

SOLTAG – energy housing

- Results of the EU “Demohouse” research project

Innovative application

- high performance insulation materials
- efficient ventilation systems
- Photovoltaic (PV) modules
- Solar heating systems

General information:

- Project developer (designer):
 - Nielsen & Rubow A/S (Denmark)
 - CENERGIA ApS (Denmark)
 - Kuben Byfornyelse Danmark A/S (Denmark)
 - VELUX A/S (Denmark)
- Location: C/O Kuben Byfornyelse Danmark, Jarmers Plads 2, 0900 Copenhagen C
- Project starting date (year): 2005
- Project status: Completed

Summary of project

SOLTAG is part of an EU demonstration project, designed as an energy generating climate shield, implemented in Denmark by VELUX, Rubow Architects, Cenergia Energy Consultants and Kuben Urban Renewal Denmark. This demo house produces energy and a healthy indoor condition without ‘polluting’ its surroundings. In fact, with the installation of solar thermal collectors, SOLTAG is self-sufficient in terms of energy for heating, and generates its own electricity by utilisation of solar cells installed in its roof.

With success the project consortium has developed a prototype - a prefabricated housing unit of a rooftop dwelling, which is build according to the new Danish low energy class 1, having only 50% of the normal energy use. At the same time, with the integration of PV modules the prototype is also a CO2 neutral and Zero energy housing unit. SOLTAG illustrates the vision that all future buildings should be sustainable.



SOLTAG is a living home, daylight and fresh air are brought into the home and transformed into natural lightning and ventilation.

The design of SOLTAG is conceived basically as a rooftop refurbishment solution - a housing unit that can be attached to existing 60s and 70s multi-storey housing without needing to be connected to the existing energy systems. SOLTAG is also ideal for new buildings, such as terraced housing units and single-family housing in towns. Considering its building design, SOLTAG can be linked to modern architecture.

SOLTAG project received the Danish Energy Saving Award 2005 and the World Globe Award for Denmark in 2006.



Description of project

Background

Future building shall have low energy consumption and use renewable energy sources. Energy consumption in EU is being reduced step-by-step towards the year 2020, which will bring major challenges to the building sector.

The CO2 neutral rooftop apartment was designed with an energy-use including operation of fans and pumps, **it consumes** only half of the allowed energy used in a new housing built according to the new Danish energy rules. With this it is possible to classify the rooftop apartment as low-energy class 1, which also means that it is not necessary to connect it to an external, separate heating supply system. By uptaking of PV modules it is possible to realise SOLTAG as a zero energy building. The principles for this is illustrated in the prototype building which was first exhibited in Ørestaden in Copenhagen for a year, and is now situated at Velux headquarter as a show room towards a large number of visitors.



Description of the development site and the project

European Project "Eco-Building International Club for advanced European sustainable energy technology dissemination in Europe and China"

Project partners:

ENEA (IT), ISNOVA (IT), FINCO (IT), ADEME (FR), AIMCC (FR), DTI (DK), DI (DK), CRES (GR), EBHE(GR), GPREC (GR), SEC(B), ZERI (CN), CBEEA (CN)



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As a CO₂ neutral rooftop dwelling, according to “Energy Quality Design” philosophy, there are 6 measures applied in SOLTAG to reduce energy consumption.

- 1: Prefabricated constructions without cold bridges and with a good airtightness. (better than 1,0 l/s , m² at 50 Pa)
- 2: Use of heat recovery ventilation (HRV) with low electricity use. Extra costs of item 1 and 2 are only 10,000 – 15,000 DKK per apartment (1,350 – 2,000 Euro), based on use of a new thin EcoVent HRV unit which is easy to integrate.

The application of item 1 and 2 is considered as the cheapest way for obtaining the new Danish low energy demands with a 25 – 30% reduction in energy use by 2006 or for achieving Low energy class 2 which is 25% better. The experiences obtained from realised Danish housing projects have shown that item 1 + 2 alone can lead to a 50% reduction of the yearly heating bill and an improved indoor air climate without moisture problems.

- 3: Use of low energy windows with a good daylighting transparency and at the same time with avoidance of overheating problems.
- 4: Use of solar domestic hot water (DHW) system to obtain a 50% reduction of the energy use for DHW. Extra costs 10,000 – 25,000 DKK per apartment (1,350 – 3,300 Euro).
- 5: Use of Photovoltaic (PV) modules to reach a desired or even a climate-neutral low energy level.

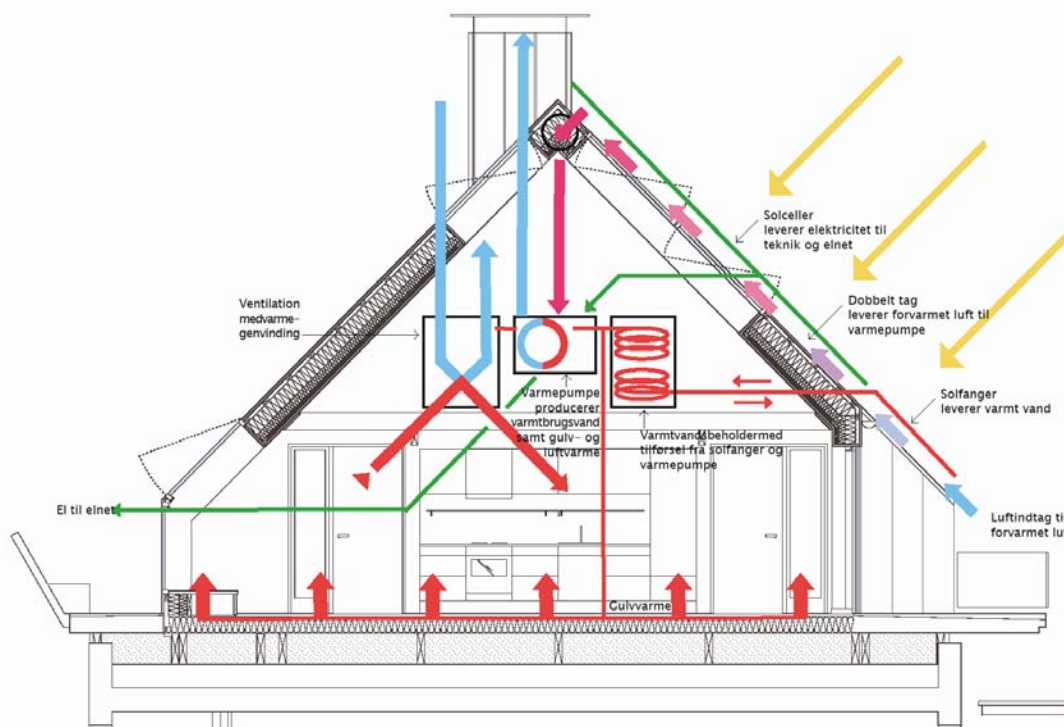
With 0.5 kWp PV panels, equal to 3.5 m² crystalline PV modules, a low energy class 1 quality can be obtained for the rooftop dwelling. Extra costs today 20,000 DKK (2,700 Euro).

With an extra 2.0 kWp PV panels, equal to 14 m² crystalline PV modules, a zero energy and climate neutral energy design can be obtained on a yearly basis. Extra costs today 90,000 DKK (12,000 Euro).

The use of PV energy is considered a very interesting energy option, because we know that we need to depend on renewables in the future and also because there has for many years been a trend of a 50% price reduction in a 7 year period. In Germany 30,000 new jobs have been created in this industry in the last few years.

- 6: Use of an adapted energy supply for heating and DHW.

For a low-energy class 1 housing unit, it will need only a very small energy supply level on a yearly basis. All existing energy supply options can in principle be used (gas furnace, district heating, a small heat pump or electric heating). When a small air and solar roof based heat pump is used, a good energy “quality” is obtained and at the same time a separate energy supply (besides electricity) will be avoided. A competitive investment cost of the energy supply system may range from 25,000 to 30,000 DKK per apartment (3,300 – 4,000 Euro). In any case it is very important to avoid heat losses from the energy supply system because a normal-size heat loss will mean a much higher percentage of this in low-energy dwellings.



Technical description (technical principle, including picture and/or technique scheme)

Above is an illustration of the energy principle of the CO₂ neutral SOLTAG dwelling. On the right in the technical room there are the domestic hot water (DHW) tank which is heated by the solar thermal collector and a small heat pump.

The project aims at promoting and widespread disseminating EU innovative Research and Technology Development and Demonstration results, as well as eco-sustainability criteria in building sector, which include:

- energy efficient building materials, components and systems not yet introduced into the building market or in their first market phase;
- innovative applications of heating/cooling and power supply technologies, combined with the use of renewable energy sources, in building sector;
- best EU demonstration eco-building projects.

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This is the heart of the energy system and provides also heating for the floor heating system. The small heat pump receives preheated air from the solar roof which functions as a large air solar collector. On the left it is shown the balanced heat recovery ventilation system which also provides heated air to the house.

The principle behind SOLTAG is that solar energy is included in an active roof design of the future, with hot air collectors for domestic hot water and PV panels as basis of solar power productions installed on the roofing panels. The energy that is collected as electricity is transmitted to the electricity grid; from the grid electricity will be drawn when required primarily in the winter months. By the low energy design and by using passive solar heat during the heating season, the need for heating is reduced to approximately 30 kWh/m². This minimal need can be attributed also to well-insulated walls, floors, roofs, and windows. The heating system used in SOLTAG is underfloor heating, which uses heat from solar panels combined with a supplementing energy supply from a small air heat pump. The heat pump, in its turn, utilises the energy of hot air preheated by the active double skin solar roof. The air for the heat pump circulates from the base to the ridge of the roof where it is pre-heated before being fed into the pump(see figure above). Here the heat in the air is used to heat the water for the underfloor heating. This is done through the DHW tank witch functions as a buffer storage.

During the design process of the rooftop building, the attention was strongly focused on how to optimise the relation between architecture and indoor climate. The aim was to give the apartment extremely good daylight conditions and at the same time control the indoor climate. The high positioned windows will ensure a good diffusion of light and natural ventilation, while the low-placed windows will give a view of the surroundings. Furthermore, a balanced heat recovery ventilation with 85-90% efficiency is used. This permits a good indoor climate in terms of temperature and humidity level as well as the avoidance of allergens in the dwelling.



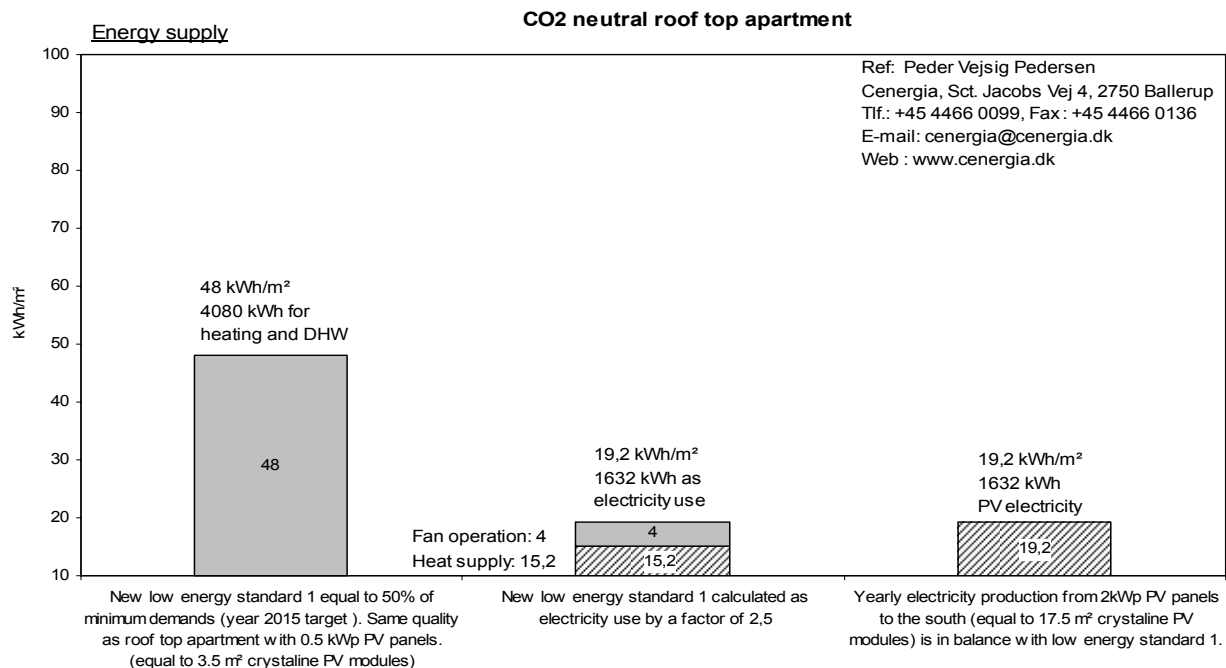
Performance:

Economic data

The extra costs for the different innovative solutions have already been mentioned. But due to the savings from prefabrication the total extra costs are not more than 5% of the normal new building costs. This will due to the savings on operation costs lead to a positive total economy (Saved operation costs – extra capital costs) for the users already from the first year.

Energy data

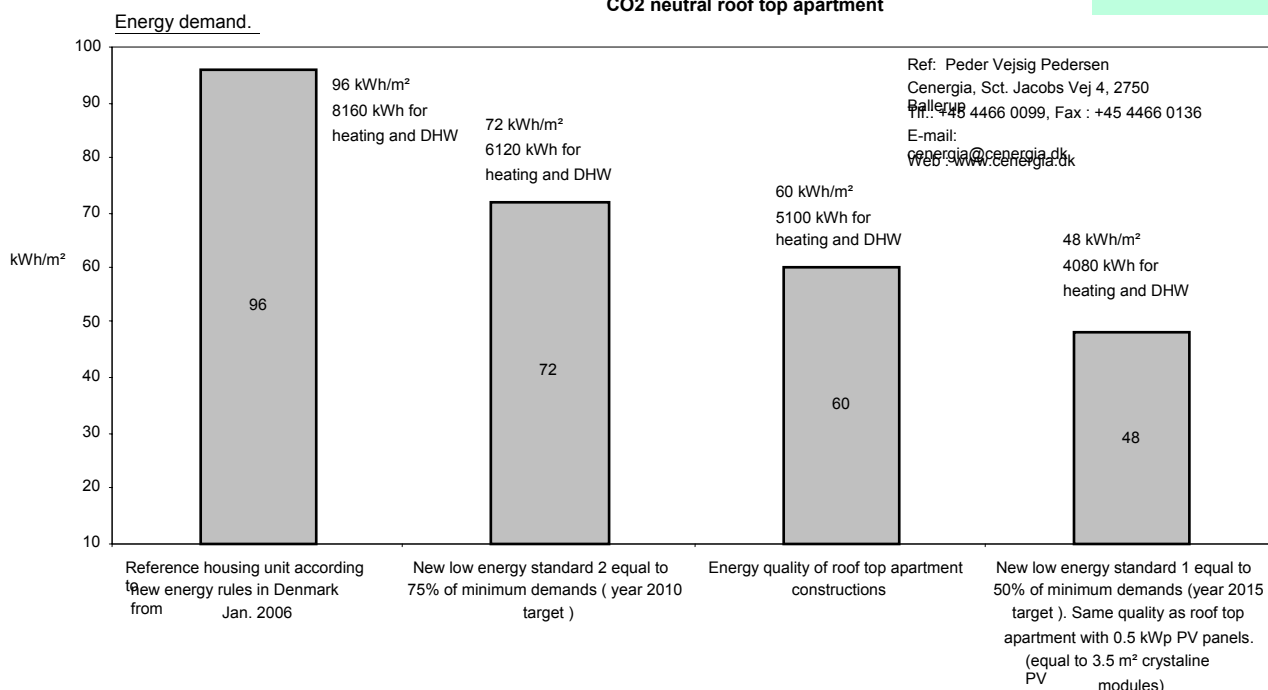
Below is presented an energy balance for the SOLTAG project.



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CO2 neutral roof top apartment



Environmental data

Environmental friendly building materials have been used wiew to a long service life. Work on swan labelling is being integrated in the SOLTAG concept at present.

Carbon Dioxide emission reduced

Due to the zero energy design no CO₂ emissions will come from heating and electricity use for operation.

Information on project developer:

A new company SOLTAG I/S was established involving Kuben Urban Renewal Denmark, Cenergia Energy Consultants, Velux and Rubow Architects.

As the result of SOLTAG project was connected to the EU Demo house FP6 project, Velux has realised new similar initiatives in several other countries. At the same time several SOLTAG implementation projects are being prepared in Denmark to be finished by 2009. New modular SOLTAG Power roofing systems are being developed in cooperation with Velux.

Further information:

Name of project developer	SOLTAG I/S
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