A new basis for buildings

Cenergia explains the emergence of a basis for a completely new building system across Europe using the near-zero energy standard

A basis for a completely new way to build in Europe has been created by the recast of the EU Energy Performance for Buildings Directive from 2010. It demands that new buildings should achieve a near-zero energy standard including use of local renewable energy sources from 2018 for new public buildings, and from 2020 for all new buildings. At the same time, EU member states will create incentives to ensure a similar development for existing buildings. In Denmark, we are well on the way towards meeting these goals due to recent improved energy saving demands in building regulations, including new protected low energy classes 2015 and 2020.

Green Solar Cities demonstration in Salzburg and in Valby, Copenhagen

This means that there is also a focus on extensive retrofitting of buildings, something which has been included in the aims of the EU-Concerto project, Green Solar Cities (2007-2013), where EU funding has been utilised as a strong support for the large-scale photovoltaic (PV) implementation plan in Valby, Copenhagen. This was launched in 2000 with the aim of supplying 15% of all electricity use in Valby by PV technology in 2025.

The central HRV system at Hornemannsvænge

In the Green Solar Cities (www.greensolarcities.com) project long term co-operation with the city of Salzburg and the SIR organisation in Austria has been continued. Here, focus is on the transformation of a whole city district into a combination of low energy new builds and renovations together with large-scale use of solar heating.

Example project in Lehen Salzburg with large solar heating plant, buffer storage and heat pump

In Salzburg, an innovative combination of 2,000m^2 solar thermal collectors together with a buffer storage and a heat pump was used for the old industrial area Lehen in conjunction with a low temperature microgrid connected to the existing district heating network. With this and several other building and renovation projects a whole city district has changed.

At the Hornemannsvænge housing estate in Valby, low energy retrofit solutions have been used together with a kind of solar energy combined heat and power, where both solar thermal and PV electricity is supplementing energy from the large combined heat and power plants in Copenhagen.

Demonstration of PV assisted ventilation for housing renovation has also taken place in Valby and Copenhagen. Here there has been focus on documenting a low electricity use which can be matched by PV electricity, and improved technology has been developed and tested in which heat recovery ventilation (HRV) units are easy to mount under the loft in existing apartments. They can then take fresh air in from the walls and lead exhausted air to the roof, a low electricity use which is matched by PV.

Monitoring results have shown very high heat recovery ventilation efficiencies of 90-98% for one apartment during winter/spring 2013. Electricity use for the fans at 115m^3/h were as low as 18W.

An additional aim is to introduce elements from the so-called 'Active House' concept (see: www.activehouse.info) in relation to the Green Solar Cities project monitoring and evaluation in Valby, which was finalised by the summer of 2014.

A number of the Active House Specifications are defined within areas like energy, indoor climate and environment; and in the energy area there is a focus on yearly energy balance, energy design, energy supply and energy monitoring, verification and follow up.

Hornemannsvænge in Valby is a large concrete housing retrofit project with 288 apartments. Here is a finished renovation

The area of energy balance is based on a calculation of all energy uses in a building, including electricity-using appliances and the effect of the used energy supply system.

In the specifications there is a demand for energy monitoring, verification and follow up. This is new compared to the situation in Denmark today, where there is a lot of focus on good calculation procedures but, like in most other countries, no link to what the actual energy use will be in practice in realised building projects. A good possibility here could be to introduce the same demands for 'verification' of all new building projects within a two-year period as have already been introduced in Sweden.

Green Solar Cities' vision is based on the universal relation between the necessary initiatives you need to work with for the future. That means that energy savings in both new builds and renovations are the first thing you need to introduce and optimise. And when this is done you should look first to an optimised energy supply solution and secondly to investigating how solar energy can be utilised with a high contribution in connection to this, e.g. making near-zero energy or even zero or plus energy building possible.

The lack of focus on performance documentation in practice is, however, still an important barrier towards realising this vision.

Example project in Valby with solar energy combined heat and power

Two types of solar energy systems, PV modules and solar thermal collectors have been integrated in each end of six housing blocks with 2x100m², working as a solar energy combined heat and power solution which matches the CHP-based district heating. In principle, the district heating is not needed for domestic hot water in sunny periods in the summer.

Central HRV systems were chosen even though it is well known that the electricity use is higher than in decentralised ventilation systems and that heat recovery efficiency is lower.

The reason for the choice of the central ventilation solution was to avoid access to apartments once or twice a year to exchange filters. With new available automatic filter boxes this should be possible to avoid in the future.

The monitoring of electricity use for centralised HRV systems in Hornemannsvænge documents a very high electricity use of 1,100kWh/year per apartment. This is equal to a continuous electricity use of 125W per apartment, which can be compared to monitored electricity use for good centralised HRV systems in new builds of 55-60W.

The difference is probably due to the more restricted possibilities for leading duct work through the building, since the engineering design seems to be of a high quality. Such a high electricity use is also a result of the special fire demands given for centralised ventilation, so extra pressure losses of typically 100Pa need to be introduced at armatures.

With installed HRV system costs around DKK60,000 (~€8,057) per apartment, there is no economic reason to choose a centralised ventilation design, but it is still the most common solution for new housing builds and renovations, and it was very difficult in the Concerto area to convince any engineering companies to utilise designs with decentralised HRV systems. The basic idea was to cover most of the yearly electricity use for ventilation by PV, but now only about 25 % can be covered.

CENERGIA

Peder Vejsig Pedersen
Director
Cenergia

tel: + 45 2046 6755

pvp@cenergia.dk
www.cenergia.dk
www.greensolarcities.com