mountEE: Energy efficient and sustainable building
in European municipalities in mountain regions
IEE/11/007/SI2.615937

D 4.5: MONITORING AND EVALUATION REPORT FOR MOUNTEE PILOTS

Name of pilot project:

Ecologic and sustainable passive house school Nya Vegaskolan, Vännäs municipality

Region / local area where the pilot is situated:

Västerbotten County, Sweden

Monitoring and evaluation report submitted by:

Nenet Norrbotten Energy Agency

Type of building: Kind of public use:	Ecologic and sustainable Passive House school building including: • daycare center • elementary school • secondary school • integration school • town library Altogether for around 600 school children, 35 teachers and other staff members. Local area where the pilot is situated: Kommendörsgaten 9, 91181 Vännäs, Västerbotten, Sweden
Total effective area:	BBR (Swedish system to calculate the area) 5189 m2 PHI (for the Passive House certificate) 4260 m2 Area outside the Passive House boundary: 310 m2
Number of levels above earth:	2 levels for school and teacher. One room for the ventilation units is on level 3.
Source of energy for heating:	District heating using renewable sources, re-use of returning district heating water.
Type of heating system:	Ceiling –mounted heating and cooling system. Radiant heating system is a comprehensive technology for realizing optimum comfort in the rooms with a simultaneous aesthetic integration in architectural room concepts. Radiant ceiling panels give off most of their heat through radiation. The remaining heat is transmitted via convection. The radiation of heat is achieved by passing heated water through pipes. The benefit of the system lies in the direct heating effect it has on the body, without the need to heat another medium for example air.
Type of water heating system:	Energy from the district heating system (returning water).
Type of ventilation system:	Passive House certified central ventilation system with heat recovery system and an effective heat recovery rate of 86%.
Owner of the building: Name of owner:	Vännäs municipality

Date of construction/renovation: Total cost: Financing resources:	3/2014 – 7/2015. 10 000 000 € (90.000.000 SEK) project costs, building included all fixed equipment, school yard an external facilities. Public financing.

1) Short description of the pilot project

The Nya Vegaskolan in Vännäs is built as Passive House according to the international Passive House criteria (PHI). It will also be certified according to the sustainable certification system "Miljöbyggnad Guld". This is so far unique for Sweden. The building envelope and insulation is of 100% renewable materials, while the inner supporting system is armored concrete due to costs. The building has 4260 m2 on two levels and will be used by 600 pupils and 35 teachers.

The heat demand is 87% below building regulations and the total energy demand is 80% below the building code. Certification criteria for total specific primary energy demand is ≤ 120 kWh/m²a), for heating ≤ 15 kWh/m2a), Airtightness Pressure test result, n50≤ 0.6 h^{-1}. All energy calculations have been done with the Passive House Planning Package (PHPP). Use of low-emission products is an important part of the project.

Time schedule:
The decision to build the new Vegaskolan as a model project for sustainable building was taken in 2012. The planning process started 2013, the same year the municipality agreed to follow the MountEE pilot project criteria. The construction work started fall 2014 and the building is expected to be completed late summer 2015.

The main objectives for the project "Ecological and sustainable passive house school" are:
- Implementation of all policy decisions of the City Council taken in the context of sustainable living and building.
- To fulfill and implement the European targets of near-to-zero energy building for the years after 2018 for public buildings and 2020 for all buildings, already today.
- To showcase the possibility of a zero energy, zero waste and zero Pollution building
- To create a NZEB as far north as possible in Europe.
- The design of a resource-effective building in all areas.
- The reduction of CO_2 emissions plus achieving a negative CO_2 balance in the life cycle of 50 years.

2) Quality of location and facilities (new buildings only)

Vega school including the municipal library will be located on municipal land in the middle of a major inner-city residential area near to a hotel and some shops for daily needs. The distance to the city center is only 200 meters.

The new school replaces a damp damaged building which also contained asbestos-containing components and which has been located at the same place. There will be no new sealed surfaces. Through the planning of the exterior surfaces ecological diversity and value of green plants will increase.

Distances to services and transport:
• Covered bicycle parking spaces are located at the main entrance.
• 200 meters from the nearest bus stop
• 700 meters to the upper school class 7-9 and high school class 10-12
• 50 meters to the nearest supermarket
• 250 meters from the town hall
• 200 meters to the town center
• 100 meters from the central bus station
• 100 meters to the train station with trains to North and Southern Sweden and commuting to Umeå
• 30 km to Umeå airport

3) Process and planning quality

The project's environmental and quality plan includes the following topics:
• Non-toxic indoor climate with low thresholds for formaldehyde, VOCs, TVOCs, CO_2, and radon – we need to build for people = strict limits on emissions in indoor air
• Highest possible resource and energy efficiency with maximum comfort and quality while also reducing CO_2 emissions = international Passive House certification
• Renewable energy for residual energy demand = Nearly Zero-Energy Building
• Renewable, zero-emission construction materials with low embodied energy levels (LCA)
• External quality assurance (not typical in the Swedish construction process) on the construction site plus quality assurance based on Passive House and sustainability certification
• Materials and structures with long service lives, low maintenance expenses, easy to update and dismantle (LCC)
• Flexible floor plans, flexible and easily accessible building services equipment, non-loadbearing walls inside, accessible ventilation system
• Possibility of prefabricating building components for higher construction quality
• Good location, well connected to local transportation and commercial and public facilities
• Use of existing infrastructure.

According to plans, continuously information exchange between MountEE and architect was provided.

Information for users:
Under the hole planning process there were meetings every 2 weeks with the project-, building- and school management. All of them have been involved in the process regarding the overall concept, the floor plans, the function of the building and the selection of materials and equipment.

A large display in the entrance area will show the current and the average annual energy consumption.

4) Energy and Utilities

The primary energy demand includes the energy demand for heating, cooling, hot water, ventilation, auxiliary electricity, lighting and all other uses of electricity. The limits set above for the specific useful cooling demand and the primary energy demand apply for schools and buildings with similar utilization patterns. These values are to be used as a basis but may need to be adjusted according to building use. In individual cases where very high internal heat loads occur, these values may also be exceeded after consultation with the Passive House Institute. Proof of efficient electrical energy use is necessary in such cases.
All energy calculations have been done with the Passive House Planning Package (PHPP) which is the key design tool used when planning a Passive House and as such, serves as the basis of verification for the Passive House Standard.

a) Specific heating demand:
Accordingly to the Passive House Certification Criteria for

- specific space heating demand ≤ 15 kWh/(m^2a)
- total specific primary energy demand ≤ 120 kWh/(m^2a)
- airtightness Pressure test result, n50≤ 0.6 h^{-1} (here n50≤ 0.3 h^{-1} or 0,15 l/(sec, m^2)

b) Specific cooling demand:
There is no cooling demand because of the temporary exterior sun protection with external venetian blinds.
They can be adjusted to almost any angle – comfortably from inside the room. Thus, the slats allow daylight to enter into the interior while still protecting visual privacy.
As a heat shield in the summer and additional insulation in the winter, the external venetian blinds improve the energy balance of building.
The adapted automated slat control ensures that external venetian blinds meet the requirements for energy efficiency class A. Optimum daylight utilization while minimizing heat input with the external venetian blinds the project benefit from significant cost and energy savings for artificial lighting and air conditioning.
Additionally there is a bus-system that coordinate the sun shading systems, ventilation, heating, with each other to be able to react effectively to external weather influences.
In addition there is an ice and a direction dependent wind monitoring.

c) Specific lighting demand
In the whole project we use demand controlled LED lights which daylight- and occupancy sensors which are cooperating with the exterior venetian blinds with concave light control slats.

d) Primary energy demand
Total specific primary energy demand *) ≤ 120 kWh/(m^2a)

Reduced primary energy demand through following measures:

1. Reduce the heating demand to around 15 kWh/m^{2}a) = intern. Passive house standard.
2. Demand controlled ventilation units with sensors for humidity, VOC, CO_2 and temperature

(An important requirement for demand controlled ventilation is a nontoxic indoor air environment/quality. If this criterion is not met it requires a much higher ventilation rate to keep the air free of unhealthy emission)

3. Avoidance of cooling demand through temporary sunshade systems, naturally night ventilation concept.
4. Reduce the use of electricity for artificial light, pumps and fans.
5. Reduce the use of hot water and the losses of the hot water circuit through extra thick insulation.
6. Use of the returning water of the district heating grid.
7. Use of district heating grid with a CHP system (combined heat and power coupling) and a PEF around 0,85.
8. Use of district heating grid which uses 90% biomass.

e) Renewable energy

District heating with renewable fuel, with only use of returning district heat water. For lighting: Certified Green Electricity. Not finally decided: a PV plant or a share in wind power plant.

All energy calculations have been done with the Passive House Planning Package (PHPP).
There is a space allocation plan for the project which also is used as a tabulation for all building materials.
Part of PHPP is to take into account of all internal heat gains, passive solar gains, thermal bridges and more.
Part of the planning process was to develop an air tightness concept with detailed drawings and material recommendations.
There is also a training of construction workers as the airtight layer may be practiced. In any case there will be two Blower Door tests together with infrared thermography.

5) Health and Comfort

High level of comfort because of the use of an exterior temporary sunshade systems and naturally cooling. Part of the sustainability and quality program in the project were these sound pressure levels:
LA,eq < 30 dB (A) class rooms
LA,eq < 25 dB (A) Rest rooms
LA,eq = effective sound pressure
Part of the tender documents are requirements for all building materials with limited values for poison / unhealthy emissions for
VOC; TVOC; Formaldehyde and Radon
Furthermore it is not allowed:
To use HFC´s in the production process of XPS insolation under the ground slap.

To use insolation panels with brominated flame retardants. To use PVC pipes for wastewater and conduits. To use refrigerants with ODP > 0 and GWP > 5 in cold storage systems. All chiller, freezer, cooler in the professional kitchen use as an environmentally friendly refrigerant CO2. All materials need an EPD, a sustainable certificate and a report for emissions.
6) Building materials and constructions Part of the tender documents were requirements for all building materials with limited values for poison / unhealthy emissions: • VOC • TVOC • Formaldehyde • Radon Furthermore it was not allowed: • To use HFC´s in the production process of XPS insolation under the ground slap. • To use insolation panels with brominated flame retardants. • To use PVC pipes for wastewater and conduits. • To use refrigerants with ODP > 0 and GWP > 5 in cold storage systems. All chiller, freezer, cooler in the professional kitchen use as an environmentally friendly refrigerant CO2. Avoidance of PVC: It was not allowed to use PVC pipes for wastewater and conduits. No floor coverings were used. Instead linoleum, wood parquet and tiles were used. Certified Passive House windows, doors and curtain walls are made of wooden frames with aluminum cladding. The exterior venetian blinds are made of aluminum. Ventilation pipes are made of galvanized sheet metal. Ecological optimization of building materials: All materials needed an EPD, a sustainable certificate and a report for emissions. The variety and numbers of materials was reduced and later on renewable, emission free building provisions produced as closed as possible to the building side were chosen. The results of a comparative LCA was the use of: • Wooden beams • Cellulose insulation (without Borax) • OSB 3 panels without Formaldehyde • Wood fiber insulation board • Ceilings with glued laminated timber • Glued laminated timber for bearing construction • Linoleum floors

- Wooden parquet
- Wooden panels
- Wooden frames for doors and windows
- Paintings with very low emissions.

7) Test of special methods (renovation only, if applicable)

N.A.

8) Service Package

Nenet was cooperating with the responsible architect Thomas Greindl and offering service and support following the structure of the service package. This means in practice that the standard was more or less the same as in the service package regarding moduls 2-5. Certification as Miljöbyggnad Guld and passive house following PHI criteria secured a high level of quality.

9) Deviations from implementation plan

No deviations from the implementation plan occurred.
The building construction outclasses all MountEE-criteria for MountEE pilot buildings: energy performance, building materials etc.
Lessons learnt from Hedlunda project in terms of building materials, communication in building team etc. could be used, which made the building process more effective and substantially cheaper.

10) Lessons learned and proposed improvements

1) It is possible to build certified Passive Houses in the cold climate of North Sweden. This is of high importance for the ongoing discussion in Sweden how to implement the EU building directive in Sweden. E.g. the national Swedish building authority Boverket is arguing that the current building standard in Sweden (e.g. 130 kWh/m2/a for Northern Sweden) is in fact already what should be seen as NZEB standard for (North) Sweden.

2) The use of the LCC method was crucial for the success of the project. The cooperation between the architect and Vännäs municipality was very fruitful and even the involvement of stakeholders and future users was an essential part of the project work.

3) A lot of communication and information activities were carried out from the very beginning of the planning work. The project was seen as a lighthouse project for Vännäs municipality from a very early stage of the planning process.

4) The procurement of ecological and low-energy building materials was decisive for the success of the project and sometimes a real challenge.

5) It could be shown that even small municipalities situated in remote rural areas can carry out innovative building projects on highest international levels and standards!

11) Next step and follow up

The project is together with other pilot projects of high importance for the ongoing discussion in Sweden how to implement the EU building directive in Sweden and as a consequence for how NZEB building criteria will be defined in Sweden.
A follow-up project on how to on a broad scale introduce a support and consulting structure which is based on Vorarlberg´s Service Package" is under preparation.
The network of Swedish regional Energy Agencies is going to strengthen the position as leading expert group and capacity building structure for sustainable building in Sweden.

Further support for the pilot project:
1) Sharing information with County Council building team, e.g. from WP2 Best Practice examples and other lighthouse constructions;
2) Facilitating continuously exchange of information with MountEE Regional Cooperation Committee;
3) Further capacity building for staff, building company and project leaders following concrete demands from the pilot;
4) Coaching and consultancy on concrete questions and problems
5) Offering contact and network for discussion questions and experience exchange with international experts;
6) Evaluation of actual project and compiling lessons learnt;
7) Documentation of building process in terms of sustainable building and publishing of results.

Evaluation process:
According to the joint evaluation guidelines and using interviews with the involved parties in the project as well as the continuous discussion of the project by the RCC.

9) Contact project owner

Organisation:
Vännäs Kommun Fastighetsavdelning/property management
Project management and contact person:
Vännäs kommun
Lars-Åke Forsgren
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http://vegaskolan.wordpress.com/

Architect:
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+46-76-8290156

10) Add Logo and 2-3 pictures or diagrams if appropriate!

Vännäs municipality: vännäs

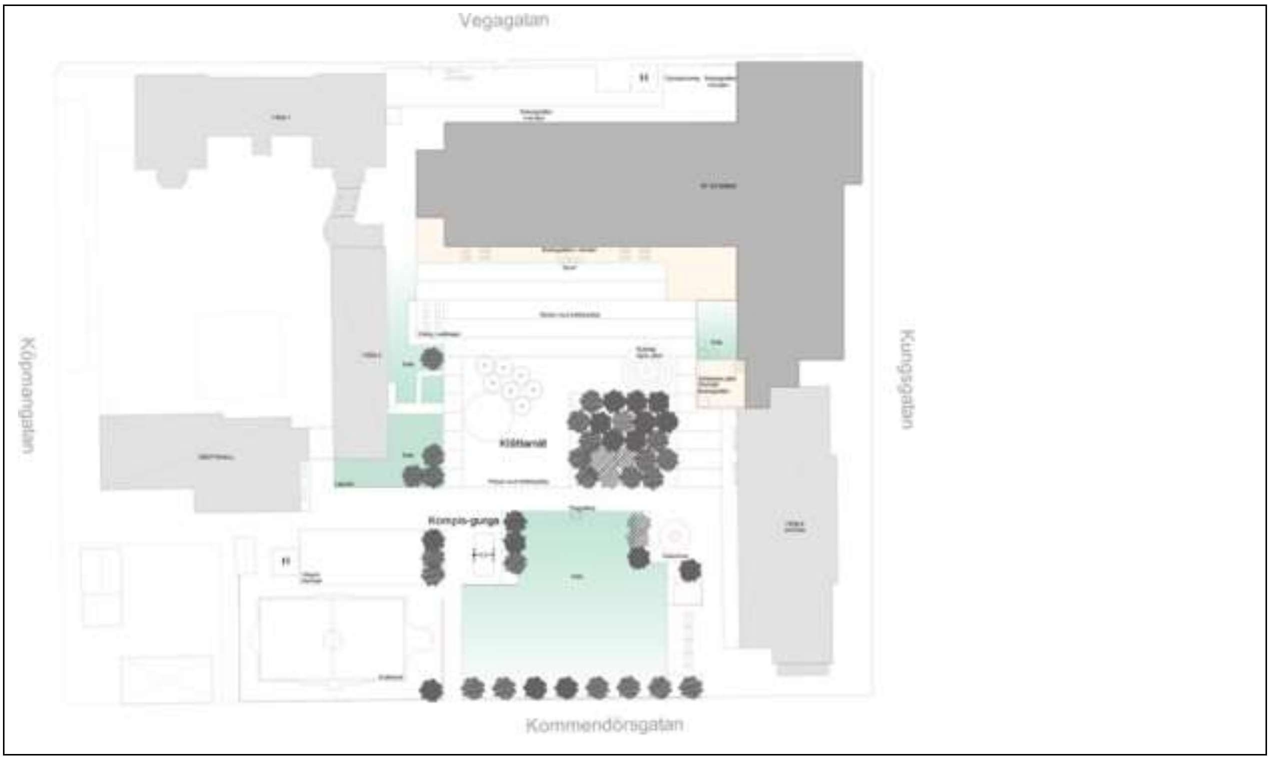
SWECO

Betyg för nyproducerad byggnad

Betygen avser byggnaden	Vega
Eventuell kommentar	Utkast med fuktsäkerhet silver
Datum (ÅÅÅÅ-MM-DD)	2013-06-02

MILJÖ BYGGNAD
CERTIFIERAD | SVERIGE

Indikatorer		Aspekter		Områden		Byggnad
1 Energianvändning	GULD	Energianvändning	GULD	Energi	GULD	GULD
2 Värmeffektbehov	GULD	Effektbehov	GULD			
3 Solvärmelast	GULD					
4 Andel av energislag	GULD	Energislag	GULD			
5 Ljudklass	SILVER	Ljudkvalitet	SILVER	Innemiljö	GULD	
6 Radonhalt	GULD	Luftkvalitet	GULD			
7 Ventilationsstandard	GULD					
8 Kvävedioxid	GULD					
9 Fuktsäkerhet	SILVER	Fukt	SILVER			
10 Termiskt klimat vinter	GULD	Termiskt klimat	GULD			
11 Termiskt klimat sommar	GULD					
12 Dagsljus	GULD	Dagsljus	GULD			
13 Legionella	GULD	Legionella	GULD			
14 Dokumentation av byggvaror	GULD	Dokumentation	GULD	Material	GULD	
15 Utfasning av farliga ämnen	GULD	Utfasning	GULD			



Vegagatan
Köpmangatan
Kungsgatan
Kommendörsgatan
Kötterräd
Kompis-gunga