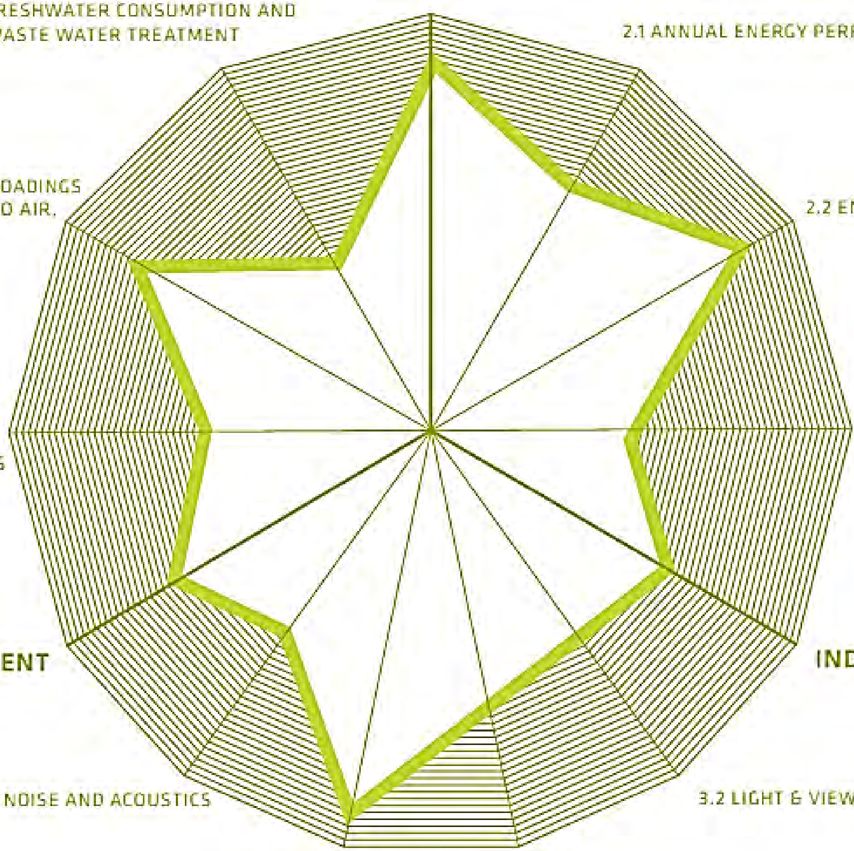

Active House Radar showing performance concerning Energy, Environment and Indoor Climate. Performance documentation is included here.

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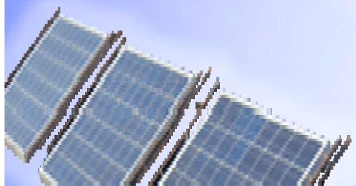
The Scandinavian inspired first Active House project in Canada was built with prefabricated construction elements in 2013.



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GREAT GULF ACTIVE HOUSE – First Active House in Canada

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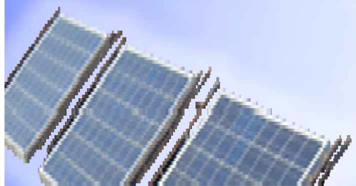

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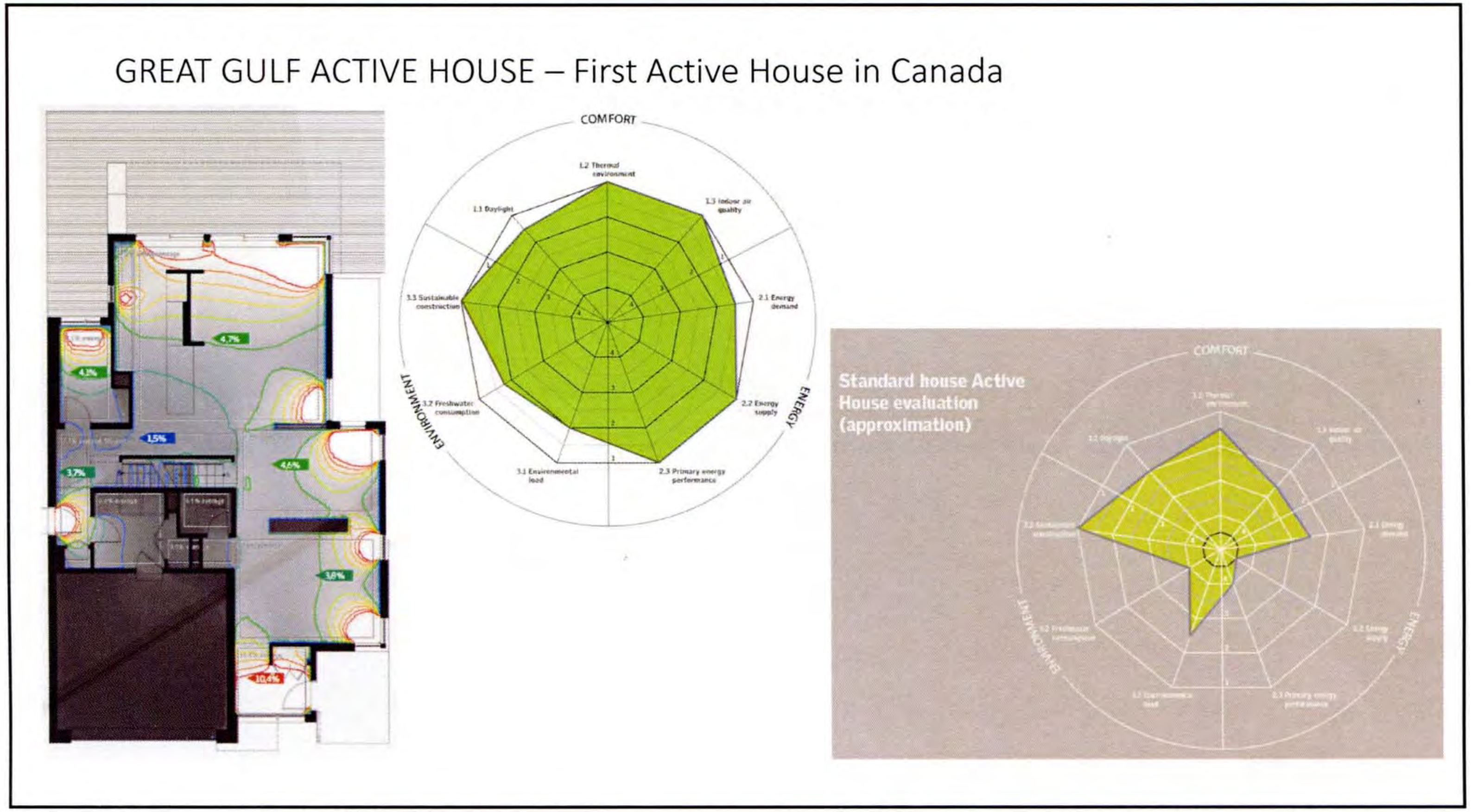

In January 2015 a Danish Active House association, www.aktivhusdanmark.dk was established

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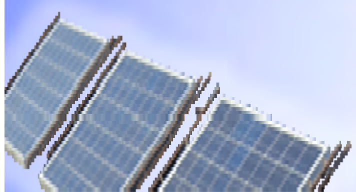

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Tendens
AKTIVHUSE

Tekst: Rikke Gundersen

Hvad er et aktivhus?

Et aktivhus skal leve op til standarder inden for 9 KATEGORIER. Her er minimumskravene.

KOMFORT

1 DAGSLYS
KRAV: Min. 100 lux i gennemsnit i rummet
METODE: Justering af vinduesorientering, størrelse, placering og glastyper.

2 TERMISK INDEKLIMA
KRAV: I maks. 5% af årets timer må temperaturen være under 18 grader eller over 0,33 x udemiddeltemperaturen + 23,8 C.
METODE: Afskærmning og ventilering.

3 LUFTKVALITET
KRAV: Maks. 5% af årets timer må CO_2-koncentrationen være over 1.600 ppm.
METODE: Mekanisk eller naturlig ventilation. Luftmængderne tilpasses rumtype og anvendelse.

7 MILJØBELASTNING
KRAV: Bygningens og materialers primære energiforbrug skal være under 200 kWh pr. m² bygning pr. år set over bygningens cyklus.
METODE: Der vælges materialer med lav miljøpåvirkning og lang levetid.

AKTIVHUSE I DANMARK

FOTO: AART ARCHITECTS
ENFAMILIEHUS
Bolig for livet. Lystrup ved Aarhus. *AART architects*
kortlink.dk/gqve

FOTO: KFS BOLIGBYG
ENFAMILIEHUS
I Sabro vest for Aarhus, *KFS boligbyg.*
kortlink.dk/gqvf

FOTO: ADAM MØRK
DAGINSTITUTION
Solhuset. Hørsholm. *Christensen & Co*
kortlink.dk/gqvg

KULTURHUS
Osramhuset. Valhalsgade, København. *Wissenberg A/S*
kortlink.dk/gqvt

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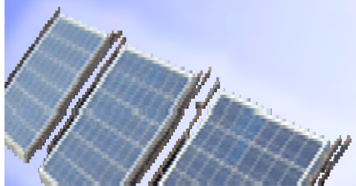

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ENERGI

5 ENERGIFORSYNING
KRAV: Min. 25% af energiforbruget skal stamme fra vedvarende energikilder
METODE: Brug af solvarme, solceller, varmepumpesystemer eller biomasse.

6 PRIMÆR ENERGIPERFORMANCE
KRAV: Må maks. være 30 kWh pr. m² bygning
METODE: Fokus på at bruge mindst mulig og producere mest mulig energi af høj kvalitet, f.eks. elektricitet.

4 ENERGIBEHOV
KRAV: Både varme og el-behovet må maks. være 120 kWh pr. m² bygning
METODE: Effektiv isolering, højisolerende vinduer og varmegenvinding af ventilationsluft.

8 VANDFORBRUG
KRAV: Min. 10% lavere vandforbrug årligt end nationale gennemsnit
METODE: Anvendelse af vandbesparende WC og armaturer samt eventuelt genbrug af regnvand.

9 BÆREDYGTIGE BYGGEMATERIALER
KRAV OG METODE:
- Min. 5% af byggematerialerne skal være genanvendt eller kunne genanvendes
- Min. 50% af træet skal være FFC- eller PEFC-certificeret. Træet skal i så høj grad som muligt stamme fra bæredygtig skovbrug
- Min. 25% af alle materialerne skal komme fra producenter, som er EMS-certificeret

MILJØ

AKTIVHUSE FREMTIDEN

Om 5-10 år vil vi, ifølge en af Danmarks førende eksperter i aktivhuse Amdi Worm, Teknologisk Institut, se:
- Omkring 100 byggerier i Danmark, som er aktivhuse.
- Typehusproducenter vil konkurrere mere med hinanden på at få de bedste evalueringer i forhold til principperne for aktivhuse.
- Flere rådgivende ingeniørfirmaer, arkitekter og konstruktører vil tilbyde aktivhuse, da det vil skabe ekstra omsætning i deres virksomheder og samtidig kunne bidrage til en kvalificeret diskussion med bygherrerne omkring komfort, energi og miljø.
- Aktørerne vil få erfaringer med aktivhuse, så de i højere grad fremadrettet kan lave huse, som lever op til de forventninger, man har i designet.

SE teknologi i et aktivhus

ENFAMILIEHUS
Hillerød.
HHM A/S
kortlink.dk/gqvn

HOTEL OG CONFERENCECENTER
Green Solution House, på Bornholm.
3XN
kortlink.dk/gqvq

UNIVERSITETS-BYGNING
Green Lighthouse. København
Christensen & Co
kortlink.dk/gqvr

AKTIVHUSE I TAL
- Der findes omkring 10 aktivhuse i Danmark og mellem 50 og 100 på verdensplan.
- Det tager den samme tid at bygge et aktivhus som et almindeligt hus.
- Et aktivhus har 10-50% lavere vandforbrug i forhold til et standardhus.
- Et aktivhus har 50-75% lavere energiforbrug i forhold til et standardhus.

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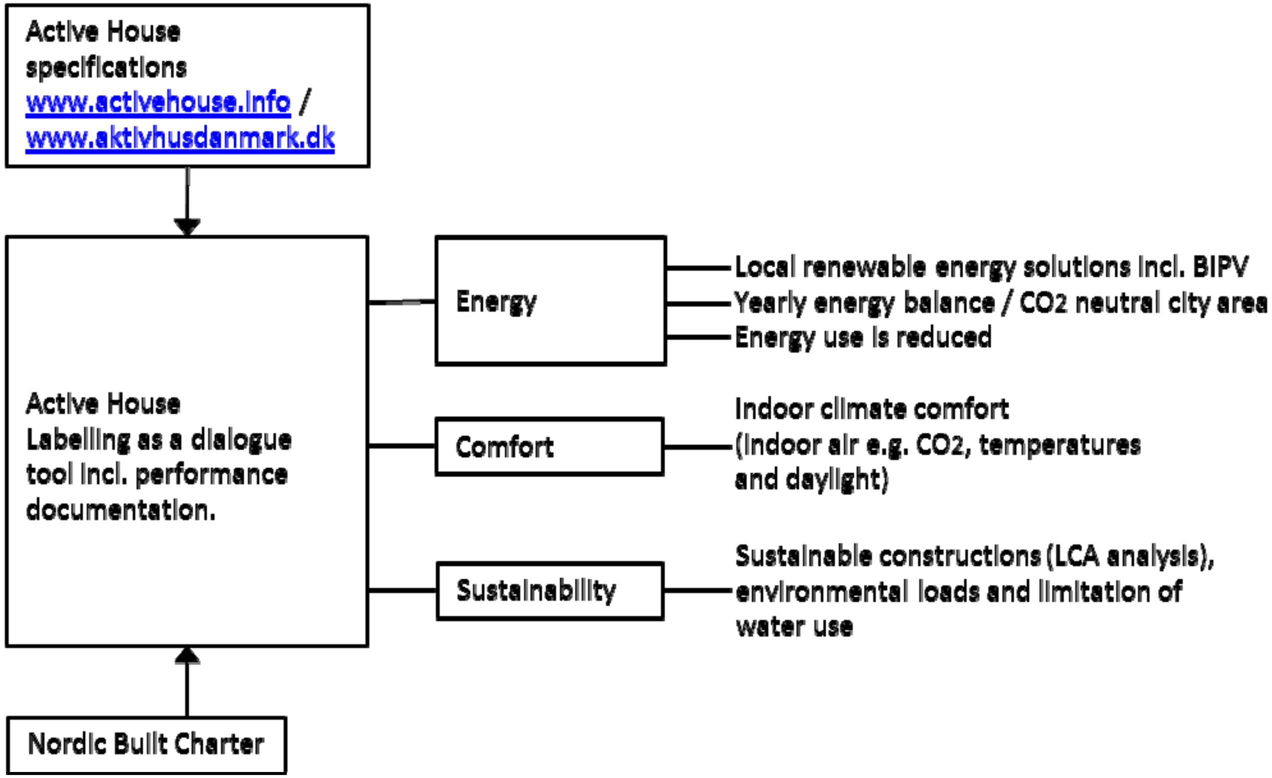

Proposal for quality agreements based on Active House labelling concerning Energy, Comfort and Sustainability, and with a special view towards use of building integrated PV, BIPV, as part of an all-over "Smart Energy" design.

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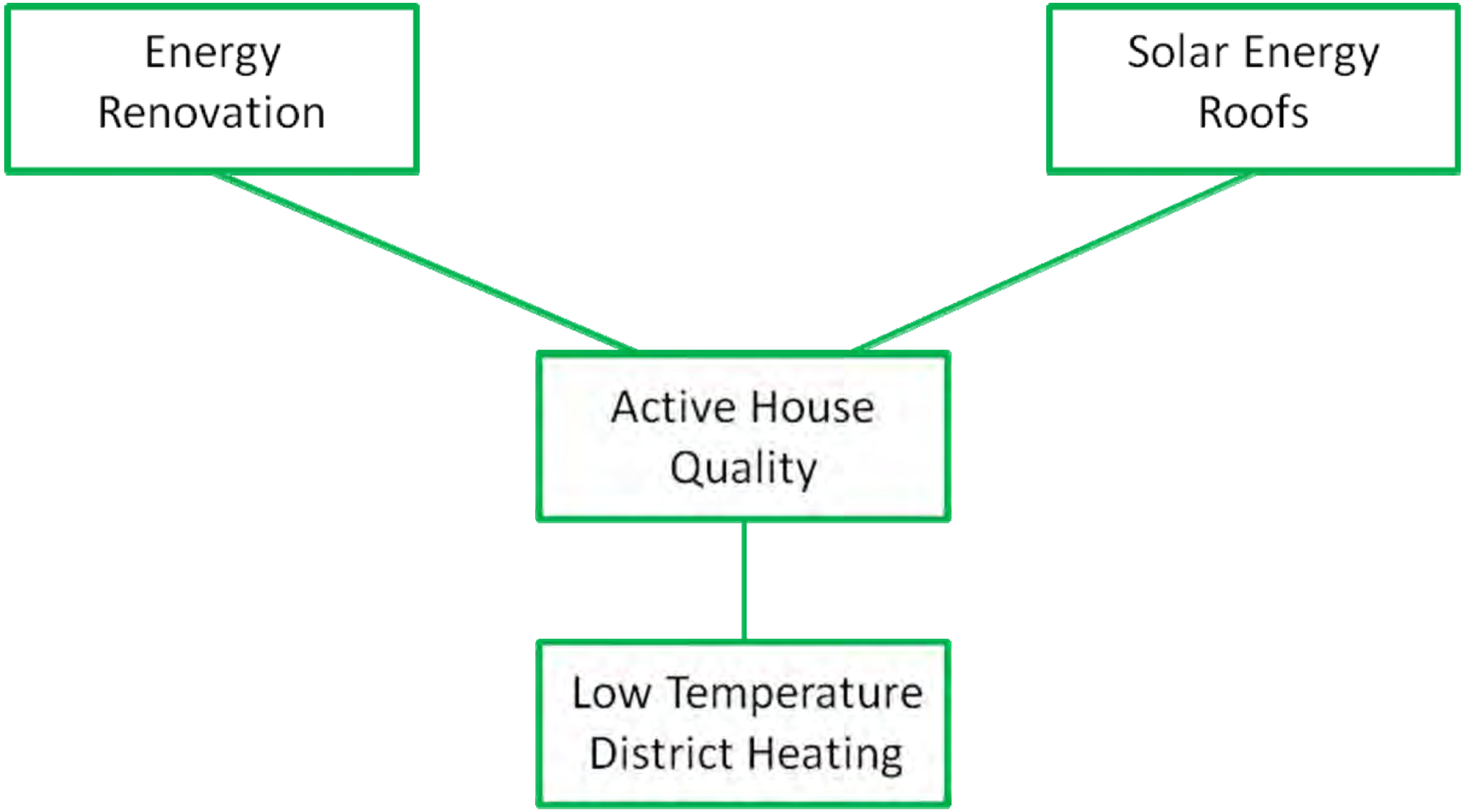

There is a need for a new approach to energy efficient housing renovation showing how renewables can be introduced together with an optimised energy supply. The Active House Specification can be useful here.

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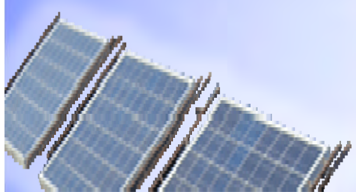

Smart Active House Building

By Peder Vejsig Pedersen, Cenergia (from 1. Oct. 2016, Kuben Management)

A Danish Smart Active House demonstration project has been suggested for 50 new build housing units linked to an existing district heating network, here utilising the international Active House standard. (www.activehouse.info)

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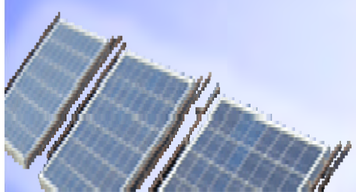

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By Peder Vejsig Pedersen, Cenergia (from 1. Oct. 2016, Kuben Management)

It is here suggested to combine a local low temperature microgrid distribution network for the houses in combination with a solar heated buffer tank and a local heat pump, which secures very low return temperatures to the district heating system. Besides there is 0,5 kWp local building integrated PV for the houses combined with selected roofs near the common house, where the whole roofs are BIPV, and connected to a local battery system also charging the heat pump and local electrical cars.

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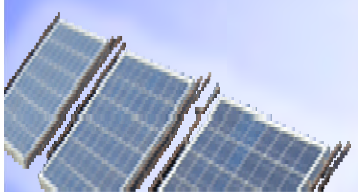
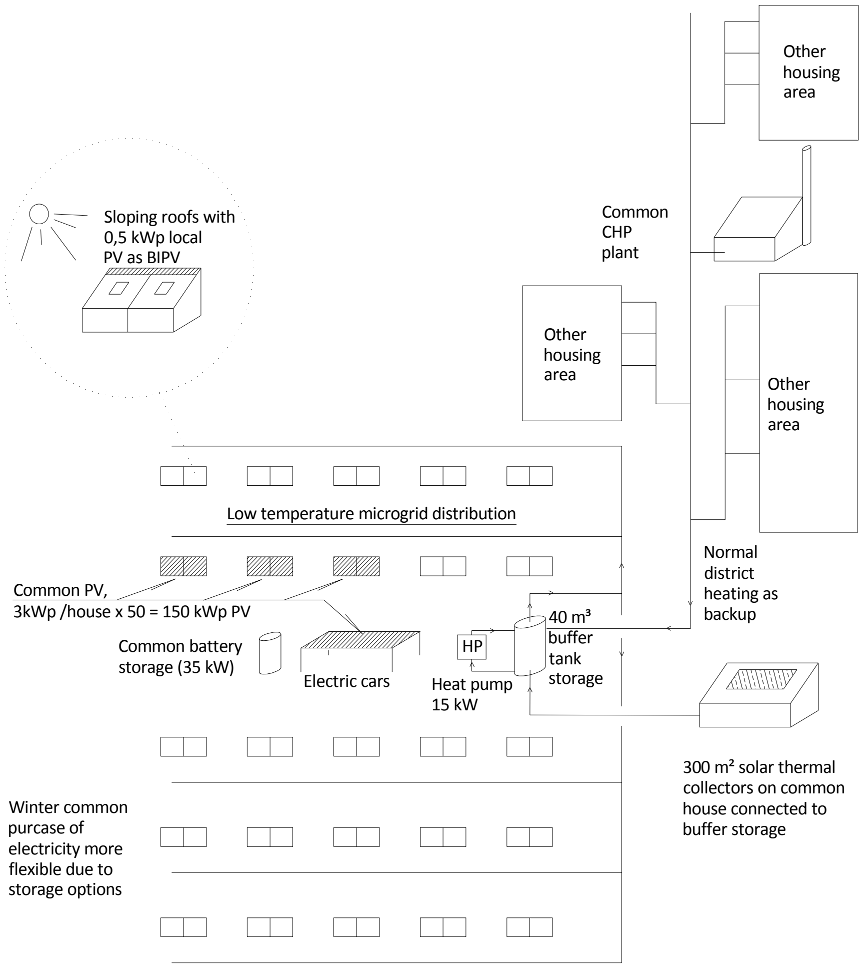


Smart Active House Building

By Peder Vejsig Pedersen, Cenergia (from 1. Oct. 2016, Kuben Management)



Proposal for a Danish Smart Active House demonstration project focussing on a Local Energy Plus, Low cost Active House district with 50 housing units:

- Zero energy design
- Sloping roof with BIPV and roof windows
- Integrated and web based local performance documentation incl. comfort
- Low temperature floor heating
- Low cost room based HRV and hybrid ventilation systems
- Web based metering and link to App Survey incl. main electricity uses (ventilation, pumps, lighting etc.)
- Constructions with passive house qualities and no cold bridges or airleakages
- Smart Grid BIPV

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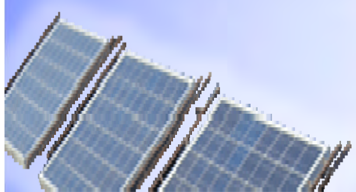

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As part of a district approach supporting the energy transition towards a high amount of renewable energy, it is the idea to utilise a local solar energy combined heat and power solution utilising a combination of PV electricity and solar heating as an ideal match to the local CHP based district heating. E.g. with 1.5 kWp PV (as BIPV) for each housing unit and 3 m² solar thermal collector also per housing unit (but mounted as a central solution connected to the district heating). A yearly production of 1,200 kWh PV electricity and 1,200 kWh solar thermal will be obtained.

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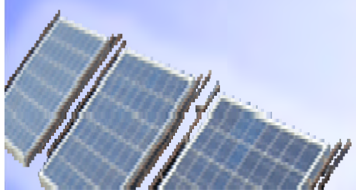

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This can be realised at very competitive costs of 9,000 DKK per housing unit for the solar thermal and 18,000 DKK per housing unit for the BIPV (27,000 DKK in total).

The value of the energy savings will be:

1,200 kWh x 1.8 DKK/kWh + 1,200 kWh x 0.5 DKK/kWh = 3,360 DKK per year,
leading to a payback time of 27,000/3,360 = 8 years.

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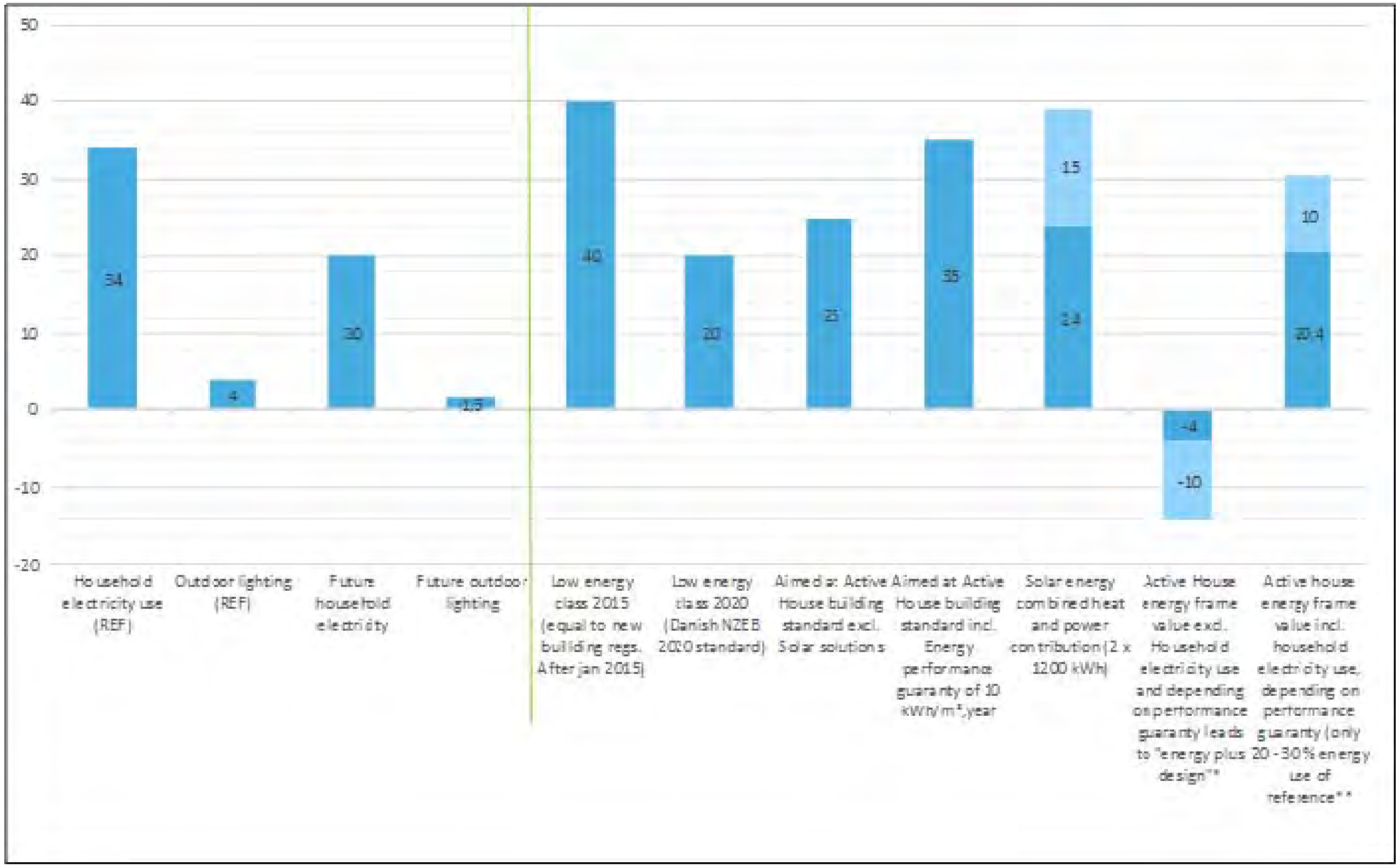
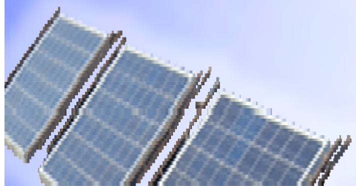


*) Reference: New build class 2015: 40 kWh/m²,year. Future energy use: 25 to 35 kWh/m²,year for building – 39 kWh/m²,year = -4 to -14 kWh/m²,year

**) Reference: New build incl. house hold electricity use with (34 + 4) x 1.6 (primary energy factor for electricity) + 2015 energy frame value of 40 kWh/m²,year = 100.8 kWh/m²,year. Future energy use: 21.5 kWh/m²,year x 1.6 + (25 to 35) – 39 kWh/m²,year = 20.4 to 30.4 kWh/m²,year.



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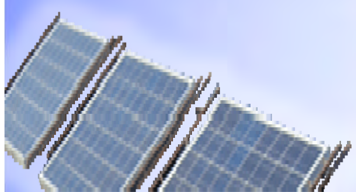

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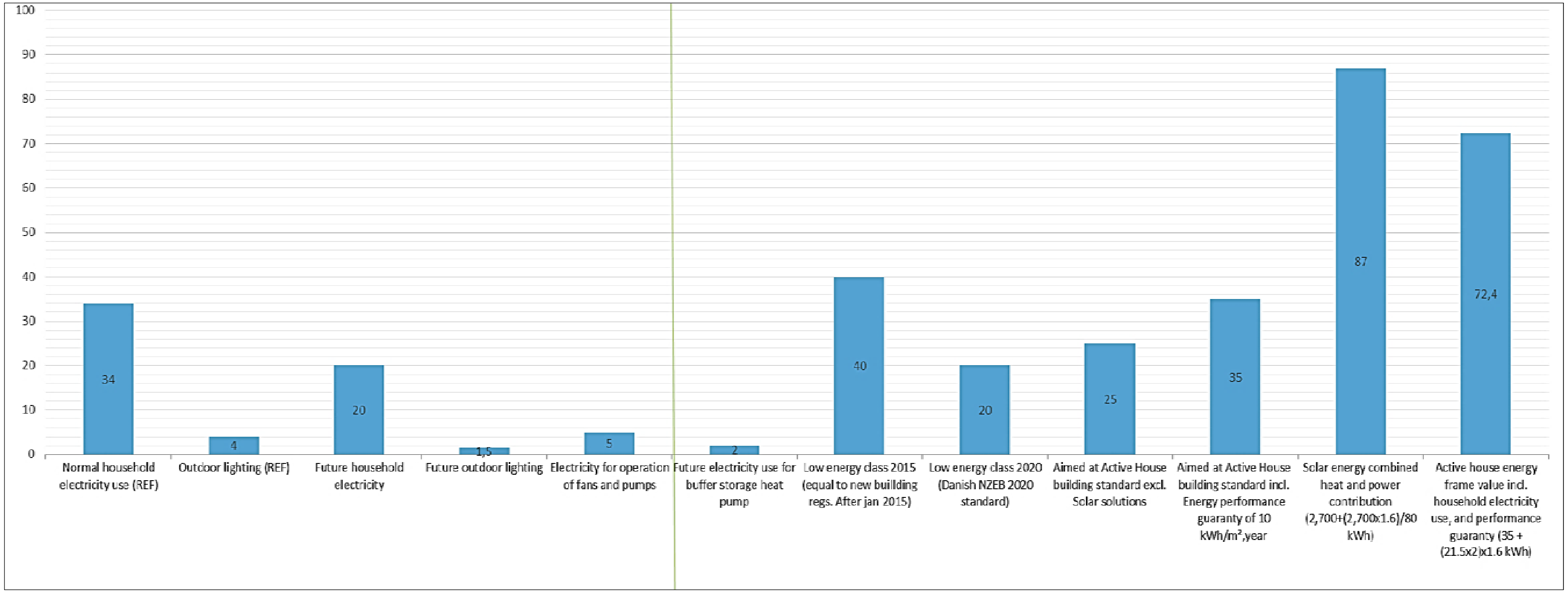

Yearly PV electricity production is (2,700 kWh/80 m² =) 33.7 kWh/m², which shall match the yearly electricity use:
21.5 kWh/m², year (Household + outdoor) + 5 kWh/m²,year (electricity for operation of fans and pumps and 2 kWh/m², year (buffer storage heat pump) = 28.5 kWh/m², year.
Small excess electricity of 5.2 kWh/m² can be sold to the electricity grid.
The energy frame value of the solar energy combined heat and power contribution (87 kWh/m², year) is also higher than the Active House energy frame value incl. household electricity (72.4 kWh/m², year). The buffer storage is linked also to neighbourhood district heating, but if the performance will live up to the design calculations, it should not be necessary to utilise this or only in a very limited way.
For the electricity system it is likely, that there will be a small outside contribution in the winter months, but on a yearly basis it will be a plus energy solution for both heating and electricity needs.

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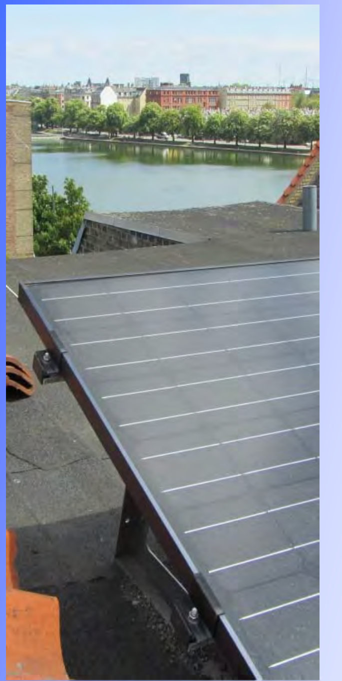

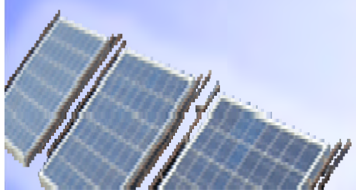

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Low Cost Active house BIPV ForskVE project, Gl. Jernbanevej, Valby

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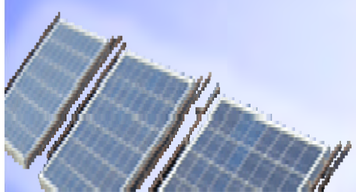

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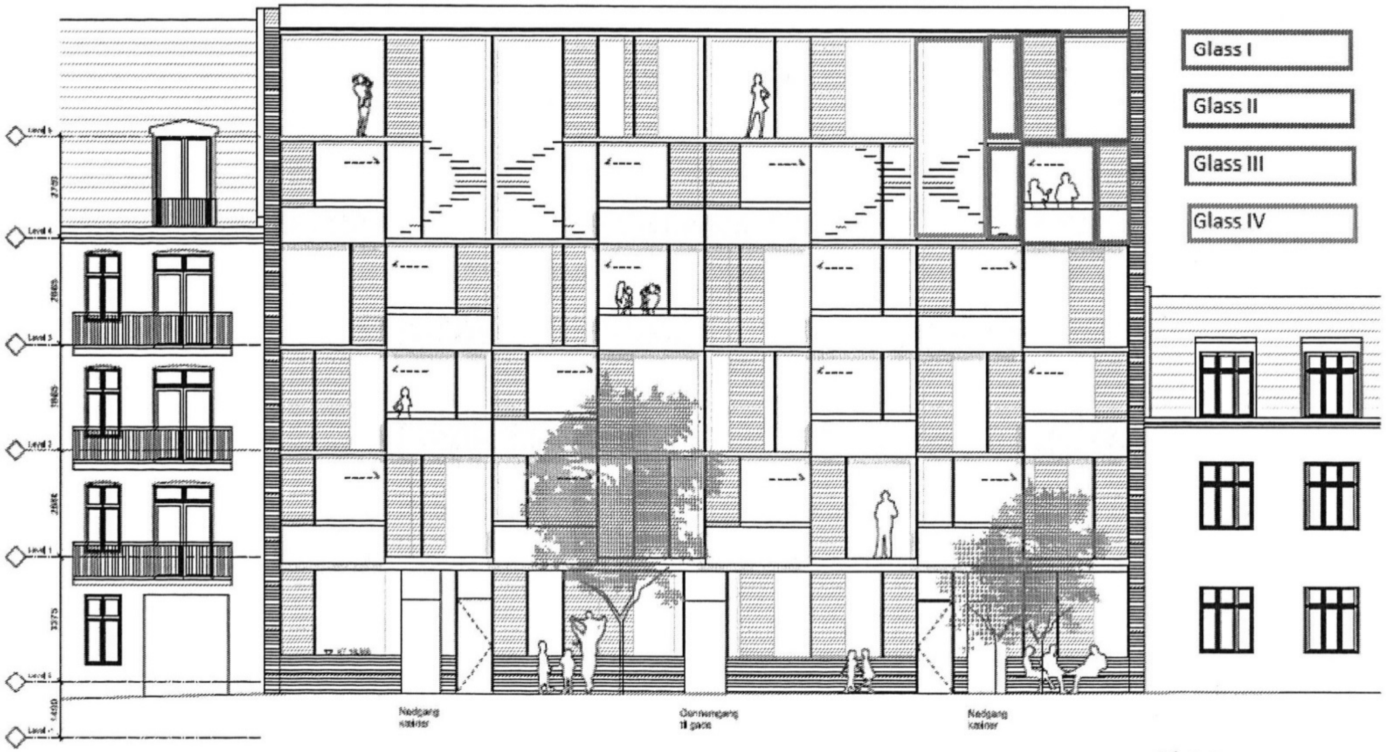

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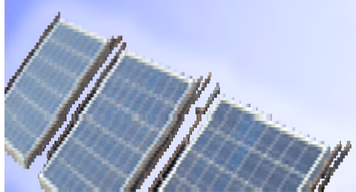

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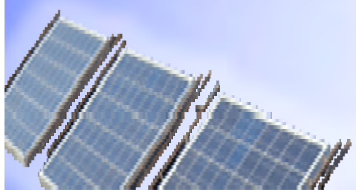
Living in Light/Valby

Analyse af energital

	Faktiske tal	Energiramme 2010			Energiramme 2015		
	[kWh]	[-]	[kWh]	[kWh/m²]	[-]	[kWh]	[kWh/m²]
Fjernvarmeforbrug	63.279	1,0	63.279	56	0,8	50.623	45
Elforbrug	4.302	2,5	10.754	10	2,5	10.754	10
Elproduktion	-25.400	2,5	-63.500	-56	2,5	-63.500	-56
Elproduktion aftages i BE10	-4.302	2,5	-10.754	-10	2,5	-10.754	-10
Resultat eksl. husholdingsel			10.533	9		-2.123	-2
Resultat eksl. husholdingsel BE10			63.279	56		50.623	45
Husholdningsel	36.800	2,5	92.000	81	2,5	92.000	81
Resultat inkl. husholdingsel			102.533	91		89.877	79

Energiramme 2020			CO_2	
[-]	[kWh]	[kWh/m²]	[Kg/MWh]	Kg
0,6	37.967	34	133	8.416.080
1,8	7.743	7	500	2.150.800
1,8	-45.720	-40	500	-12.700.000
1,8	-7.743	-7	501	-2.155.102
	-10	0		-2.133.120
	37.967	34		
1,8	66.240	59	500	18.400.000
	66.230	59		16.266.880

Energiramme 2010 81 kWh/m² pr. år	√
Energiramme 2015 47 kWh/m² pr. år	√
Energiramme 2020 20 kWh/m² pr. år	×



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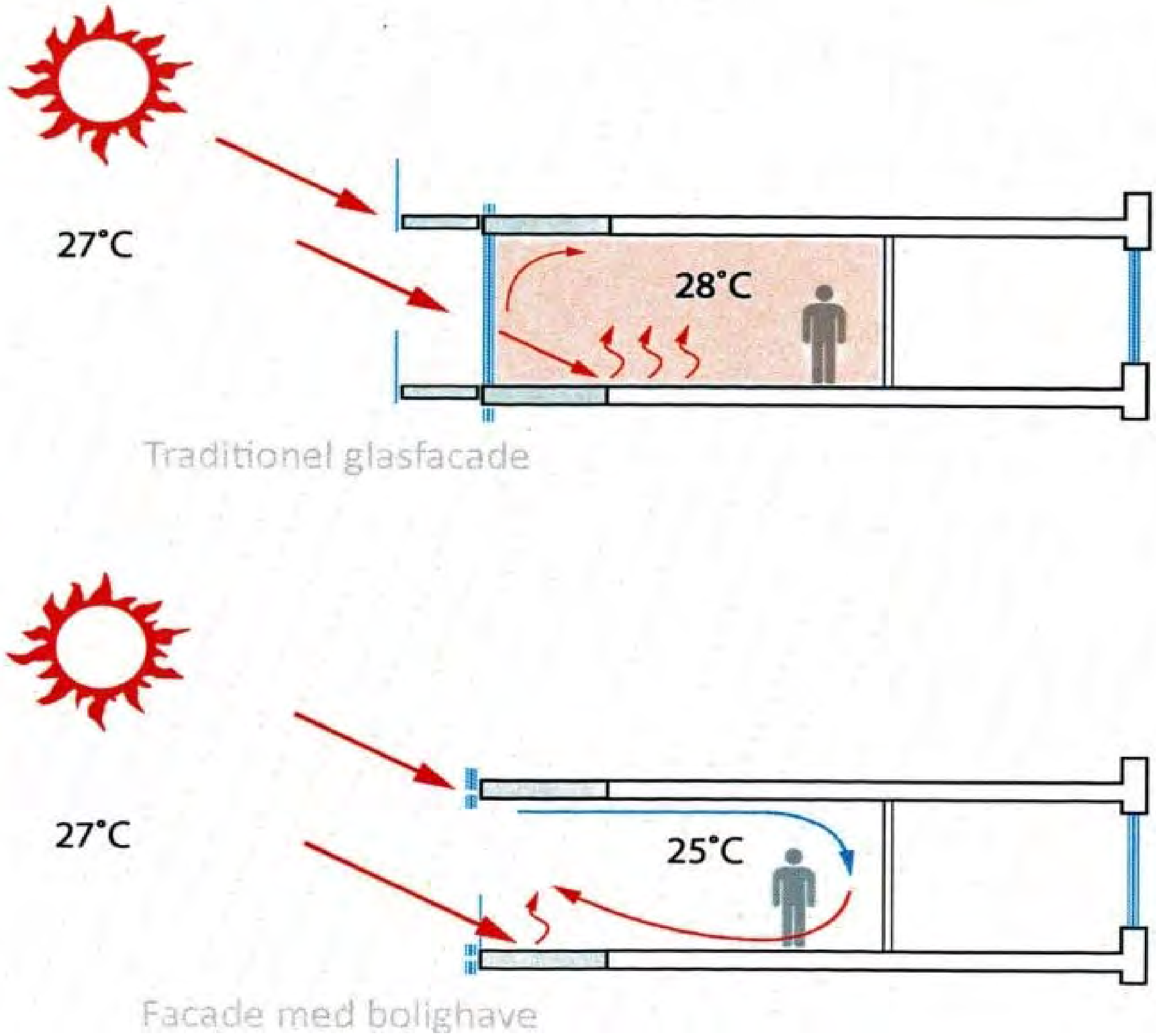

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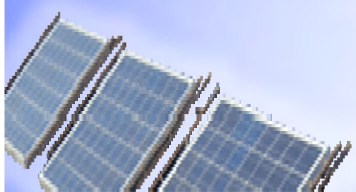

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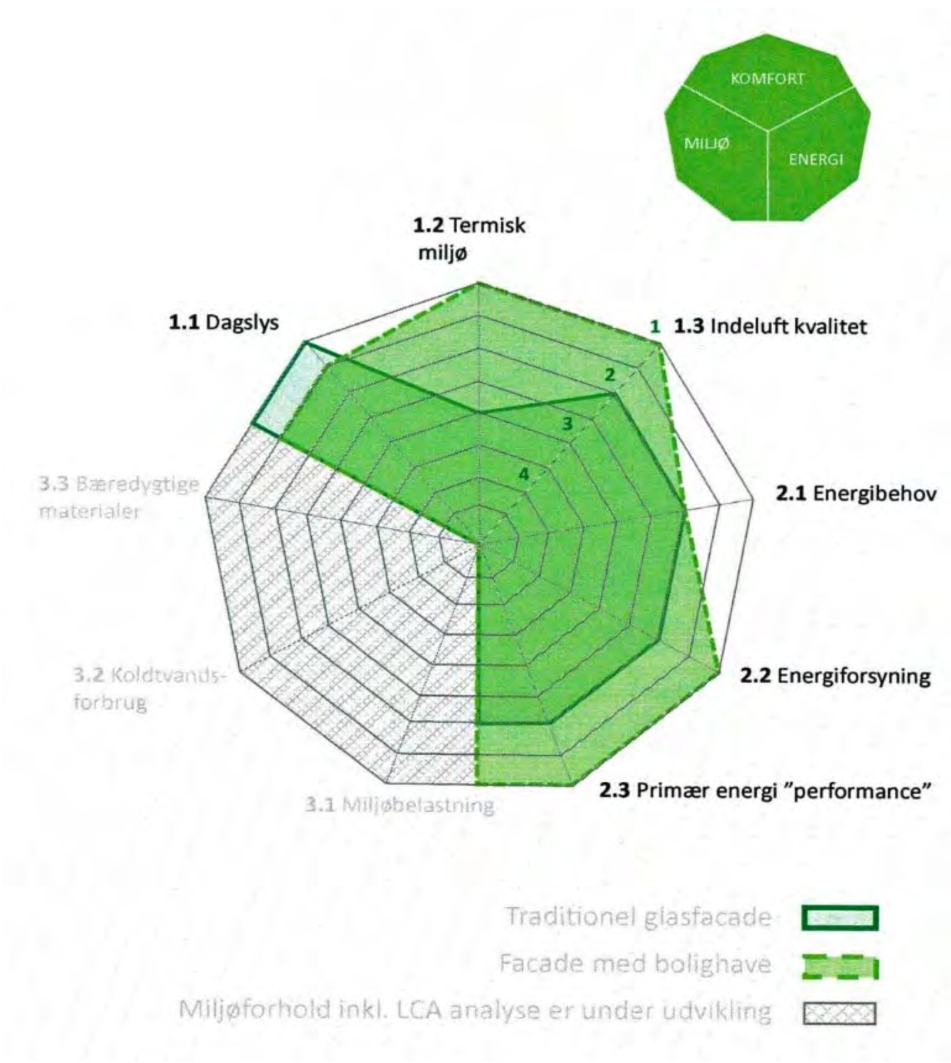

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