Availability of components for very low energy residential buildings on the North European Building Market

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1 EXECUTIVE SUMMARY

A previous NorthPass study “Barriers to implementation of very low energy residential buildings and how to overcome them” concluded that in some of the participating countries there is to some extent a lack of suitable components for very low energy residential buildings. The study also stated that some of the existing products are not fully suitable for very low energy residential buildings. Besides, the components are not always easy to find. Therefore this study was carried out to determine the state-of-the-art and need for further development of components for very low energy residential buildings in Sweden, Finland, Denmark, Norway, Poland, Latvia, Estonia and Lithuania.

Analyses of existing very low energy buildings and reports on very low energy buildings were made. Designers and contractors of very low energy buildings were interviewed. Discussions were carried out with the expert groups involved in the NorthPass study on barriers to implementation of very low energy residential buildings and how to overcome them. The target groups were participants of the NorthPass project, designers, contractors and building industry.

However, this detailed study shows that most components needed for very low energy residential buildings are available on the markets in the participating countries i.e. thermal insulation, airtightness products, windows, doors, solar shading, structural frame components, ventilation systems, heat recovery systems, heat pumps, heat distribution systems, pumps, control systems, household appliances and tap water taps. However, in the Baltic States some airtightness products are not available. The available components obviously have to better marketed, to ensure that e.g. more designers know that they are available. Whether there will be enough components in a growing market is difficult to say.

Most participating countries ask for more cost efficient systems for very low energy residential buildings. The need for development of components for very low energy residential buildings varies from country to country. In Denmark further development of many components and especially airtightness of prefabricated buildings elements and individual control systems for air heating is desired. In Sweden airtight doors at a lower price, ventilation heat recovery systems with a lower use of electricity, supply air terminal devices for a wider range of supply temperatures, better insulated ground pipes and district heating sub centres are needed. In Sweden, Finland and Norway user friendly ventilation heat recovery systems are wanted. In Finland, Norway and Latvia user friendly heat distribution systems are asked for. Obviously there are components, which can be further improved and international competition and a bigger market are likely to speed up the development.

Within the NorthPass project a database with major components needed for very low energy houses will be developed. The results of this study will also be an important input to the NorthPass work package on user-oriented market penetration of very low energy houses.
2 INTRODUCTION

2.1 Purpose of the report

The purpose of this report is to determine the state-of-the-art and need for further development of components for very low energy residential buildings in Sweden, Finland, Denmark, Norway, Poland, Latvia, Estonia and Lithuania:

- Market studies concerning availability of components suitable for very low energy residential buildings in the participating countries (concepts on the market, material and equipment availability)
- Compiling relevant information of needs of special very low energy house components and availability of components in each country.
- Mapping whole building solutions with components that can be applied in different types of very low energy houses.
- Analyses of needs for further development of components for very low energy houses.

This was determined by

- Analysing existing low energy houses and passive houses
- Reading reports on low energy houses
- Interviewing designers and contractors of low energy houses
- Discussions with the expert groups involved in the study on barriers to implementation of very low energy residential buildings and how to overcome them Blomsterberg (2010). Participants in the expert groups were mainly representatives of developers/owners, architects, energy consultants, manufacturers, contractors, researchers, users/operation managers, authorities, health organisations and policymakers.
- Internet search

An important source of background information is the determination of the technological barriers as documented in the previous NorthPass report “Barriers to implementation of very low energy residential buildings and how to overcome them”.
3 RESULTS

Assuming that the principles of low energy design are according to the Kyoto pyramid (Dokka 2006), where first of all heat losses are reduced, then the electricity use is reduced, then solar heat is utilized, then energy use is displayed and controlled and finally the energy source is selected. The process is of course to some extent iterative.

In order to design and erect residential buildings with a very low energy demand, many or all of the following products are needed:

- Thermal insulation, where the thermal conductivity should not exceed 0.05 W/mK
- Airtightness products of high quality
- Windows, where the U-value should be at least less than 1.0 W/m²K
  - Glazing, where the g-value (solar transmittance) should be higher than e.g. 0.4 (40 %) and daylight transmittance higher than 0.5 (50 %). These values depend on the glazing area related to the façade and/or floor area.
- Solar shading
- Doors, where the U-value is at least less than 1.0 W/m²K
- Structural frame components, which minimize the thermal bridge.
- Ventilation systems with fans (supply and exhaust air systems), where the SFP (specific fan power) should be less than 1.0 kW/(m³/s). The SFP value does of course depend on the design of the whole ventilation. The pressure losses have to be minimized.
- Ventilation systems with air-to-air heat recovery, where the energy efficiency should be higher than 80 %
- Heat pumps with the ground, exhaust air or outdoor air as a source, where the COP (coefficient of performance) should be higher than 3.0
- Heat distribution systems, which are suitable for very low energy residential buildings
- Pumps, with a low use of electricity
- Domestic hot water heaters, with low standby losses
- Control systems, which are suitable for very low energy residential buildings
- Household appliances, which should be of at least class A
- Tapwater taps, which are energy efficient.

Many of these components are needed in most residential buildings. For very low energy buildings they furthermore have to fulfil high energy performance requirements e.g. at least the above suggested levels.

3.1 Sweden

Author: Åke Blomsterberg, University of Lund

The information on components is based on discussions with the expert group and on own studies of the market and experience from completed demonstration projects of low energy buildings.
3.1.1 Availability of components

Most components are available for low energy residential buildings.

3.1.1.1 Thermal insulation

Thermal insulation, where the thermal conductivity is less than 0.05 W/mK is widely available. The most common materials are mineral wool, fibreglass and cellulose, which all of them are used in low energy residential buildings. The insulation is also applied as loose fill insulation. Polystyrene and polyurethane are used quite frequently in low energy residential buildings, but mostly only as ground insulation and occasionally as roof insulation. There are also some examples of using this material for wall insulation, sometimes alone or in combination with mineral wool. Transparent insulation materials are hardly ever applied. Vacuum insulation panels with a very low thermal conductivity will be tested in a low energy renovation project.

Examples of suppliers, which can be found on http://byggkatalogen.byggtjanst.se, are: FOAMGLAS Nordic AB, Genevad Cellplast AB, Isola-Platon AB, Jackon AB, Leif Tjällden AB, Nordiska Ekofiber AB, Träullit AB, Paroc AB Byggisolering, Rockwool AB, Saint-Gobain Isover AB, Sundolitt AB, ThermiSol AB and Thermofloc Scandinavia AB.

3.1.1.2 Airtightness products

Airtightness products are available for most applications in low energy residential buildings. A study was recently made to survey the availability of airtightness products (Johansson 2010). The study concluded that there are several products (see table 3.1) and solutions available, but they can be hard to find. The suppliers and the contractors do not have the same opinion of what is the “right solution”. There are new and old airtightness products. The new ones are often good at airtightness but their reliability or durability is not always known.
Table 3.1 Examples of suppliers/manufacturers of airtightness products on the Swedish market. The suppliers/manufacturers can be found on [http://byggkatalogen.byggtjanst.se](http://byggkatalogen.byggtjanst.se).

<table>
<thead>
<tr>
<th>Supplier/-manufacturer</th>
<th>1: windows/doors</th>
<th>2: Joining of plastic vapour/air barrier</th>
<th>3: Sill and foundation</th>
<th>4: Sill and wall</th>
<th>5: Floor structure lead-through</th>
<th>6: Pipe through concrete</th>
<th>7: Electrical outlet</th>
<th>8: Spotlights</th>
<th>9: Small pipe</th>
<th>10: Between outer and inner pipe</th>
<th>11: Ventilation duct</th>
<th>12: Stove</th>
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### 3.1.1.3 Low energy windows

Windows are available, where the U-value is less than 1.0 W/m²K and where the glazing has a g-value higher than e.g. 0.4 (40 %) and daylight transmittance higher than e.g. 0.5 (50 %).

The introduction of passive houses in Sweden has meant that the availability of low energy windows has increased. Quadruple-glazed windows with a U-value of 0.6 W/m²K, g-value of 0.45 and daylight transmittance of 0.59 are available. Triple-glazed windows with a U-value
of 0.7 W/m²K, g-value of 0.50 and daylight transmittance of 0.71 are available on the Swedish market. In low energy residential buildings quadruple-glazed windows are rarely used. Windows in low energy residential buildings are mostly triple-glazed.

Examples of suppliers of low energy windows with a U-value better than 0.9 W/m²K are: Domlux Fönster, Elitfönster, Fönsterfabriken FF, Fönstergruppen, Mockfjärds Fönstermästaren, Skaala Fönster och Dörrar, SP Fönster, Traryd Fönster, VELFAC. These suppliers are listed on the Swedish web site for energy-rated windows [http://www.energifonster.nu/](http://www.energifonster.nu/).

### 3.1.1.4 Solar shading systems

Solar shading systems of most types are available e.g. Venetian blinds for installation inside, outside or between the panes. In some passive houses the solar shading is solved with overhangs and/or solar control glazing. There is a wide variety of small and large suppliers of solar shading systems.

### 3.1.1.5 Low energy doors

Doors, where the U-value is less than 1.0 W/m²K are available on the Swedish market. Several Swedish door manufacturers sell doors with a U-value, which is better than 0.9 W/m²K. These are typically used in low energy residential buildings.

Examples of suppliers of doors are: Dörr & Portbolaget i Vittaryd AB, Ekstrand o Son AB, JELD-WEN Sverige AB, Leksandsdörren AB, Polardörren AB, Diplomatdörrar i Sverige AB and JELD-WEN Sverige AB. Most of these suppliers are listed among test results of U-values and rain-tightness from the Swedish Energy Agency: [http://www.energimyndigheten.se/sv/Hushall/Tester/Testresultat/](http://www.energimyndigheten.se/sv/Hushall/Tester/Testresultat/).

### 3.1.1.6 Low energy structural frame components

Structural frame components, which minimize the thermal bridge e.g. I-beams of Masonite and wood are available since many years. There is at least one supplier, Byggma Group Masonite. Otherwise a very common solution in low energy residential buildings is multi-layer constructions.

### 3.1.1.7 Low energy ventilation systems

Ventilation systems with fans (supply and exhaust air systems), where the SFP is less than 1.0 kW/(m³/s) are available from several suppliers. Examples of suppliers of efficient fans can be found among the suppliers of ventilation systems.

Ventilation systems with air-to-air heat recovery, where the energy efficiency is higher than 80 % are available. A common air-to-air heat exchanger in passive houses is the counter flow heat exchanger. In low energy residential buildings rotary regenerative heat exchangers are sometimes used.

Examples of suppliers are: Enervent AB, Flexit Sverige AB, Fläkt Woods AB, GEA Exos Ventilation AB, IV Produkt AB, Janssons Thermoteknik AB, LTS Products AB Luftmiljö AB, Menerga AB REC Indovent AB, Systemair AB, Swegon AB, Weland Luftbehandling AB and AB C A Östberg. The suppliers of air handling units with heat recovery for one-family houses and apartments are listed among test results from the Swedish Energy Agency: [http://www.energimyndigheten.se/sv/Hushall/Tester/Testresultat/](http://www.energimyndigheten.se/sv/Hushall/Tester/Testresultat/). The suppliers of the other units can be found on [http://byggkatalogen.byggtjanst.se](http://byggkatalogen.byggtjanst.se).
3.1.1.8 **Heat pumps**

Heat pumps, where the COP (coefficient of performance) is higher than 3.0 are available from several suppliers. The heat pumps are either ground-to-water, air-to-air or air-to-water heat pumps.

Examples of suppliers of air-to-air heat pumps are: Carrier AB, Electrolux AB, FG Nordic AB, AQS Produkter, IVT Industrier AB, Mitsubishi Electric, Clima Sverige AB, Panasonic Nordic AB, Ahlsell AB and Toshiba. Examples of suppliers of air-to-water heat pumps are: Thermia värme AB, Sirius Värmeknik AB and Viessman Värmeknik AB. Examples of suppliers of ground-to-water heat pumps are: Thermia värme AB, Nibe, Thorén and Stiebel Eltron. These suppliers are listed among test results for one-family houses from the Swedish Energy Agency: [http://www.energimyndigheten.se/sv/Hushall/Tester/Testresultat/](http://www.energimyndigheten.se/sv/Hushall/Tester/Testresultat/). Many of the suppliers have also heat pumps suitable for entire apartment buildings.

3.1.1.9 **Low energy heat distribution systems**

Heat distribution systems, which are suitable for very low energy residential buildings, exist to some extent. Many of the passive houses are heated by the supply air, which means that the above mentioned suppliers of ventilation systems with heat recovery are the suppliers. Some are heated by one or two radiators per apartment.

3.1.1.10 **Pumps**

Several pumps, with a low use of electricity, can be found. In very low energy residential buildings with hot water central heating a circulating pump is needed, which should have a low use of electricity.

Examples of suppliers of energy-efficient pumps are: Flygt, Grundfos, Perfecta, Smedegaard and Wilo. These suppliers are listed among test results from the Swedish Energy Agency: [http://www.energimyndigheten.se/sv/Hushall/Tester/Testresultat/](http://www.energimyndigheten.se/sv/Hushall/Tester/Testresultat/).

3.1.1.11 **Domestic hot water heaters**

Domestic hot water heaters, with low standby losses, are available.

3.1.1.12 **Low energy control systems**

Control systems, which are suitable for very low energy residential buildings, can be found. One example of suppliers is: TemoSat. However, on the Swedish market automation systems using components from well-known international suppliers are widely available.

3.1.1.13 **Low energy household appliances**

There are many household appliances, which are of class A. Most suppliers have class A household appliances and the products of most major manufacturers can be found on the Swedish market.

3.1.1.14 **Tapwater taps**

Tapwater taps, which are energy efficient, exist since a couple of years. These were developed by a Swedish technical procurement. One example of suppliers is: Gustavsbergs AB.

3.1.2 **Lack of components**

Most components exist on the market, but a few doesn’t exist (Janson 2010):
- Heat distribution systems: Affordable pellets burners in combination with solar collector systems for single-family houses.
- Heat distribution systems: Wood-burning stoves with a low power outlet for single-family houses

### 3.1.3 Need for development of components

Several components need to be further developed (Janson 2010):

**Airtightness products:** Airtight apartment doors.

**Doors:** Entrance doors with a low U-value at a reasonable cost.

**Doors:** Well insulated airtight roof hatches. There is one Swedish manufacturer claiming to have a roof hatch suitable for very low energy residential buildings.

**Ventilation systems:** Air handling units incl. heat recovery with a user-friendly (for the tenants) interface:
- for lowering or raising the indoor temperature
- showing the current indoor temperature
- showing how much energy has been used for a certain period of time
- showing if the bypass is in operation
- showing if the heating coil is on
- showing whether the fans are running at high or low speed
- showing if the filters need to be changed

**Ventilation systems:** Supply air terminal devices usable for both low and high supply air temperatures at the low (compared with e.g. office buildings) ventilation rates required in residential buildings. This is relevant for passive houses where the space heating is supplied by the ventilation system.

**Ventilation systems:** Air terminal devices which are easy to clean for the tenants.

**Ventilation systems:** Air inlets in the façade which are not blocked by white frost in winter.

**Ventilation systems:** Air handling units incl. heat recovery with a very low use of electricity for single-family houses.

**Heat distribution systems:** Better insulation for pipes installed in the ground (e.g. heating pipes between buildings).

**Heat distribution systems:** Single-family house district heating sub centres suitable for a very low energy use.

More efficient pumps for circulating water.

### 3.1.4 References


### 3.2 Finland

Author: Jari Rintamäki, Tampere University of Technology
The answers from the Finnish advisory group members to the question «What is the most important technological barriers on passive house markets?», can be summarized in a couple of bullet points:

- Regarding dwellings, to a great extent, Finland has got the necessary know-how and technical solutions. However; so far, only a few companies have gained experience regarding passive/very low energy houses.

- There is a need for more competing products to decrease the market costs.

3.2.1 Availability of components

3.2.1.1 Insulation products

So far, mainly traditional mineral wool insulation has been used in Finnish very low energy house projects. Also polyurethane insulation has been used in some cases which make it possible to use clearly lower insulation thicknesses.

Examples of suppliers are: Paroc Oy AB, Termisol Oy, Isover-Saint Gobain, Ekovilla Oy, and Suomen Selluvilla Oy.

3.2.1.2 Products for air tightness of the building envelope

Significant development work has been dedicated to finding good solutions to reduce the air infiltration through the building envelope, particularly for residential buildings. Demands for the tightness of the envelope are increasing (Finnish RakMK D3, 4.0 m³/h/ envelope /m²) The improvement of tightness there is however also the question of good workmanship e.g. in the low-energy apartment house of Lakia company (Vaasa) the construction workers were educated for achieving a good tightness.

Examples of suppliers are: Tiivistalo Oy, Rockwool Oy, and Test-Air Oy.

3.2.1.3 Very low energy windows and doors

There are no special windows for very low energy houses. For the best windows the U-value of the whole window is 0.6 W/m²K. The critical point is the frame whose U-value should be improved e.g. with a polyurethane fill to minimize the thermal bridge or the frame is hidden in the wall. Also the improvement of the U-value of the glazing can cause visual problems with frost on the outer pane.

Examples of doors and windows suppliers are: Fenestra Oy, Lammin Ikkuna Oy, Hämeeenkyrö Ikkunatehdas Oy, Skaala Ikkunat ja Ovet Oy, Alavus Ikkunat Oy, Domus Ikkunapiste Oy and Pihla Oy.

3.2.1.4 Structural frame components

There are a couple of Finnish suppliers for structural frame components, which minimize the thermal bridge e.g. I-beams of Masonite and wood. Otherwise a very common solution in low energy residential buildings is multi-layer constructions.

Examples of suppliers are: PRT-Lami Oy, Koskisen Oy

3.2.1.5 Solar shading systems

Most very low energy houses built so far have used exterior venetian blinds, which are very effective in regulating the solar gains, in particular if they are automatically controlled. The
problem with these systems is that they are relatively expensive, at least the high-quality products, and that they can block out daylight and view.

Examples of suppliers are: Sun Shading association: Apollokaitadin Oy, Kaidinkulma Oy, Artic Kaidin Oy and Aurinkosuoja Oy Auri.

3.2.1.6 Water based heat distribution systems

Simplified heat distribution systems (e.g. water based radiator heating) may be necessary to improve a good indoor climate on winter conditions: Products are standard type, but the sizes are smaller compared to normal type of building.

Examples of suppliers are: Uponor Oy, Purmo Retting Lämpö Oy and Nereus Oy.

3.2.1.7 Ventilation heat recovery systems

Ventilation heat recovery systems with annual temperature efficiency above 80% are available on the market. Mostly rotary heat exchangers have been used in the Finnish very low energy house projects.

Examples of suppliers are: Enervent Oy, Fläkt Woods Oy, Iito Oy: Air Wise Oy, Iloxair Oy and Vallox Oy.

3.2.1.8 Low energy facade elements

Different kinds of low energy block elements are used in Finland as buildings envelope material with minimized thermal bridges for low energy houses. Usually elements have been made from insulation material and its structure works as the concrete mold. Because of modular structure, buildings envelope can be build up very fast.

Examples of suppliers are: Finneps Oy, Passiivikivitalot.fi and Lammibetoni Oy.

3.2.1.9 Heat Pumps, systems and solar systems

Air-to-air, air-to-water and ground-to-water heat pumps have been installed in the Finnish very low energy house projects. A variety of products and suppliers are available. Usually those are oversized to very low energy house heating needs.

Examples of Heat Pumps suppliers are: Oilon Home Oy, Suomen Lämpöpumppu Oy, Kaakon Lämpö ja huoltopalvelut Oy, Sinidos Oy, Nereus Oy, Kaukora Oy and Ekowell Oy.

Some very low energy houses have also solar collector systems. There are some suppliers of solar heating systems in Finland, but more are coming.
Examples of suppliers are: Aurinkotori Solar Viatorum, RICA - Riihimäen Metallikaluste Oy, Porin Termolaite Oy and Savo-Solar Oy

3.2.1.10 Cooling and pre-heating

Earth–to-air heat exchangers i.e. earth pipes have been used both for pre-heating of ventilating air in winter and for cooling in summer.

3.2.1.11 Pumps

There are some pumps with a low use of electricity. The efficiency of the pump is up to 60% and the efficiency of the whole equipment up to 50%.

Examples of suppliers are: Kolmeks Oy, Wilo Finland Oy

3.2.1.12 Control systems for low energy houses

There are only few Finnish building automation system/components manufacturer.

One example of supplier is: Ensto Oy.

However there are many Finish contractors, which offer automation systems using well known, international suppliers components

Examples of suppliers are: Berker Oy and Elko Oy.

3.2.1.13 Household appliances

Household appliances, which are of class A. Most suppliers have class A household appliances and the products of most major manufacturers can be found on the Finnish market.

3.2.1.14 Tapwater taps

Tapwater taps, which are energy efficient. Examples of suppliers are: Oras Oy.

3.2.2 Lack of components

The basic components are available on the market, but there is a need for more cost-efficient systems.

There is also a lack of smaller sizes of ground heat pumps, which are suitable for the lower heating energy demand in very low energy houses.

3.2.3 Need for development of components

There is a need for development of more cost-efficient systems, in particular with regards to energy supply systems for low loads. There is also a need for user-friendly systems for operation of ventilation systems and energy supply systems. Moreover, there is a need for developing cost efficient solar heating systems and solar shading systems that don’t reduce view and daylight penetration.

During the last winters there have been extremely long cold periods (-30 °C) everywhere in Finland, which causes freezing of air-to-air and air-to-water type of heat pumps. Because of that reason, some kind of air preheating system before heat recovery unit should be developed to solve the problems.

3.2.4 References

3.3 Denmark

Author: Ole Balslev-Olsen, CENERGIA

The information on components is based on discussions with the expert group and from own studies of the market and experience from completed demonstration projects of low energy buildings.

3.3.1 Availability of components

Many standards and guidelines on how to reduce heat loss from buildings and to achieve low energy building requirements are available on the Danish market. Several manufacturers of insulation materials exist and technical specifications can be found on manufacturers’ websites including instructions on how to achieve high isolation level of the construction. The instruction also includes advice on how to avoid thermal bridges in the constructions.

There are numerous manufacturers of low energy windows. Test results of the thermal performance of windows exist from independent testing centre. To ensure that consumers get quality products, most of the Danish window and glazing manufacturers joined volunteers’ certification scheme, which also includes test results of products.

To achieve very low energy building standards it is often necessary to use balanced ventilation with heat recovery. The Danish building code includes a minimum requirement of the temperature efficiency of the heat recovery unit on 80%. That means that manufacturers have developed good air handling units during recent years.

In recent years, micro heaters, also called compact units, have been developed for very low energy houses also called compact units. They are often based on heat pumps and include heat recovery units, domestic hot water storage and some with solar heat.

3.3.1.1 Thermal insulation

Thermal insulation materials for buildings are available. The thermal insulation association VIF is the trade association of Danish manufacturers of thermal insulation and companies who promote insulation materials in Denmark. For more information see www.VIF-isolering.dk. The most common materials are mineral wool, fibreglass and cellulose. Transparent insulation materials are hardly ever applied. Vacuum insulation panels have been tested. Examples of suppliers are: Egen Vinding & Datter, FOAMGLAS, H+H Danmark a/s, Microtherm Aps, Nordisk Perlite, Papiruld Danmark Aps, Rockwool a/s, Saint-Gobain Isover, Saint-Gobain Weber, Styrolit a/s, Sundolitt as, and ThermiSol.

3.3.1.2 Airtightness products

Different air tightness products are available. The Danish Building regulation has minimum requirements for air tightness. Examples of suppliers are: Saint-Gobain Isover (Isover-Vario) and Rockwool A/S (Rocktaet).
3.3.1.3 Low energy windows and doors
Many low energy windows and doors are available. A minimum requirement for windows and glass walls has been introduced in the current building regulations BR10. The energy gains should not be less than -33 kWh / m² per year. The introduction of passive houses in Denmark has lead to the availability of very low energy windows. Quadruple-glazed windows with a U-value of 0.6 W/m²K, g-value of 0.45 and daylight transmittance of 0.59 are available. Triple-glazed windows with a U-value of 0.7 W/m²K, g-value of 0.50 and daylight transmittance of 0.71 are available on the Danish market. Examples of suppliers are: Glasbyg a/s, HS Hansen, Horn Aps, Krone Vinduer a/s, Komfortvinduer, Aarhusvinduer, Protec, Rehau a/s, Rationel vinduer a/s, Ulsted Vinduer & Døre, Velfac a/s, Vrøgum a/s, Vipo Vinduer a/s, Vildbjerg Vinduet Aps, Velux a/s.

3.3.1.4 Solar shading systems
Different solar shading systems exist. Systems with automatic or manual control.

3.3.1.5 Thermal bridges
Guidelines on how to avoid thermal bridges and suppliers of products exist. Examples of suppliers are: Saint Gobain Weber and Rockwool.

3.3.1.6 Ventilation systems
Mechanical ventilation systems with heat recovery with high energy efficiency and low electricity consumption exist. A common air-to-air heat exchanger in very low energy houses is the counter flow heat exchanger. Rotary regenerative heat exchangers are sometimes used. Examples of suppliers are: Sand Energi, Ecovent Aps, Exaustor a/s, Danfoss a/s, Genvex a/s, Dantherm Air Handling a/s, Nilan a/s, Link Nordic Aps. An interesting approach is to use an air-to-earth heat exchanger. Examples of suppliers are: Ecovent Aps, Genvex a/s, Nilan a/s and Rehau a/s.

3.3.1.7 Heat pumps
Many heat pump systems for space heating and domestic hot water exist on the Danish market. Examples of suppliers are: Nilan a/s, Danfoss, Genvex, Vølund, IVT Greenline.

3.3.1.8 Heat distribution systems
Heat distribution systems for low energy buildings exist on the market such as floor heating, air heating and radiators. An interesting product is the micro-heater. Examples of suppliers are: Dansk Varmpumpe Industri a/a, Genvex a/s, Salling Vaske- og Køleservice a/s, Sand Energi, Nilan, Velux/Danfoss, Viesmann, Danfoss/Sonnenkraft, Icpopl/Danfoss, Solar'PST, Evi Heat, Nordic Energy Group and Solar Venti.

3.3.1.9 Low energy pumps and fans
There are many energy-labelled pump and fans on the market which are shown on the homepages www.sparepumper.dk and www.spareventilatorer.dk. Examples of suppliers are: Grundfos DK s/s, Smedegaard of Denmark and Wilo Danmark a/s.

3.3.1.10 Domestic hot water heaters
Domestic hot water heaters with low standby losses exist on the market.
3.3.1.11 Control systems
Control systems as intelligent house control exist on the market.

3.3.1.12 Household appliances
Household appliances with energy label A exist on the market.

3.3.2 Lack of components
Many low energy building components exist on the Danish market and together with existing standards and norms the basis for very low energy houses exist.
Survey systems to ensure optimal operation of micro heaters don’t exist.
There is no documentation of low energy houses.

3.3.3 Need for development of components
Control systems for individual temperature control in air heat distribution systems have to be developed.
Survey systems to ensure optimal operation of micro heaters have to be developed.
Many low energy components need to be further developed. That includes air tightness of prefabricated building elements assembled on site, heat pumps and geothermic heat, thermal bridges, windows, lights, photovoltaic and optimisation of building envelope and installations.
There is a need for very low energy demonstration building projects.

3.4 Norway
Author: Karin Buvik, SINTEF
The answers from the Norwegian advisory group members to the question «What is the most important technological barriers on very low energy house markets?», can be summarize in a couple of bullet points:

- Regarding dwellings, to a great extent, Norway has the necessary know-how and technical solutions. However; so far, only a few companies have gained experience regarding very low energy houses.
- There is a need for more competing products to decrease the market costs.

3.4.1 Availability of components

3.4.1.1 Insulation products
So far, mainly traditional mineral wool insulation has been used in Norwegian passive/very low energy house projects. A couple of projects have applied a small amount of transparent insulation materials, but these products are not readily available on the Norwegian market. The interest in vacuum insulation panels (VIP) is growing, in particular for the renovation of existing buildings. The interest is spurred by the wish to have thinner walls, but so far VIPs have not been used in any Norwegian projects.
Wall thickness is an important topic, as thicker walls are «steeling» valuable area, indoors or outdoors. Skanska, one of the biggest entrepreneurs in Norway, and member of the advisory group for the Northpass project, states that traditional mineral wool most likely will be replaced by 33-insulation mineral wool (Glava Extreme: Thermal conductivity of 0.033
W/mK) in very low energy houses. U=0.15 W/m²K can then be obtained with solid wooden frames (223 + 73) x 48 mm. In combination with Iso-3 pillars (insulated wooden pillars from Moelven) the wall thickness will be 250 mm, or may be down to 220 mm.

PIR (polyisocyanurate) insulation has compressive strength, is not inflammable and has a thermal conductivity of (λ) 0.025W/mK. Since PIR is a firm material, it is not fit for infill in wooden frames, but very well fit as continuous insulation outside wall constructions and roof rafters. Of most interest is the use of PIR in roof terraces. PIR is considered as too expensive where thickness is not critical, e.g. on roof and in foundations.

In grounds Skanska is using granulated extruded concrete or Glasopor as filling compound, instead of gravel under foundations and around pipes. This is both practical and gives extra insulation. With 200 mm EPS (extruded polystyrene) on top, the U-value for the floor can come down to 0.08–0.10 m²K, which is valuable in trade-off calculations.

Suppliers can be found in the website of the industrial building materials trade association (Byggevareindustrien – en bransjeforening for norsk byggevareindustri):
http://www.byggevareindustrien.no/bedriftene/

Examples of suppliers are: Glava AS and Rockwool AS

3.4.1.2 Products for air tightness of the building envelope

Significant development work has been dedicated to finding good solutions to reduce the air infiltration through the building envelope, particularly for residential buildings. Construction details and special products for air-tightness (e.g. special tape products) have been developed, lab tests have been carried out, and pilot building projects have been constructed. Also, simplified equipment for measuring air leakage during construction, have been developed. Buildings with measured air leakage numbers between 0.2 and 0.6 ACH (air changes per hour) at 50 Pa have been demonstrated. Main remaining challenges include developing a larger variety of standardized construction details and testing the longevity of the solutions. Main actors have been Boligprodusentene, a trade association for producers of dwellings (www.boligprodusentene.no), producers of building envelope products, SINTEF Building and Infrastructure, Husbanken (the Norwegian State Housing Bank) and Enova (the national agency for energy efficiency).

There are several brands in the marked, but documentation regarding durability is missing. Among the wind blocker tapes only the Tyvek tape has a technical approval, and is therefore the only one that Skanska will recommend. Further; a representative for Skanska says that the products from Swiss Siga are excellent, but the Norwegian marked is too small for Siga, who doesn’t find it payable to apply for a technical approval. Skanska will, however, ask for documentation according to Prodok, a Norwegian documentation system under development.

Skanska recommends – and use – prefabricated sleeves for lead-in pipes, especially round pipes and ventilation channels. In addition, there are flexible Butyl tapes (e.g. from Siga) which are very applicable, but lack a technical approval.

Details are just as important as materials. Planners and entrepreneurs have to focus on details to reduce air leakage. In air leakage tests in early phase of construction, Škanska has obtained 0.6 ach (Δp=50 Pa) or better in several projects.

Suppliers can be found in the website of the industrial building materials trade association (Byggevareindustrien – en bransjeforening for norsk byggevareindustri):
http://www.byggevareindustrien.no/bedriftene/
Examples of suppliers are: Isola AS and Glava AS.

### 3.4.1.3 Very low energy windows

The introduction of the passive house standard in Norway has led to the development of windows with significantly improved thermal insulation. The Norwegian window manufacturer, Nor-Dan, was the first to introduce a passive house window to the market in 2007. The window is triple glazed with argon gas filling, 2 low emissivity coatings, foam spacers and insulated frame. The total rated U-value is 0.7 W/(m²K), compared to 1.6 W/(m²K) which is the minimum requirement in the code. In 2009-2010, several other Norwegian window manufacturers are introducing passive house windows.

Suppliers can be found in the website of the Glass, Glazing and Facade Federation (Glass og Fasadeforeningen): [http://www.glassportal.no/](http://www.glassportal.no/)

Example of suppliers: Nor-Dan.

### 3.4.1.4 Solar shading systems

Most very low energy houses built so far have used exterior venetian blinds, which are very effective in regulating the solar gains, in particular if they are automatically controlled. The problem with these systems is that they are relatively expensive, at least the high-quality products, and that they block out daylight and view.

Suppliers can be found in the website of the Glass, Glazing and Facade Federation (Glass og Fasadeforeningen): [http://www.glassportal.no/](http://www.glassportal.no/)

Examples of suppliers are: Nicopan AS (venetian blinds between glass panels) and Pilkington Insulight™ Sun (glazing with coatings).

### 3.4.1.5 Simplified water based heat distribution systems

In Norway, there has been scepticism related to heating systems based solely on ventilation air heating, mainly due to indoor comfort considerations. Since the passive house concept is depending on minimizing the installation costs of the heating system, simplified water based heating systems were investigated. A system configuration for dwellings was developed, tested in the lab, and installed in a pilot building project (Løvåshagen, described below). Also, general guidelines for designing such systems have been produced. Remaining challenges includes developing simplified systems for different types of buildings and room layouts, further reduction of the installation cost and collection experience with respect to operation and maintenance of the systems. Main actors have been SINTEF Building and Infrastructure, Varmeinfo (information office for flexible heating systems), Boligprodusentene, a trade association for producers of dwellings ([www.boligprodusentene.no](http://www.boligprodusentene.no)), OBOS (Oslo Bolig- og Sparelag, a membership organisation for residents) ([www.obos.no](http://www.obos.no)), CTC Ferrofil (member of the Enertech Group), Husbanken (the Norwegian State Housing Bank) and Enova (the national agency for energy efficiency).

Suppliers can be found in the website of Varmeinfo: [http://www.varmeinfo.no/](http://www.varmeinfo.no/)

Suppliers can also be found in the website of and the Enertech Group: [http://www.enertech-group.com/](http://www.enertech-group.com/)

Examples of suppliers are: CTC Ferrofil.
3.4.1.6 Ventilation heat recovery systems

Ventilation heat recovery systems with annual temperature efficiency above 80% are available on the market. Mostly rotary heat exchangers have been used in the Norwegian very low energy house projects. For situations where rotary systems cannot be used due to the transmission of pollutants, counter-flow heat exchanger are also used, but these have lower efficiencies (around 80%), especially in the coldest climates, due to defrosting needs.

Suppliers can be found in the website of and Norsk VVS / Hvem Leverer Hva Norsk – VVS's leverandørguide på nett og papir (Norwegian HVAC association): [http://www.vvs-foreningen.no/portal/page/portal/vvs](http://www.vvs-foreningen.no/portal/page/portal/vvs)

Suppliers can also be found in the website of Finn Firma (find suppliers).

3.4.1.7 Heat Pumps, biomass systems and solar systems

Both air-to-water and ground-to-water heat pumps have been installed in Norwegian very low energy house projects. A variety of products and suppliers are available. Several projects have solar collector systems. There are only a few suppliers of solar systems in Norway, but more are coming. A few projects have biomass systems based on pellets. There are several suppliers of biomass systems. One challenge is to find systems that have sufficiently low power output.

Suppliers can be found in the website of Enertech Group.

3.4.2 Lack of components

The basic components are available on the market, but there is a need for more cost-efficient systems. For some components, the numbers of suppliers are too few, and the suppliers are not sufficiently professional.

ByBo, the first company to build apartment blocks in very low energy house standard in Norway, and member of the advisory group for the Northpass project, is pointing out a lack of:

- Prefabricated solutions for heat recovery and SPF (specific fan power), with documented fulfilment of requirements set for passive houses, if the houses have to be connected to district heating grid.
- Data bases that allow for a quick and simple search for products, solutions and suppliers that fulfil requirements.

3.4.3 Need for development of components

There is a need for development of more cost-efficient systems, in particular with regards to energy supply systems for low loads. There is also a need for user-friendly systems for operation of ventilation systems and energy supply systems. Moreover, there is a need for developing cost efficient solar shading systems that allow view and daylight penetration.

3.4.4 References


3.5 Poland

Author: Szymon Firląg, NAPE

Most of the components needed for all very low energy residential buildings are available on the Polish market. They are produced in Poland or imported from countries like Germany or Austria. But availability doesn’t mean that they are used in buildings. The problem is high prices, lack of experienced companies which know how to apply and maintain them. That is why Poland needs more examples of very low energy buildings and more competing products to decrease the market costs. The information on components is based on the experience and knowledge of the author.

3.5.1 Availability of components

A number of products are available for very low energy residential buildings.

3.5.1.1 Thermal insulation

Thermal insulation, where the thermal conductivity should be less than 0.05 W/mK. The main insulating material in Poland is polystyrene, with about a 80 % market share. There is wide range of products available, the best like gray EPS (extruded polystyrene) called Platinium Plus or Neopor have declared thermal conductivity equal to 0,031 W/mK. There are also mineral wools with very low thermal conductivity, like ISOVER Multimax 30 with $\lambda_D = 0,030$ W/mK. New products on the market are based on polyurethane foam like PUR or PIR. Their thermal conductivity is even better, $\lambda_D = 0,027$ W/mK.

Examples of suppliers are: Rockwool, Termo organika, Swisspor, Isover, Kingspan

3.5.1.2 Air tightness products

A whole system of air tight products and connections is available e.g. from company Pro Clima. They have products for sealing the building inside like INTELLO® with variable diffusion permeability under any climatic condition, joint adhesive for junctions with adjoining building components, e.g. plastered masonry or wood, adhesive tapes for bonding air-proofing membranes with very high tack (initial adhesiveness), sealing flange (Fig. 1).

Fig. 1. KAFLEX mono sealing flange [source: Pro Clima]

Examples of suppliers are: Rockwool, Soudal, Illbruck, Pro Clima

3.5.1.3 Low energy windows

Windows, where the U-value should be less than 1.0 W/m²K. One of the best available
window frames are Clima-Design from Rehau with \( U_f = 0.71 \text{ W/m}^2\text{K} \) or Corona SI 82+ from Schüco with \( U_f = 0.75 \text{ W/m}^2\text{K} \).

Glazing, where the g-value (solar transmittance) should be higher than e.g. 0.4 and daylight transmittance higher than 0.5. These values depend on the glazing and area related to the façade and/or floor area. One of the best available glazing SUPERtermo from MS Okna have \( U_f = 0.5 \text{ W/m}^2\text{K} \), \( g = 0.50 \), \( L = 71.5 \% \). It is built as 3T-16Ar-3-16Ar-3T with 3mm glass, both exterior covered with low emission coatings, warm spacers, 16mm space between glass filled with argon).

Examples of glazing suppliers are: Insoglas, Saint-Gobain Glass, Rehau, Schucko, MS Okna

### 3.5.1.4 Solar shading

In most of the cases architectural solutions like moving forward eaves or side vertical elements are used. Another way of shading is use of external shutters, awnings, roller shutters.

In most cases, simple manually operated solutions are used. Proper design of greenery can also serve as a natural shading solution.

Examples of suppliers are: WAREMA Renkhoff, SOBIMEX,

### 3.5.1.5 Frame components

Frame components, which minimize the thermal bridge. There are construction products like I-beams e.g. from Kronopol or ready prefabricated frame systems available on the market.

Frame constructions are not very popular on the Polish market.

Examples of frame suppliers are: Kronopol

### 3.5.1.6 Ventilation systems

Ventilation systems with fans (supply and exhaust air systems), where the SFP is less than 1.0 kW/(m³/s).

Examples of suppliers are: Pro-Vent, Systemair

Ventilation systems with air-to-air heat recovery, where the energy efficiency is higher than 80 %. In most of the ventilation units counter flow heat exchangers are being used, e.g. StorkAir AERIS CA 350. There is an interesting polish construction of ventilation unit with spiral air to air heat exchanger (Fig. 2). According to the producer the special construction is preventing against frosting of the heat exchanger. There is therefore no need to use an electric preheater. The efficiency of the heat recovery is up to 84 %.
3.5.1.7 Heat pumps

Heat pumps with the ground, exhaust air or outdoor air as a source, where the COP (coefficient of performance) is higher than 3.0.
Examples of suppliers are: Stiebel Eltron, Nibe

3.5.1.8 Heat distributions systems

Heat distribution systems, which are suitable for very low energy residential buildings. Such systems like Compact Heating Towers are designed for very low energy housing. They are usually responsible for ventilation, air and domestic hot water heating. As a heat source a small air heat pump is being used. The system can include solar collectors and air to ground heat exchangers.
Examples of suppliers are: Nilan, Viessmann,

3.5.1.9 Pumps

Pumps, with a low use of electricity.
Examples of suppliers are: Danfoss, Grundfos

3.5.1.10 Domestic hot water heaters

Domestic hot water heaters, with low standby losses.
Examples of suppliers are: Junkers, Vaillant

3.5.1.11 Control systems

Control systems, which are suitable for very low energy residential buildings.
Examples of suppliers are: Viessman, Buderus

3.5.1.12 Household appliances

Household appliances, which should be of at least class A.
Examples of suppliers are: Whirlpool, Bosch
3.5.2 Lack of components

Listed components are available on the market but the number of suppliers is small. That causes high prices and problems with service. What is more, there are no Polish producers of the following components:

- Doors, where the U-value is less than 1.0 W/m²K
- Heat distribution systems, which are suitable for very low energy residential buildings

More problematic are systems for very low energy multifamily buildings like small ventilation units with heat recovery or heat sources. Because a very small number of multifamily buildings with mechanical ventilation and heat recovery are being built there are no specific products for such purpose. Meanwhile lack of place and high requirements regarding noise protection are causing that the ventilation units should be built in a different way. A second problem can be small heating substations for apartments connected to district heating network.

3.5.3 Need for development of components

There is a need for development of more cost-efficient components in almost all areas. But especially with regard to thermal bridge free building components further development should be done. There are problems with finding fixing techniques for window blinds, rollers etc. or skylights. Need for development of Polish components applies also to heating systems with very small heating capacity or compact heating systems (heating, domestic hot water and ventilation together). Unfortunately there are not enough national products on the market.

3.5.4 References


3.6 Latvia

Author: Agris Kamenders, Riga Technical University

Availability of components and challenges for very low energy residential buildings on Latvian building market have been discussed among Latvian advisory group members. The main question which has been discussed was about difficulties to get suitable and enough quality components for low energy buildings.

3.6.1 Availability of components

The following components are available for low energy residential buildings:

3.6.1.1 Thermal insulation

The most well-known insulation materials like mineral wool, fibreglass, cellulose and polystyrene are available in Latvia. As till now there have been built only very few very low energy buildings and usually mineral wool has been used as insulation material. The biggest insulation material producers like Isover, Paroc and Rockwool are promoting the low energy building idea in their Latvian websites. Special solutions and detail designs are also available. As very low energy building concept mostly requires quite thick insulation levels new ways
of insulating construction techniques are tried in practice. Several practical trainings have been organized to introduce new renovation and construction techniques for Latvia, see figure below (Photo: arch. Ervīns Krauklis).

Fife day training seminar “Renovation with Passive house elements”

3.6.1.2 Airtightness products

Airtightness products are available. However, they are not wildly spread in building material supply stores. Small distributors are specialized in offering specific components. For example products from “Pro clima” are available and are used in very low energy buildings. Some other well-known products also are available from companies like: Icopal, Isover, Paroc and Rockwool. There is no common practise to use airtightness products and to think about airtightness separately in the building design process for low energy buildings.

3.6.1.3 Windows and doors

There are windows suitable for very low energy buildings but the choice is not very big. Some components are available from big company representatives like Schuco and Rehau. With growing interest in low energy building some local companies also have been started to produce low energy windows and develop low energy building windows and systems: ARBO, SVEKIS. However better and cheaper solutions are needed on the Latvian market. In the door segment it is hard to find suitable components. At the moment there do not exist special offers for low energy buildings. Usually doors are not airtight enough.

3.6.1.4 Solar shading systems

In the first very low energy building built external shading devices are not used however overhangs have been designed to protect the building from overheating during summer. External shading systems usually are used in office buildings but that kind of systems are still quite expensive for application in residential buildings. Examples of suppliers are only from international companies like: Schueco.
3.6.1.5 Ventilation heat recovery systems

Ventilation systems with heat recovery above 80% are available in the Latvian market. For very low energy buildings the most popular producer is Paul counter flow heat recovery systems as they are well represented in the Latvian market by company ARTIVA. Some other companies have also been offering heat recovery systems promising very high efficiency but their real efficiency is not known.

3.6.1.6 Heat pumps

A lot of different companies are represented in the heat pump market and competition is high. At the moment Climate Change Finance Instrument’s (CCFI) funding is available for renewable energy and heat pump use projects in households. Ministry of environment and regional development listed around 30 different heat pump providers. Some times it is hard to find very small capacity heat pumps in the market. (List available in ministries website: [http://www.vidm.gov.lv/lat/darbibas_veidi/KPFI/projekti/?doc=11385](http://www.vidm.gov.lv/lat/darbibas_veidi/KPFI/projekti/?doc=11385).) Examples of suppliers are: SIA „ALTENERGO”, SIA “Divine Heat Company”, SIA "Eva sistēmas", SIA „Vidzemes siltumnieks”, SIA "ARX" ect.

3.6.1.7 Heating systems

Biomass and solar energy systems are available in Latvian market. In the first very low energy building PV (photovoltaic) elements have been installed (see figure below. Photo by: Ansis Starks).

![First very low energy building in Latvia with integrated PV elements](image)

Ministry of environment and regional development listed more than 40 biomass and solar heating system providers. List available in ministries website: [http://www.vidm.gov.lv/lat/darbibas_veidi/KPFI/projekti/?doc=11385](http://www.vidm.gov.lv/lat/darbibas_veidi/KPFI/projekti/?doc=11385). The problem is that biomass boilers usual are too big for low energy residential buildings.

3.6.1.8 Control systems

At the moment there exist several companies which can provide control systems for low energy buildings. Examples of suppliers are: Siemens, Danfoss, ABB, Lafipa, Lafivent.

3.6.1.9 Household appliance and pumps

There is no problem to buy very efficient (A, A+, A++) household appliances in the Latvian market. Also pumps with low use of electricity are available in the Latvian market.
3.6.2 Lack of components

More cost effective systems are needed. For example good heat recovery units are available in the market but they are still quite expensive. There is still a big need for good and cheap windows as well as for good airtight door systems. In Latvia good pellet boilers are available but their loads usually are too big therefore boilers or stoves with low power outlet are needed. At the moment there are no suitable roof windows for very low energy buildings available in Latvian market. Overall there is still too few suppliers of low energy components like windows and doors in the Latvian market.

3.6.3 Need for development of components

Several components still need to be developed:

- Airtight and well insulated doors;
- User friendly low temperature heating systems;
- Low costs windows and window installation systems;
- Low costs and user friendly indoor climate and energy use monitoring system;
- Low costs high efficiency recuperation and ventilation systems with simple control;
- Inexpensive automatic external shading systems.

3.6.4 References


3.7 Estonia

Author: Helen Hirv, University of Tartu

The results are based on web sites of and interviews conducted with the representatives of the companies mentioned above.

3.7.1 Availability of components

Below products available in the Estonian market are presented.

3.7.1.1 Thermal insulation

Thermal insulation, where the thermal conductivity is less than 0.05 W/mK. There are several suppliers whose products meet the requirements. For example – both AS Reideni plaat and Estplast Tootmine OÜ have expanded polystyrene insulation materials with a thermal conductivity value of 0.031 W/mK in addition to other products with a slightly higher thermal conductivity value. Isover glass wool products with thermal conductivity value ranging from 0.031 to 0.040 W/mK are also available. AS Paroc markets rock wool insulation materials with thermal conductivity as low as 0.032 W/mK. Additionally Tervemaja OÜ imports Steico hemp insulation materials with a thermal conductivity between 0.039 and 0.051 W/mK for different products.

3.7.1.2 Airtightness products

Airtightness products – Tervemaja OÜ imports different products from Pro clima: Intello, Intello Plus, which are fully synthetic and designed for indoor use; DB and DB+ moisture
barriers which are made of cardboard and polyethylen and are also for indoor usage; DA, DA connect, Intesana and Intesana connect synthetic moisture barriers for roof insulation; Dasatop synthetic vapour barrier with high permeability; Santa UT, Santa DT vapour barrier wallpapers and RB synthetic vapour barrier for intermediate ceilings. Isover Vario Duplex vapor barrier is available in most home improvement stores.

3.7.1.3 Low energy windows

Wiking Window AS provides triple-glazed windows where the U-value is less than 1.0 W/m²K and glazing, where the g-value is 0.4 and daylight transmittance is higher than 0.5. Pazen ENERsign windows are available, which have excellent properties. The U-value of ENERsign windows is 0.65 W/m²K and the g-value is 0.52.

3.7.1.4 Solar shading systems

Solar shading is available from Schüco EESTI OÜ or EuroVent EST OÜ.

3.7.1.5 Low energy doors

Jeld-Wen and Hörmann provide doors, where the U-value is less than 1.0 W/m²K.

3.7.1.6 Frame components

Wolf Thermo Module floor slabs, floors, wall and roof systems, which minimize the thermal bridge are available.

3.7.1.7 Ventilation systems

Intelivent OÜ markets inVENTer ventilation systems where the SFP (specific fan power) is less than 1.0 kW/(m³/s).

PassiveHouse OÜ markets Paul Ventilation systems with counter flow air-to-air heat recovery, where the energy efficiency is up to 93%.

3.7.1.8 Heat pumps

Several companies – for example OÜ ABC Kliima or Adler Kliima OÜ market different heat pumps with the ground, exhaust air or outdoor air as a source, where the COP (coefficient of performance) is higher than 3.0.

3.7.1.9 Heating systems

PassivHouse OÜ imports Sonnenkraft solar heating systems, which are suitable for very low energy residential buildings.

3.7.1.10 Pumps

Grundfos Pumps Eesti OÜ and Wilo Eesti OÜ provide pumps of energy classs A.

3.7.1.11 Domestic hot water heaters

Sonnenkraft supply domestic hot water heaters, with low standby losses.

3.7.1.12 Control systems

OÜ Targa Maja Lahendused provides comprehensive control systems, which are suitable for very low energy residential buildings.
3.7.1.13 Household appliances

Household appliances, which are of energy class A, are available in most consumer electronics stores.

3.7.2 Lack of components

The component availability itself is not a problem - most components are available in Estonia or can be ordered from other countries. There are no indicators that the supply would become insufficient if demand increases. The basic problem lies in consumer awareness and information availability. Most buyers, if not related to the development or construction of low energy buildings, are not aware of the benefits of these buildings and may not find all the information needed. The lack of information about these products sets back the distribution of low energy buildings in Estonia.

3.7.3 Need for development of components

There is a need for more affordable components and more components should be produced in Estonia as to encourage business activity and the distribution of low energy buildings. Furthermore, the availability of information must be improved.

Estonian window makers should develop their products to meet low energy standards and improve them even further. Also, to this time ventilation systems have only been imported to Estonia and none are produced here. This segment should be developed.

3.8 Lithuania

Author: Audrius Banaitis, Vilnius Gediminas Technical University

The information on components is based on discussions with the expert group and from own studies of the market and experience from completed demonstration projects of low energy buildings.

3.8.1 Availability of components

3.8.1.1 Thermal insulation

Traditional rockwool, glass wool, cellulose (mainly for renovation) are the most common materials. Rockwool insulation has been used in the first Lithuanian passive house project (see http://www.pasyvusnamas.lt/). Vacuum insulation panels have not yet been introduced in the market but information is available.

Examples of suppliers are: UAB “Gera vata”, UAB “Paroc”, UAB “Saint-Gobain statybos gaminiai”, UAB ”Rockwool”, UAB ”Ekorema”, UAB ”Ekovila”, UAB ”Juodasis gintaras”, etc.

3.8.1.2 Products for airtightness

Some airtightness products are available on the market. Main actors have been producers of dwellings UAB “Veikme” (builder of the first passive house in Lithuania (see www.veikme.lt)), producers of building envelope products UAB “Paroc”, UAB “ISOLA”, UAB “Alseka”, UAB “Megrame medis”, UAB “Doleta”, UAB “Saint-Gobain statybos gaminiai”, UAB ”Rockwool”, UAB „ALKESTA“, UAB „UPONOR“, UAB “AMALVA”, etc.

3.8.1.3 Very low energy windows

Several Lithuanian window manufacturers are introducing windows for low energy houses, e.g. UAB “Alseka”. The window is triple glazed (SGG Planitherm One), U-value is 0.729 W/(m²K). UAB “Hronas” was window manufacturer for the first Lithuanian passive house. Other manufacturer UAB “Sumeda” introduces MIRA Therm system of windows - a combination of wood, plastic and aluminium that ensures the best thermal properties of the window frame. U-value is 0.76 W/(m²K), window structure width - 138 mm. UAB “AVELPAST” produces plastic “EnergyART” window: PVC profiles: „Salamander BlueEvolution“, of new generation: 6 chambers, width – 103 mm; Reinforcement armor – made from thermal insulation composite with glass fiber, warmed by polyurethane foam; Glazing. Made of 3 transparent glasses, two of them – energy-efficient (Selective) glasses, with “Swisspacer” frame of insulating composites, gap filled with argon gas. Ventilation - with micro-ventilation supplement; U-value is 0.729 W/(m²K).

Examples of suppliers are: UAB “Alseka”, UAB “Megrame medis”, UAB “Doleta”, UAB “AVEPLAST”, UAB “Tikri langai”, etc.

3.8.1.4 Very low energy doors

Several Lithuanian doors manufacturers (actually there are too few specialised doors producers. Companies producing doors also produce windows and other wood elements) are introducing doors for low energy houses, e.g. UAB “Alseka”, UAB “Megrame medis”, UAB “Doleta” and others. Doors for passive houses have U-values lower than 1.0 W/m²K. The problem is that they are relatively expensive.

Examples of suppliers are: UAB “Alseka”, UAB “Megrame medis”, UAB “Doleta”, UAB “Totum”, etc.

3.8.1.5 Structural frame components

There are construction products e.g. from UAB “REZETAS” K-KONTROL system, SAM sytem from UAB ”Statinių apšiltinimo medžiagos” or ready prefabricated frame systems available on the market. Frame constructions are not very popular on the Lithuanian market.

Examples of suppliers are: UAB “KNE”, UAB “REZETAS”, UAB “Eurofasadas”, UAB ”Statinių apšiltinimo medžiagos”

3.8.1.6 Solar shading

Solar shading systems are available in the market like: external venetian blinds (made of flat moving 0.42 mm thick aluminum strips, coated with special dyes, resilient to atmospheric mechanical changes), sunshields (uses aluminum or wooden slats, the same as in 50 mm venetian blinds), etc. Systems are expensive.

Examples of suppliers are: UAB ”ARDENA”, UAB ”Protingi namai”, UAB “DEXTERA”, etc.
3.8.1.7 Ventilation/air handling units with heat recovery systems

Ventilation/air handling units with heat recovery systems with annual temperature efficiency 80% and higher are available on the market. Rotary heat exchangers, recuperators (vertical, horizontal, cellular) are used in the Lithuanian low energy house projects.


3.8.1.8 Heat Pumps, solar energy systems

Air-to-water, ground-to-water, water-to-water heat pumps have been installed in Lithuanian low energy house projects. A lot of products and suppliers are available. Several projects have solar collector, solar batteries systems, and photovoltaic systems.


3.8.1.9 Heat distribution systems

On site heating systems, which are suitable for very low energy single-family buildings, exist in the market. Problems are with district heating centres/subcentres suitable for a very low energy use in single-family and multi-family buildings.


3.8.1.10 Pumps

There are energy-labelled pump and fans on the market.

Examples of suppliers are: Danfoss, Grundfos

3.8.1.11 Control Systems

Control systems (smart house systems) are available in the market like: EIB/KNX (modern computerized building control systems), My home system, Ave Domina, Tebis TX, ELDES Smart House, etc. Systems which unites all house equipment: security, air conditioner, heater, ventilation, illumination, blinds control, etc. Systems are expensive.


3.8.1.12 Household appliances

Household appliances, which are of class A are available in the market. A lot of products and suppliers are available.

Examples of suppliers are: UAB “Ogmina”, UAB “Topo centras”, UAB “Mediashop”, UAB “Senukai”, etc.
3.8.2 Lack of components

The basic components are available on the market (mainly imported and expensive for average Lithuanian). There is a lack of up to date innovative components e.g. biomass systems, vacuum insulation panels, solar shading systems, etc. in the market. Too few suppliers offer complex solutions for very low energy houses.

3.8.3 Need for development of components

There is a need for developing of almost all cost efficient components for very low energy house projects. The price of components (e.g. recuperators, heat pumps) and structural solutions (e.g. windows, doors) is rather big (considering the salaries and the saved energy).

3.8.4 References

4 SUMMARY AND CONCLUSIONS

A previous study on barriers to implementation of very low energy residential buildings and how to overcome them concluded that there can be problems with technical solutions/concepts for very low energy residential buildings in some of the participating countries (Blomsterberg 2010). The problems can be inadequate product development resulting in poor products, lack of low energy components, difficulties to find low energy products as there is no list easily available, lack of proven technologies, and lack of information. These are real and perceived problems. The difference between real problems and perceived problems is that real problems have to be solved by improvements of processes and products, but perceived problems can sometimes be solved by information and a good dialogue. It is equally important to solve both types of problems.

According to this study, however, most components needed for very low energy residential buildings are available on the markets in Sweden, Finland, Denmark, Norway, Poland, Latvia, Estonia and Lithuania (see table 4.1). Most products for thermal insulation are available. Most airtightness products are available, except for in the Baltic States where only some products are available. Almost all countries have windows with a U-value lower than 0.6 W/m²K, except for Latvia with known best windows with a U-value lower than 1.0 W/m²K. Different kinds of solar shading systems exist in all countries. Entrance doors with a U-value lower than 1.0 W/m²K can be found in all countries. Structural frame components, which minimize thermal bridges, are on the market in most countries. Air-to-air heat recovery units should operate at an efficiency better than 80%. Units fulfilling this requirement are available in all countries. Energy efficient heat pumps, pumps and household appliances are available on all markets. This is also true for heat distribution systems, domestic hot water heaters and control systems for very low energy houses. So far the demand for components for very low energy residential buildings is rather low. Whether there will be enough components in a growing market is difficult to know. The available components for very low energy residential buildings obviously have to be better marketed, to ensure that e.g. more designers are aware.

The lack of components was also examined (see table 4.2). In Latvia it was concluded that there are too few suppliers of low energy windows and doors. In Poland manufacturer of structural frame components minimizing thermal bridges and ventilation heat recovery units for apartment buildings are not available In Norway prefabricated ventilation heat recovery units are needed. In Finland small ground heat pumps are asked for. In Sweden affordable pellets burners with solar collector systems for single-family houses and wood-burning stoves with a low power outlet are missing. In Denmark control systems for micro heaters are asked for. Most countries ask for cost efficient systems. This lack of components can be solved to some extent with an international market, making components available not only in some countries.

The need for development of components for very low energy residential buildings varies from country to country. In Denmark one would like to see further development of many components, and especially airtightness of prefabricated buildings elements and individual control systems for air heating. In Sweden airtight doors at a lower price, ventilation heat recovery systems with a lower use of electricity, supply air terminal devices for a wider range of supply temperatures, better insulated ground pipes and district heating sub centres are needed. In three countries user friendly ventilation heat recovery systems are desired. The three countries are Sweden, Finland and Norway. In Finland, Norway and Latvia user friendly heat distribution systems are asked for. Obviously there are components, which can be further
improved and an international competition and bigger market are likely to speed up the development.

The results of this study will be an important input to the NorthPass work package on user-oriented market penetration of very low energy houses, where detailed suggestions on how to increase the market penetration of low energy houses in Northern Europe will be made.

To make it easier to find components for very low energy houses a database with links to web sites of suppliers/manufacturers will be created. The database will include the major components needed for very low energy houses.

Table 4.1 Availability of components for very low energy residential buildings in the Nordic countries, Poland and the Baltic States.

<table>
<thead>
<tr>
<th>Component</th>
<th>Sweden</th>
<th>Finland</th>
<th>Denmark</th>
<th>Norway</th>
<th>Poland</th>
<th>Latvia</th>
<th>Estonia</th>
<th>Lithuania</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal insulation</td>
<td>Yes, of most products</td>
<td>Yes, of most products</td>
<td>Yes, of most products</td>
<td>Yes, of most products</td>
<td>Yes, of most products</td>
<td>Yes, of most products</td>
<td>Yes, of most products</td>
<td>Yes, of most products</td>
</tr>
<tr>
<td>Airtightness products</td>
<td>Yes, of most products</td>
<td>Yes, of most products</td>
<td>Yes, of most products</td>
<td>Yes, of most products</td>
<td>Yes, of most products</td>
<td>Yes, some products</td>
<td>Yes, of most products</td>
<td>Yes, some products</td>
</tr>
<tr>
<td>Windows</td>
<td>Yes, U-value 0.6 W/m²K</td>
<td>Yes, U-value 0.6 W/m²K</td>
<td>Yes, U-value 0.6 W/m²K</td>
<td>Yes, U-value 0.7 W/m²K</td>
<td>Yes, U-value ≤ 1.0 W/m²K</td>
<td>Yes, U-value ≤ 1.0 W/m²K</td>
<td>Yes, U-value 0.65 W/m²K</td>
<td>Yes, U-value 0.7 W/m²K</td>
</tr>
<tr>
<td>Solar shading</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Doors</td>
<td>Yes, U-value 0.9 W/m²K</td>
<td>Yes, U-value ≤ 1.0 W/m²K</td>
<td>Yes, U-value ≤ 1.0 W/m²K</td>
<td>Yes, U-value ≤ 1.0 W/m²K</td>
<td>Yes, U-value ≤ 1.0 W/m²K</td>
<td>Yes, U-value ≤ 1.0 W/m²K</td>
<td>Yes, U-value 1.0 W/m²K</td>
<td>Yes, U-value 1.0 W/m²K</td>
</tr>
<tr>
<td>Structural frame components</td>
<td>Yes, e.g. light studs</td>
<td>Yes, e.g. light studs</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>?</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Ventilation with heat recovery</td>
<td>Yes, efficiency &gt; 80 %</td>
<td>Yes, efficiency &gt; 80 %</td>
<td>Yes, efficiency &gt; 80 %</td>
<td>Yes, efficiency &gt; 80 %</td>
<td>Yes, efficiency &gt; 80 %</td>
<td>Yes, efficiency &gt; 80 %</td>
<td>Yes, efficiency &gt; 80 %</td>
<td>Yes, efficiency &gt; 80 %</td>
</tr>
<tr>
<td>Heat pumps</td>
<td>Yes, COP &gt; 3</td>
<td>Yes, COP &gt; 3, often oversized</td>
<td>Yes, COP &gt; 3</td>
<td>Yes</td>
<td>Yes, COP &gt; 3</td>
<td>Yes, COP &gt; 3</td>
<td>Yes, COP &gt; 3</td>
<td>Yes, COP &gt; 3</td>
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<tr>
<td>Heat distribution system</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes?</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Pumps</td>
<td>Yes, efficiency 10-60 %</td>
<td>Yes, efficiency up to 60 %</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Domestic hot water heaters</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Control systems</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Yes</td>
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<tr>
<td>Household appliances</td>
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<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<td>Yes</td>
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</tr>
</tbody>
</table>

Table 4.2 Lack of components for very low energy residential buildings in the Nordic countries, Poland and the Baltic States.

<table>
<thead>
<tr>
<th>Component</th>
<th>Sweden</th>
<th>Finland</th>
<th>Denmark</th>
<th>Norway</th>
<th>Poland</th>
<th>Latvia</th>
<th>Estonia</th>
<th>Lithuania</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>Cost efficient systems</td>
<td>Cost efficient systems</td>
<td>Cost efficient systems, small number of suppliers</td>
<td>Few suppliers</td>
<td>Cost efficient systems</td>
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<tr>
<td>Thermal insulation</td>
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<tr>
<td>Airtightness products</td>
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<tr>
<td>Windows</td>
<td>Few suppliers</td>
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<tr>
<td>Solar shading</td>
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<tr>
<td>Doors</td>
<td>Few suppliers</td>
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</tr>
<tr>
<td>Frame components</td>
<td>Polish producers</td>
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<tr>
<td>Ventilation with heat recovery</td>
<td>Prefabricated solutions</td>
<td>For apartment buildings</td>
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<tr>
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<tr>
<td>Heat distribution systems</td>
<td>Affordable pellets burner with solar collector systems for one-family houses. Wood-burning stoves with a low power outlet</td>
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<td>Pumps</td>
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<tr>
<td>Domestic hot water heaters</td>
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<tr>
<td>Control systems</td>
<td>For micro heaters</td>
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</table>
Table 4.3  Need for development of components for very low energy residential buildings in the Nordic countries, Poland and the Baltic States.

<table>
<thead>
<tr>
<th>Component</th>
<th>Sweden</th>
<th>Finland</th>
<th>Denmark</th>
<th>Norway</th>
<th>Poland</th>
<th>Latvia</th>
<th>Estonia</th>
<th>Lithuania</th>
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</thead>
<tbody>
<tr>
<td>General</td>
<td>More cost efficient systems</td>
<td>Further development of many components</td>
<td>More cost efficient systems</td>
<td>More cost efficient systems</td>
<td>More cost efficient systems</td>
<td>More cost efficient systems</td>
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<tr>
<td>Thermal insulation</td>
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<td>Airtightness products</td>
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<td>Air tightness of prefabricated building elements</td>
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<tr>
<td>Windows</td>
<td>Low cost Estonian</td>
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<tr>
<td>Solar shading</td>
<td>More cost efficient systems</td>
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<td>Low cost automatic external shading systems</td>
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<tr>
<td>Doors</td>
<td>Airtight doors with lower price</td>
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<td>Airtight and well-insulated doors</td>
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<td>Ventilation with heat recovery</td>
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<td>User friendliness</td>
<td>User friendliness</td>
<td>Low cost Estonian</td>
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<tr>
<td>Heat distribution systems</td>
<td>Better insulated ground pipes, district heating sub-centres</td>
<td>User friendliness</td>
<td>Individual control of air heating</td>
<td>More cost efficient systems, user friendliness</td>
<td>Polish systems</td>
<td>User friendliness</td>
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<tr>
<td>Pumps</td>
<td>More efficient</td>
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<tr>
<td>pumps</td>
<td>Domestic hot water heaters</td>
<td>Control systems</td>
<td>Household appliances</td>
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5 REFERENCES
