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LIVING IN LIGHT BOX

LIVING IN LIGHT®

eUDP

KUBEN MANAGEMENT NRGi

THE MINDSET

The living in Light/BOX mimes an apartment block in Valby, the Living in Light/Valby Project.
It is made for human livability using an approach: People before buildings.

We are in a transition phase where the cities around the world are facing challenges as more dense urban environment in combination with the need for thinking in renewable energy sources is facing our daily work. All of it in a contemporary context where the demands and needs are rapidly changing from traditional smaller apartments into apartments where daylight and green areas are one of the most important criteria to fulfill the demands and to improve everyday life and health.

Living in Light mindset and attached solutions, is a holistic alternative to present focus, when refurbishing existing housing in urban context. Living in Light address people and people's health and wellbeing, as the point of entry. This human focus is important, before focusing on the actual building. We call this focus; People before buildings. Daylight is the driver for attractive indoor comfort.

Daylight is life, no life without daylight. Spending a vast majority inside, being at home, at work or at leisure or sport, we are suffering for a lack of sufficient daylight exposure, according to our physiological needs.

Living in Light strives simple but attractive configurable solutions, suitable for most existing conditions. In Living in Light/Valby Project, a new zone has been created, a zone in between outside and inside, a zone named BOLIGHAVEN (the summer garden). This zone will act as an extension to the exiting indoor situation, but incorporate nature (daylight & fresh air) to a much larger extend. Outside and inside will melt together and seasonal changes can be cherished to a much larger extend.

Johnny Svendborg, Svendborg arkitekter, Torben Thyregod, KADK & Eirik Bjørn, Dovista

THE PURPOSE OF THE LIVING IN LIGHT BOX

The Living in Light Box, a carbon neutral Active House test-housing unit demonstrating innovative Active Roofs and Facades technologies.

The Living in Light Box is a carbon neutral prefabricated Active House test-housing unit that is realised in connection to the Nordic Built projects "Living in Light" and "Active Roofs and Facades in Sustainable Renovation". Also representing the result of a cooperation with the city of Copenhagen, first in the EU-Concerto project "Green Solar Cities" and later in the EUDP project "Smart Grid School Renovation". All projects coordinated by the Kuben Management organisation and with technical coordination by Cenergia, which is now part of Kuben Management.

In connection to the Nordic cooperation, it has been possible, to realise important research and development work in connection to using the international Active House labelling standard and to make full scale testing of the Living in Light concept before full scale realisation in connection to the renovation and urban renewal of a small housing block in Valby in Copenhagen. Active House labelling has the benefit of a combined focus on Energy, Comfort and Sustainability

The Living in Light Box test-housing unit includes important work concerning solar energy integration in practice, both with focus on building integration of solar thermal and PV into a carbon neutral housing design.

The relatively low cost solar thermal solution integrated in the south façade represents a strong architectural optimised technology from the Norwegian producer Aventa, which has made housing projects in Norway that, according to measurements by Sintef from Norway, performs better on a yearly basis than heat pumps.

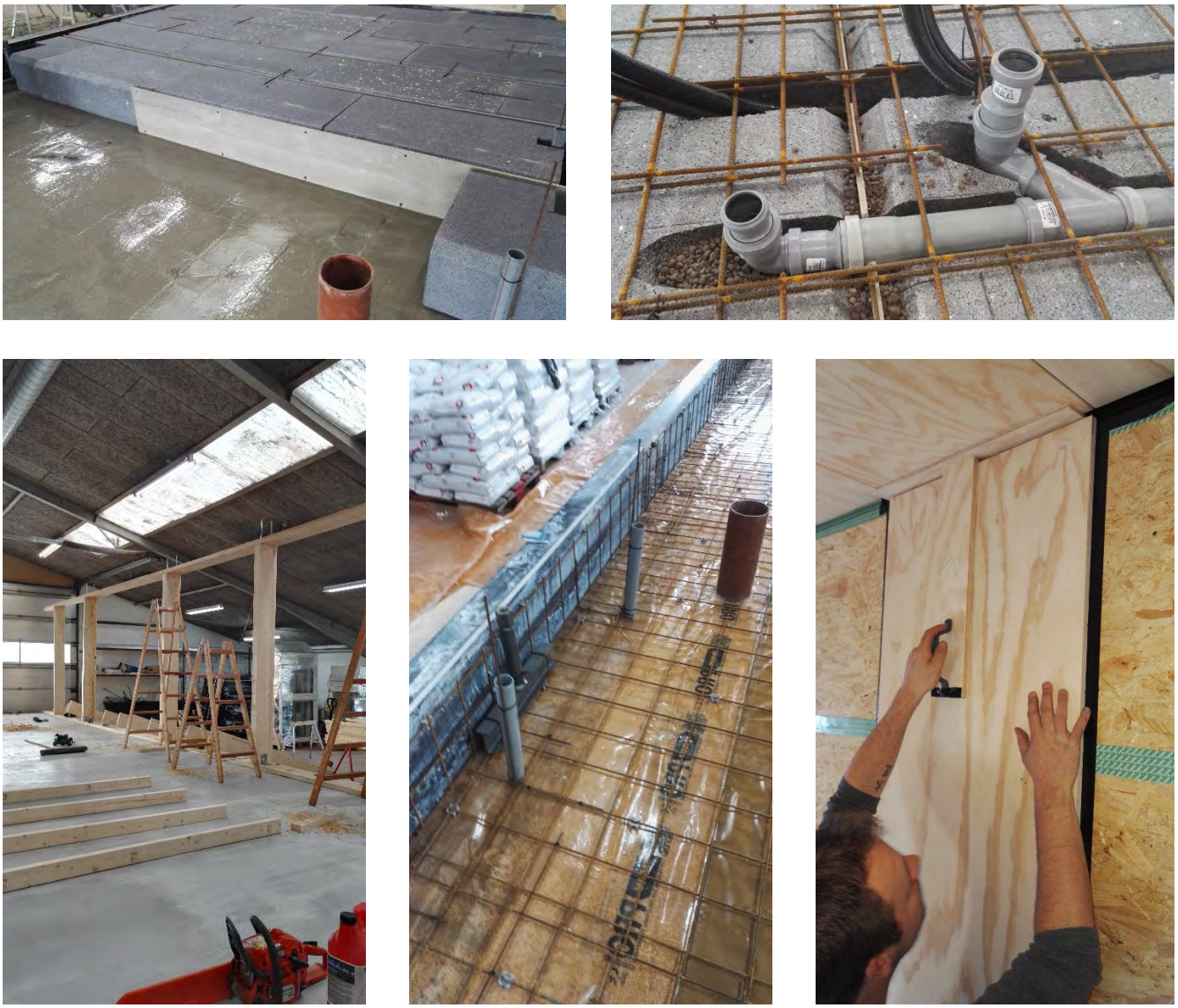
The Danish PV company, Racell has provided building integrated PV both for the facades and for the roofs, which together with a battery secures an overall carbon neutral design for the building.

Roof windows from VELUX secures together with façade windows from VELFAC a good daylight level for the house, and the company Ecovent International is responsible for a building integrated ventilation solution, which as an extra benefit also has a directly PV driven ventilation to secure against overheating in correspondence to natural ventilation provided from the roof windows. Visility has delivered the integrated energy management and survey system, while Husfabrikken, also working with Nordic Flexhouse has been overall responsible for producing/building the prefabricated housing unit.

Peder Vejsig Pedersen and Jakob Klint, Kuben Management

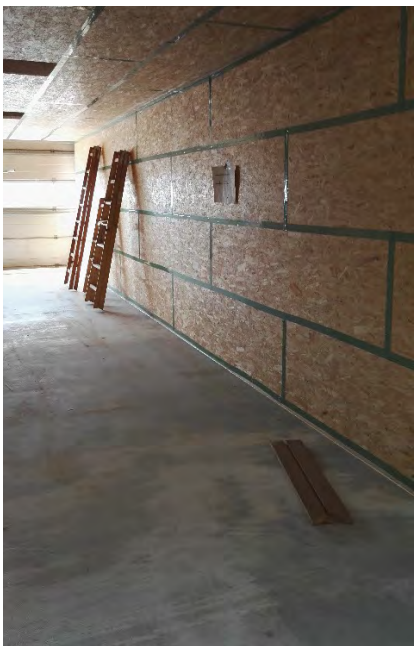
THE HOUSING CONSTRUCTION

The Living in Light Box has been manufactured at Husfabrikken in Assens, based on the idea of securing a full prefabrication here and transport to the building site. This gives some limitations concerning the dimensions of each building element, but also has clear benefits with respect to a more simple working process and higher mounting quality independent of the outdoor climate.



Picture 1. The construtions at Husfabrikken in Assens

Picture 2. The constrution at Husfabrikken in Assens



Facts
Supplier: Husfabrikken
Contact: Claus Valsøe, cv@husfabrikken.dk
Suppliers in cooperation with Husfabrikken

Lilleheden, Klaus Becker, Kb@lilleheden.dk
Golan Pipe Systems, Martin Have, mh@golan.dk
Build a House, Casper La Cour, casper@buildahouse.dk
Kroghs, Erling Johansen, ej@kroghs-as.dk

Picture 3. The transportion to The Architectural School of Copen Hagen at Holmen

Illustration 1. of ”Summer Garden” at the Valby project

THE SUMMER GARDEN

In cooperation with Velfac and Torben Thyregod, the Living in Light Box will be testing the “Summer Garden” concept, BOLIGHAVEN, which is a new development of the traditional winter garden.

Here is utilised the much improved quality of window systems. And from 2017 these principles will be implemented in a new urban renewal housing renovation project at Gl. Jernbanevej in Valby, Copenhagen.

The idea with the “Summer Garden” is that in the summertime, part of the living room along the facade will be utilised as an exterior area. This is secured by help of two different window façades, which is used in summer periods and in winter periods. The winter façade is the glass façade which is the exterior. This has a u-value of 0.9 W/m^{2}°C. The summer façade is the inner glass façade and has a higher u-value. There is in the Living in Light Box used another summer façade solution that there is going to be used in Gl. Jernbanevej project.

In the summer, the exterior glass façade will be opened and the inner glass façade will function as an active facade. By help of this, the “Summer Garden” is introduced as a covered exterior outdoor space, where the cover also function as a horizontal solar shading system.

During winter, the outer façade is closed and the inner glass facade is opened. In this way, the whole space is useful as heated space area.

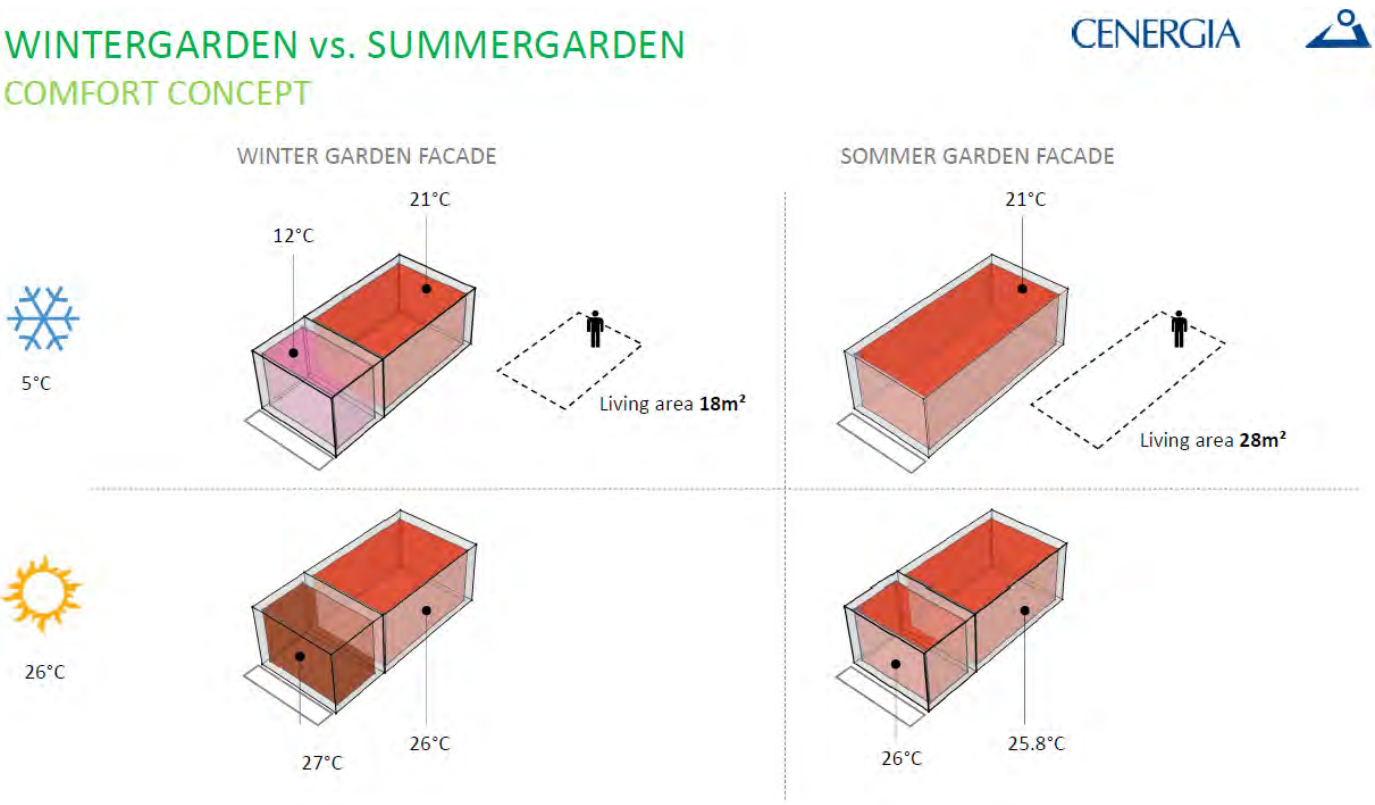


Illustration 2. The winter gardem vs. the summergarden concept

The “Summer Garden” is depending on an active role from the tenants. They will feel, that it will be too hot in summer, if they do not open the outer glass façade, while it will be too cold, if it’s not closed in winter. The illustration here is without the roof windows from VELUX.

Facts

Developers of “Summer Garden”:
Kuben Management, Cenergia, Ishøy&Madsen, Dovista, Torben Thyregod, Svendborg Arkitekter, Domus Arkitekter

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hhj@domus.dk

DAYLIGHT

Ideal daylight and sun screening It is the strategic use of natural daylighting that defines the true character of the Living in Light Box where little to no artificial lighting is required during the day. Simulations in the VELUX Daylight Visualizer 2, a software tool dedicated to daylighting design and analysis, helped the design team from VELUX to develop a plan for achieving optimal daylight conditions during different periods of day and year, and as well uses of Living in Light Box. The addition of 2 VELUX INTEGRA® Curved glass rooflights ensures optimal daylight and possibility for use of natural ventilation. Their unique curved glass surface lets in more daylight and stands out externally as a modern addition to roof surfaces – ideal for design-conscious homeowners. Fully programmable control pad offers remote control operation of out-of-reach flat roof windows. Practical pre-fitted rain sensor closes the rooflight automatically in the event of rain.

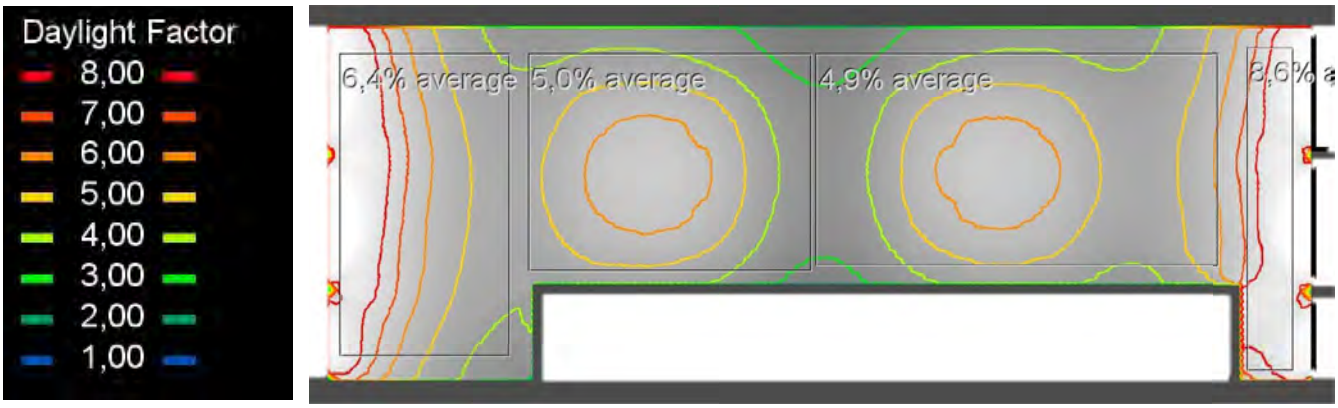
The Double Pleated blind, automatically managed by VELUX INTEGRA® controls, provides the perfect amount of light for your space – from daylight dimming to soft lighting. Due to the aluminium coating between the cloth layers the blind improves insulation and increases indoor comfort.

Facts/Roof windows
Product name: VELUX INTEGRA®
Supplier: VELUX

Facts/Glass facade
Supplier: Velfac

Benefits

- Curve-shaped edge-to-edge glass that allows raindrops to easily run off;
- Insulating PVC frame and two-layer low-energy pane for optimal energy efficiency;
- Compatible with a discreet heat protection awning blind for ideal indoor temperature;
- Suitable for 0-15 pitched roofs;
- 3-layer glass construction ensures optimal energy performance;
- Available in 8 sizes.



Picture 4. Daylight calculation for the Living in Light Box made with VELUX Daylight Visualizer 2

DECENTRAL VENTILATION

In the Living in Light Box there is installed a decentralised ventilation unit with heat recovery, which is integrated into the kitchen wall. The idea here is to demonstrate a low electricity consumption decentralised solution, which is useful for renovation projects, and where also the inlet air solution is building integrated, here utilising a normal building plate with holes in for introducing fresh air to the housing unit without draft or noise. To secure easy maintenance an innovative automatic filter system is used, which only need to be exchanged every 5 years.

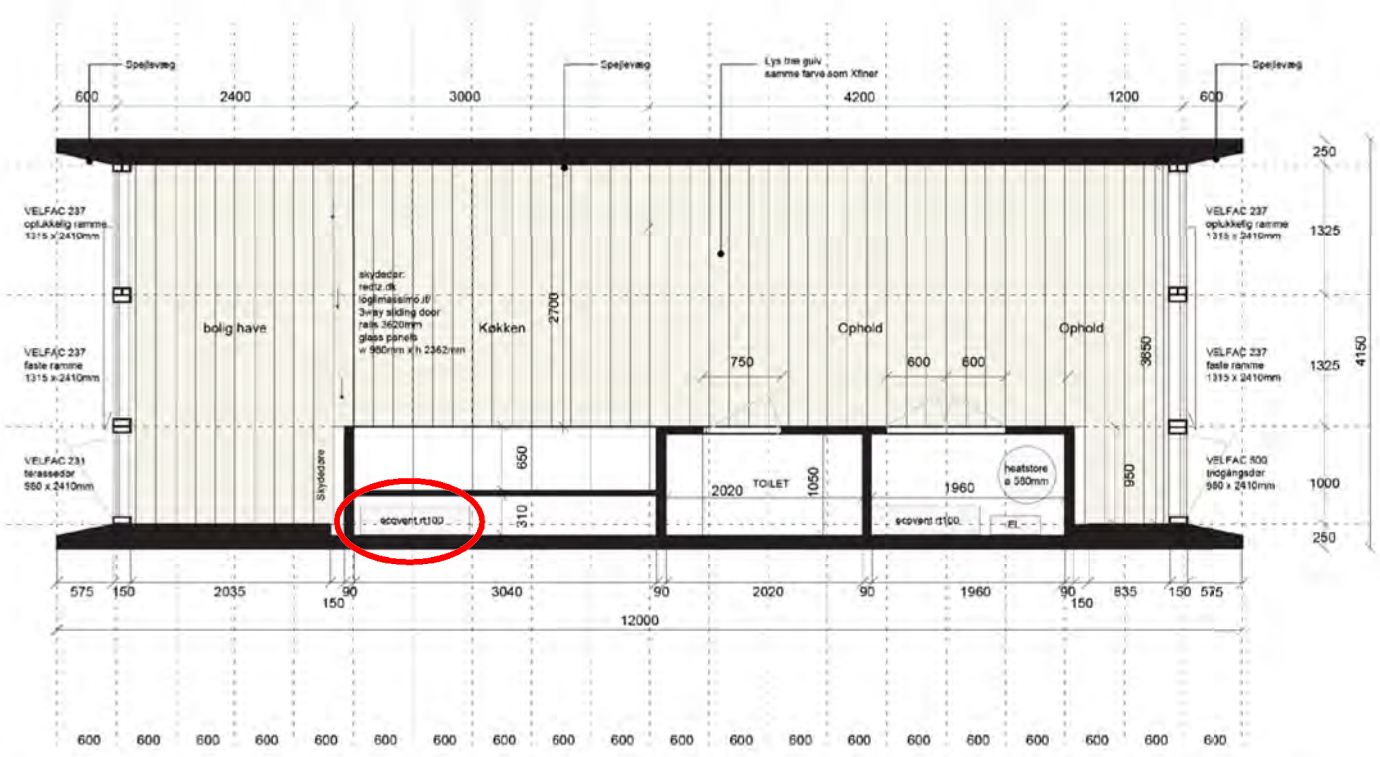


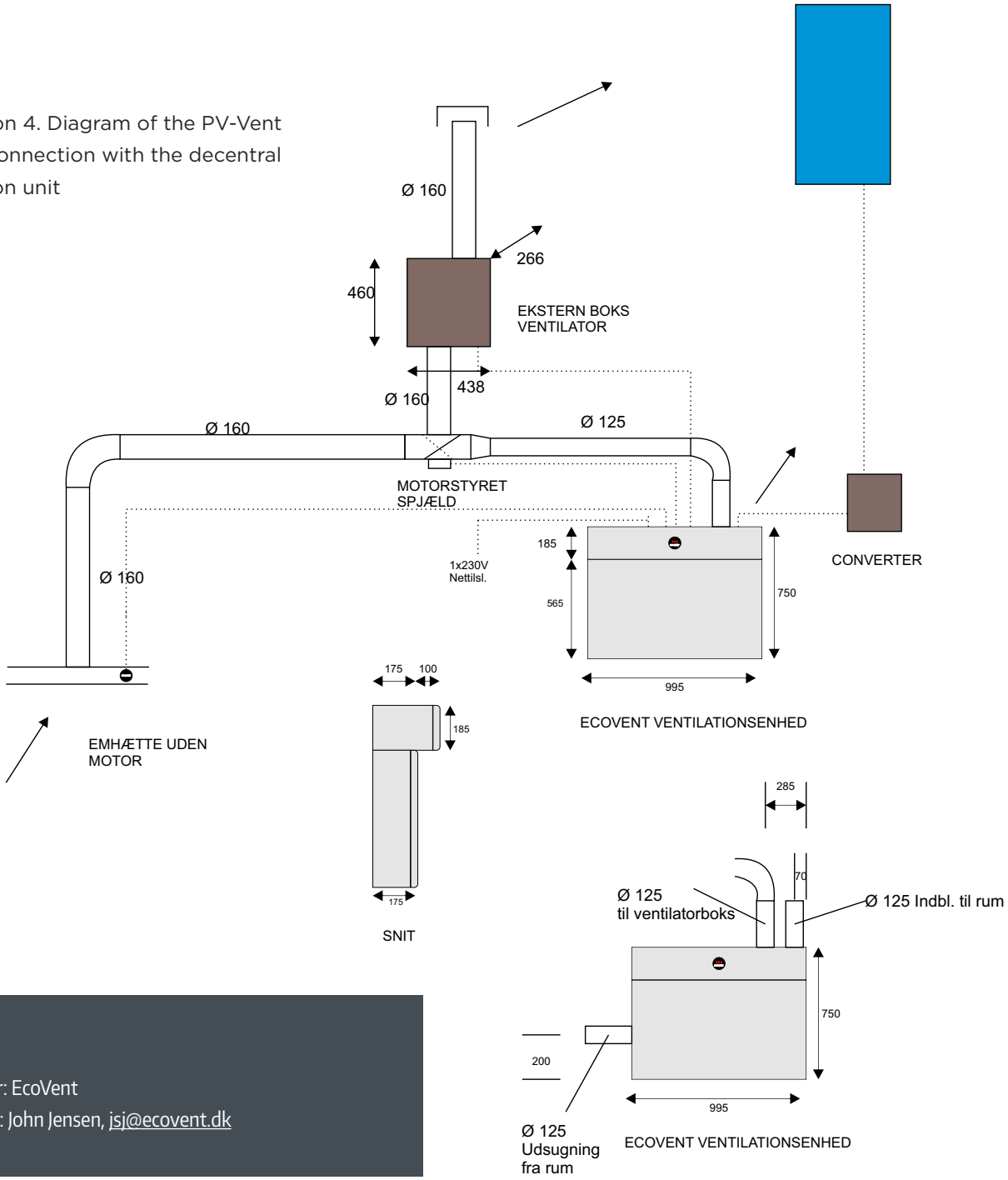
Illustration 3. The placement of the ventilation unit

Facts
Supplier: EcoVent
Contact: John Jensen, jsj@ecovent.dk

PV-VENT

In relation to the installed cooker hood in the kitchen, a special exhaust fan, which is driven by a 20 W PV panel on the roof, will secure 300 – 400 m^3/h of exhaust air, when a predefined max. temperature, e.g. 26°C is reached. In this way, a good supplement to the build in natural ventilation gives an extra certainty against overheating. When normal cooker hood operation is needed, it will change the electricity use, so it will be normal grid based.

Illustration 4. Diagram of the PV-Vent and its connection with the decentral ventilation unit

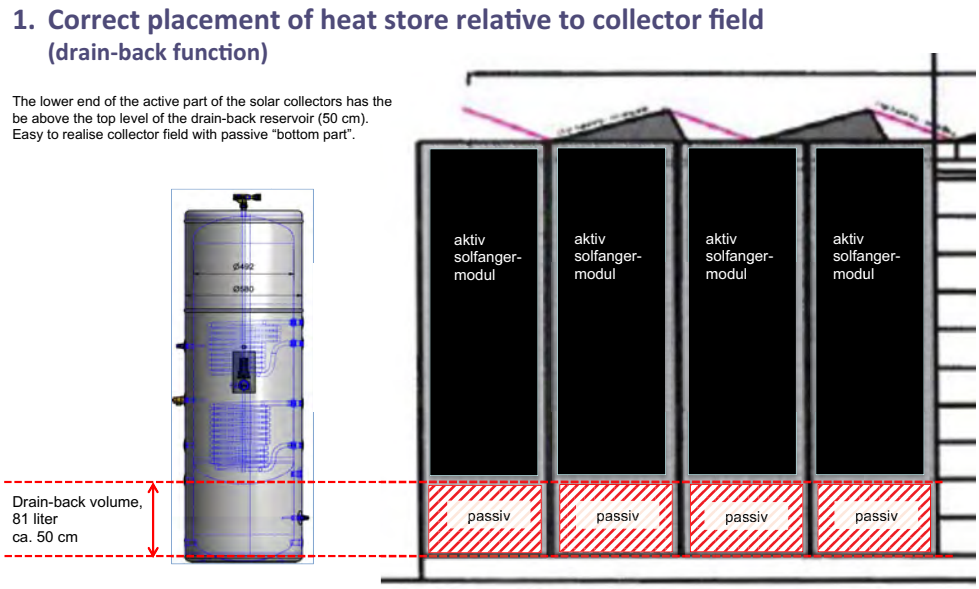


Facts
Supplier: EcoVent
Contact: John Jensen, jsj@ecovent.dk

SOLAR THERMAL COLLECTOR SYSTEM

On the south façade of the Living in Light Box, 12 m^2 façade integrated solar thermal collectors from the Norwegian company Aventa are installed, which will take care of both room heating and the domestic hot water (DHW) demand, supplemented by an electrical heating supply. The experience from Norway is that it is possible to obtain a coefficient of performance (COP) of 3.0, which is just as good as heat pumps according to the Norwegian research institution SINTEF. And since it is aimed to obtain a CO_2 neutral operation on a yearly basis, it is the idea that as much of the electrical heat supply as possible will be secured from the PV modules and the connected battery used in the Living in Light Box.

Illustration 5. of the solar collector solution



Calculations of Aventa Solar heating system in the Living in Light Box in Copenhagen

Here is illustrated that a yearly solar contribution of 68 % of the heating demand should be possible to obtain. Simulations performed with SolDat v. 1.2.

Simulation results		Month	Solar irradiation	Heat demand	Solar gain	Auxiliary heat	Solar Fraction
TESLA House, Copenhagen			(kWh/m^2 month)	(kWh/month)	(kWh/month)	(kWh/month)	(%)
		January	27.2	302.1	94	208.1	31
Input parameters for simulation:		February	58	274.6	167.9	106.7	61
Latitude (º)	55.7	March	72.5	240.3	152.7	87.6	64
Solar collector area (m^2)	12	April	111.1	165.1	165.1	0	100
Tilt angle (º)	90	May	107.4	54.1	54.1	0	100
Azimuth angle (grader)	0	June	90.7	30.7	30.7	0	100
Active heat store volume (litres)	250	July	82.3	30.9	30.9	0	100
DHW consumption (litres/day)	0	August	89.8	32.9	32.9	0	100
DHW temperature (ºC)	55	September	92.3	54.2	54.2	0	100
Temperature heat distribution (ºC)	30	October	101.9	177.4	174.7	2.7	98
Base heat demand (kWh/day)	1	November	46.4	233.5	153	80.5	66
Heat loss coefficient (kWh/(K day))	0.5	December	51.3	303.6	181.5	122.1	60
Threshold temperature for heating (ºC)	16	**SUM**	**930.9**	**1899.4**	**1291.7**	**607.7**	**68**

Table 1. Simulation results for the TESLA house at Nørrebro. The solar fraction for chosen conditions is 68%

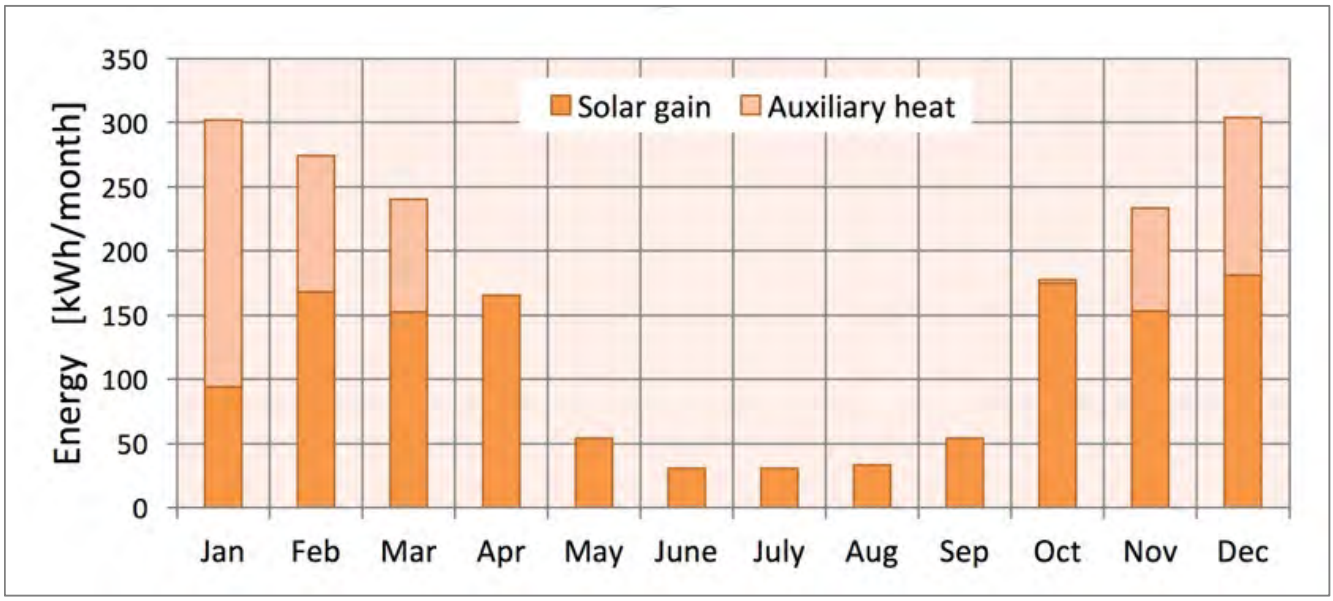


Figure 1. Total heat demand and fraction, which will be covered by solar and auxiliary energy (monthly basis)

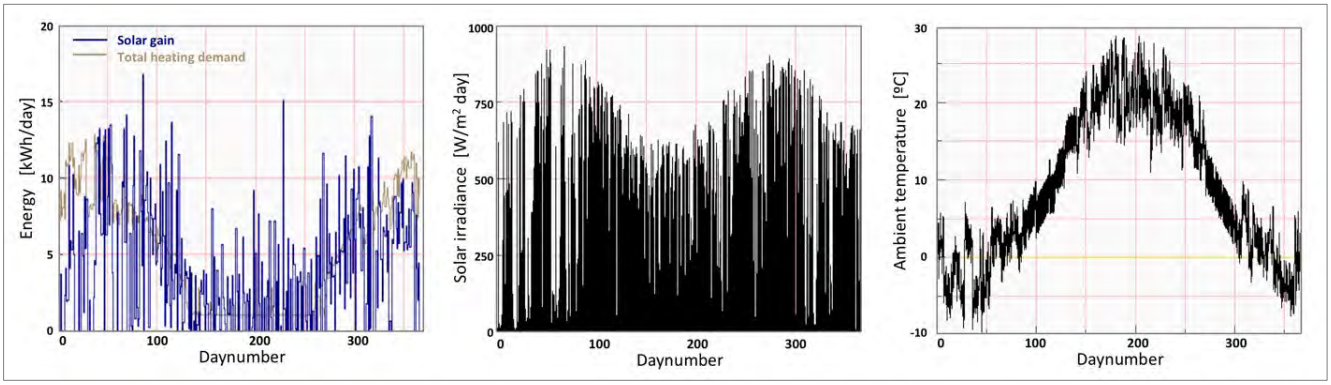


Figure 2.

Left: Total heat demand and fraction, which will be covered by solar and auxiliary energy (daily basis); Middle: Solar radiation (kWh/m²) on a vertical surface at Nørrebro with direction south;

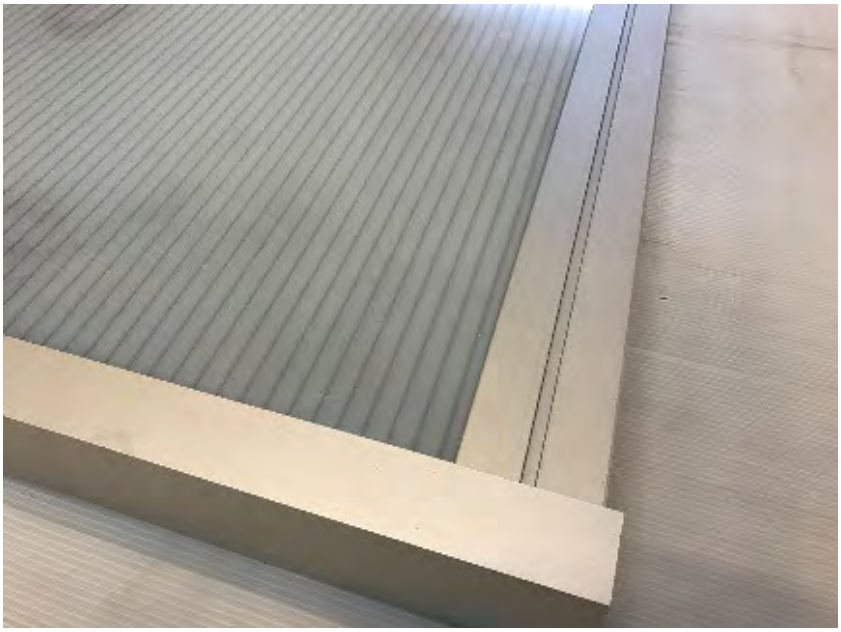
Right: Ambient temperature at Nørrebro

Facts
Product name: AventaSolar collector
Supplier: AVENTA
www.aventa.no
Contact: Michaela Meir, mm@aventa.no

Facts
Supplier: Racell
http://racell.com
Contact: yakov@saphire.com

THE PV FACADE

Concerning the reminder of the south façade, which is not being used for solar thermal collectors, it was decided to use 3 kWp PV panels from Racell, which is integrated into the same Aventa glazing system as is used for the solar thermal collectors. This system is connected to a combined SMA inverter and battery system.



Picture 5. From the idea fase

Facts
Supplier: Racell
Contact: Architect on this part of the project Klaus Boyer Rasmussen, solarvent@solarplan.dk

THE PV ROOF

The almost flat roof of the Living in Light Box has an installation of 4.9 kWp PV modules from Racell, which cannot be seen from the street area. The PV modules are connected to a combined SMA inverter and battery, and the aim is together with the façade PV system to obtain a yearly solar electricity production of 4.200 kWh.

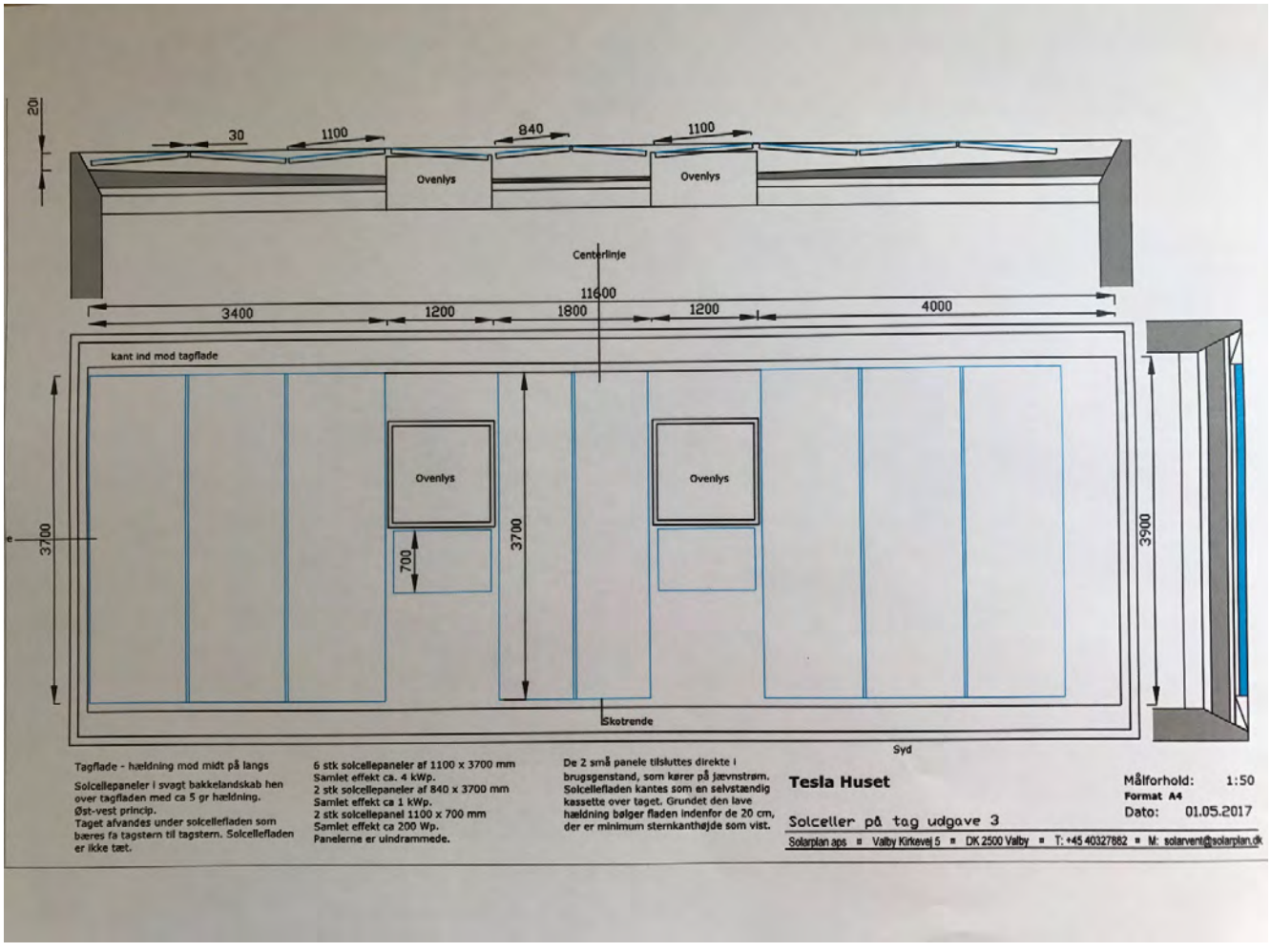


Illustration 6. working sketch of roof with PV installation

THE BATTERY SOLUTION

In Denmark, it is possible to use net metering of PV electricity, which you can use yourselves in the hour that it is produced. The rest of the PV electricity can at best obtain the spot price, which is around 0.03 €/kWh. In connection to this, it is the idea to increase the 68 % coverage of electricity use for heating to a higher value by the installed battery solution from SMA.

Facts
Product name: SMA
Supplier: Racell
Contact: Kenn Frederiksen, Kenergy
kf@kenergy.dk

MEASUREMENT, INTEGRATED CONTROL AND FEEDBACK

A wide measurement setup is realized in the Living in Light Box. Inspired by the Active House specification, both comfort, energy and environmental parameters is measured and saved for later analyses, but also for realizing of a real-time Active House Radar, where the performance and the influence of the users behaviour is visualized. (See also: www.activehouse.info)

To realize this the following measurements will be made during next year by Visility:

- Electricity split into 9 groups;
- Energy used for heating;
- Energy used for hot water production;
- Amount of hot and cold water;
- Temperatures;
- Humidity, CO_2;
- Performance of ventilation.

ONLINE ACTIVEHUS RADAR

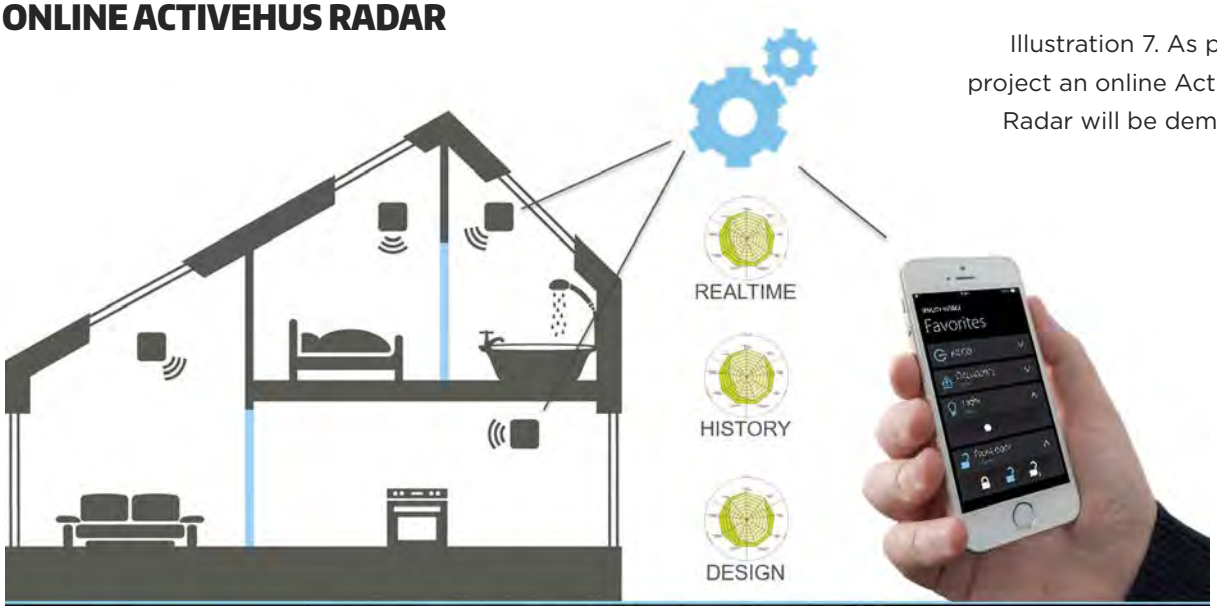


Illustration 7. As part of the project an online Active House Radar will be demonstrated

In addition, Visility will demonstrate a natural ventilation solution, developed with AAU, Velux and Dovista, with the addition of integration with the Ecovent decentralized ventilation. With the integration, we combine the best from both natural ventilation and mechanical ventilation. The control strategies cover both indoor air quality and cooling.

HYBRID VENTILATION

Illustration 8. A hybrid ventilation solution will be demonstrated

Facts
Supplier: Visility ApS
Contact: Thøger Lyme, Tel: 31 792 792

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