NorthPass

INTELLIGENT ENERGY EUROPE

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Barriers to implementation of very low energy residential buildings and how to overcome them

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1 SUMMARY

In Denmark, Norway, Sweden and Finland several very low energy residential buildings such as passive houses have been built since the millennium, which however constitute only a small part of the total market for new construction of residential buildings. These countries have an official definition or standard for very low energy buildings, mainly passive houses. The other participating countries i.e. Poland, Latvia, Estonia and Lithuania have only a few low energy residential buildings and don't yet have any official definition or standard for low energy residential buildings.

Therefore the purpose was to determine the barriers, technological and non-technological, to implementation of very low energy residential buildings and how to overcome them in Sweden, Finland, Denmark, Norway, Poland, Latvia, Estonia and Lithuania. This was carried out by PDS (problem detection studies) and literature studies. The target groups were: the participants of this project, designers, building industry and building authorities.

A SWOT analysis was carried out to structure the information and data prior to making suggestions on how to overcome the barriers. In the SWOT analysis questions was put to enable to assess and determine whether low energy housing will have real possibilities on the market and which are the limitations/barriers obstructing a market establishment.

Several problem areas were considered to have a high priority. Four of the problem areas were common for all of the participating of countries: market, requirements/regulations, knowledge, and costs. Other problem areas were given a high priority only by some countries: instruments of control, design, technical solutions/concepts, function/performance, user/behaviour and risks.

There doesn't seem to be any major difference in problems between the countries with several very low energy residential buildings built and the countries with only a few. The magnitude of some of the problems is likely to be different. There is of course a difference in the number and level of good examples which influences the market, the level of knowledge and instruments of control. The non-technological problems/barriers are mainly within the following areas: market, requirements/regulations, knowledge, costs, instruments of control, responsibility, policy, society and incentives i.e. many problems are non-technological.

The problems mentioned above can be perceived or actual problems. The perceived problems can sometimes be solved with information and a good dialogue. To overcome the perceived or actual potential internal weaknesses of low energy dwellings several suggestions were made. Some suggestions were highlighted by several countries e.g.:

- Methods: Introduce and apply LCC-analysis, and develop common specifications for low energy residential buildings.
- Knowledge: Feedback from previous experience, update the educational level of designers and contractors and introduce low energy house design at universities
- Market: Publish more good examples and increase the size of the market for low energy products.

To overcome the perceived or actual potential external threats to low energy dwellings several suggestions were made of which some were highlighted by more than one country e.g.:

- Market: Market well documented good examples of low energy buildings.

- Incentives: Political lobbying and information activities, and lobby for tax credits and specific loans for low energy buildings.

There are several barriers to implementation of very low energy residential buildings in Northern Europe. However many of these barriers should not be impossible to overcome if we want to increase the number of low energy residential buildings. In order to increase the awareness, knowledge and market it is crucial to have reliable and convincing information on successful low energy house projects in Northern Europe. The performance of these projects should be based on a standardised way to measure and compare performance. More successful and well-documented low energy buildings are needed.

To promote low energy residential buildings in Northern Europe it is important to maintain, improve and market the strengths (such as good indoor environment, low running costs, low LCC, growing market), minimise the potential weaknesses (such as poor performance due to insufficient competence, lack of robustness and quality, poor operation and use, mistakes in planning and design). It is also important to make use of the opportunities (such as future stringent performance oriented legislation/standards, increasing energy cost, low running costs and expected good reputation) and forestall and neutralize the potential threats (low interest in low energy buildings, inadequate knowledge). A national strategy towards making very low energy buildings the standard for new buildings should be developed. To increase the market European legislation/standards/specifications should be better harmonized.

To ensure that a low energy house is accepted by the occupants, it has to be introduced to the occupants and guidelines on how to use the building are required. The low energy house must also function as expected, be user-friendly, ensure good comfort, deliver expected energy savings and supply good living conditions. To succeed with these ambitions a dialogue has to be created between occupants of low energy buildings and developers/building owners.

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.

2 INTRODUCTION

2.1 Purpose and target group

2.1.1 Introduction

In Denmark, Norway, Sweden and Finland several very low energy residential buildings such as passive houses have been built since the millennium, which however constitute only a small part of the total market for new construction of residential buildings. These countries have an official definition or standard for very low energy buildings, mainly passive houses. In the other NorthPass participating countries i.e. Poland, Latvia, Estonia and Lithuania only a few low energy residential buildings have been built and there is not yet any official definition or standard for low energy residential buildings.

Therefore the purpose of this study (Blomsterberg 2010) was to determine the barriers, technological and non-technological, to implementation of very low energy residential buildings and how to overcome them in Sweden, Finland, Denmark, Norway, Poland, Latvia, Estonia and Lithuania.

Two slightly different approaches for the determination were considered:

- Qualitative interviews as carried out in the SECURE-project (Jarnehammar 2008)
- PDS (Problem Detection Study) incl. focus groups

The first approach would mean carrying out semi structured interviews with open ended questionnaires, where only some of the questions and topics are predetermined. The interviewees are relevant stakeholders.

The second approach is similar, but with the difference that meetings with stakeholders are arranged. At the meetings the group of stakeholders takes part in the choice and formulation of problems/issues. During the meeting the participants trigger each other.

In the project description workshops or seminars with different actors from the building sector were foreseen. The second approach is a combination of workshops/seminars and qualitative interviews.

Therefore the determination was carried out by:

- PDS incl. focus groups
- literature studies

The target groups was:

- the participants of this project
- designers
- building industry
- building authorities

Why carry out a problem detection study with focus groups?

- Difficult to evaluate new, almost untried system (e.g. zero energy residential buildings and in some countries passive residential buildings) for uninitiated parties

- Focus groups requires little effort and time for the stakeholders (ca 3 hours) -> sufficient participation is likely
- Easy way of determining which features are most important for each category of stakeholder
- Focus groups is a means of generating information on public understandings and viewpoints

Who should participate?

- Impartial facilitator/controller
- Scientific partner
- Stakeholders:
    - Property developers/owners/managers of apartment buildings
    - Property developers/owners/managers of one-family houses
    - Consultants
    - Architects
    - Contractors
    - Suppliers/manufacturers
    - End users/operations manager
    - Building code authorities
    - Health authorities
    - Policymakers
    - Other?

The results from the PDS were used in a SWOT-analysis. The PDS was managed by a behavioural scientist (Engvall 2010).

2.1.2 Problem detection study of residential low energy buildings

The PDS method (Problem Detection Study) is a structured approach to estimate and determine existing problems with and basic requirements on a product, building, organization etc. (Engvall 2010). The method has previously been used in connection with market analysis's of different kinds but has been further developed by the city of Stockholm in connection with the evaluation of the built environment e.g. housing for elderly, housing for people with allergies, feedback from new construction, before reconstruction as well as for renewal of city districts. The method is distinguished from traditional questionnaires by the fact that the planned target group itself takes part in the choice and formulation of problems.

The method works mainly according to the description given below and in the following flow chart – here adapted to low energy dwelling projects.

STEP 1:

A reference group of experts with one representative each main stakeholder on the subject is brought together, e.g. building and HVAC consultants, installers, operations engineers, architects, property owners/developers/managers, users for a **first meeting** in order to highlight the **problems of today's low energy housing** seen from their own perspective. The experts were experts with experience of low energy buildings, not low energy building enthusiasts.

Based on this first meeting an **interview guide is compiled** with the areas of problems and connecting keywords, which have been brought up during the first expert meeting. This interview guide is then sent to the expert group, who checks that everything has been included and evaluates from their own perspective what is most important to highlight. It is also possible for the members of the expert group to add areas of problem, which were thought of after the meeting.

STEP 2:

With this interview guide as a starting point, **one or several focus group meetings (second meeting in the PDS process)** are carried out with persons from different areas of activity with low energy residential buildings as a common denominator. In Sweden four different focus groups were organized, developer/owners, architects/designers/consultants, contractors/manufacturers and users/operations managers. The other participating countries divided the expert group into subgroups and didn't organize any separate focus group meetings. Each focus group meeting is with a different group of people involved in the same area of activity. The aim of the group meetings is to have the experts more or less theoretically formulated problems expressed in daily words of people working with residential buildings and people living in and operating residential buildings.

The **compilation of problems**, which is the result of the group meetings, is formulated as problem statements, which are then presented to and discussed with the expert group, which is the **third meeting** in the PDS process.

STEP 3:

The confirmed problem statements could then be sent as a **questionnaire to a larger target group** in order to determine which problems most stakeholders agree with. This was however not possible to do in this project. Instead the results were sent out to the expert and focus groups for comments. The result is analysed with respect to different basic requirements on what is important to fulfil to arrive at good residential buildings. It can also be analysed with respect to the opinion of different stakeholders or be divided according to the different functions of a dwelling etc.

This form of problem inventory can reveal additional needs and solutions and give an impartial and detailed description of requirements on dwelling solutions and design.

2.1.3 Guidelines for problem detection study of residential low energy buildings

The first meeting with the expert group is basically a workshop (typical duration 3 hours) and should be led by an impartial facilitator (see Appendix 1 Instructions).

Issues to be dealt with are:

- What are the most important *features* of residential low energy buildings
- What are the most common *problems* with residential low energy buildings
- *Priorities* – which issues are considered most important by which stakeholder?

The first meeting with the expert group and the focus group meetings are "brainstorming's" and should not be overly controlled or directed

- participants should be chosen with care to be representative for their area of activity and to minimise the number of non-arrivals
- to the expert group meeting experts from many areas of competence should be invited (see introduction and appendix 1 letter of invitation)
- persons from each "category" of stakeholder should be invited to the expert group meeting. Ensure minimum one participant per category.
- the impartial facilitator/controller manages the workshops
- important to have all stakeholders represented at the same workshop (expert group meeting)
- the participants should fill in the information on meeting participants in conjunction with the workshop

The meetings start with a general introduction and the participants are given 15 minutes to write down what first comes to their minds as to **the problems** they see **with today's low energy housing** seen from their own area of activity and perspective. Next step is to let the

participants present their opinions. At an expert meeting let the authorities and health organisations be the first ones to present their opinions, then the users, then the architects, then the technical designer/consultant, then the supplier, and finally the property manager/developer/owner. Allow everyone to comment during the presentations. If a topic/keyword (see interview guide) is not touched upon bring it up.

During the expert meeting have an impartial assistant to the facilitator write down the opinions on e.g. a billboard so that all the participants can see them. After the expert meeting the facilitator and the scientific partner systematises the opinions in a preliminary interview guide.

The preliminary interview guide is then mailed to the participants of the expert group and they are asked to review the guide and rank the different problems according to importance/relevance/priority.

The resulting weighted interview guide is used as a base for focus group meetings with e.g. a group consisting of only property managers/owners or only operations engineers or only architects/technical consultants.

During the focus group meetings it is easiest to tape the whole discussion.

After the discussion the participants are asked to evaluate how important the different problem areas are when developing new low energy housing concepts and how well existing solutions perform with regard to these problem areas.

After the focus group meetings the expert and focus groups are asked to comment on the results. In the end the final results from the expert and focus group meetings are interpreted by the Scientific Partner for each of the high-priority features/problems

- Does a passive or zero energy dwelling have this feature or solve this problem?
- How well does a passive or zero energy residential building compare with traditional residential buildings for this feature/problem?

The thus determined problem statements are analysed with regard to the basic requirements on a good low energy dwelling. The analysis can also be done with regard to the opinion of the different participants or with regard to the different performance aspects of a low energy dwelling.

2.1.4 SWOT-analysis and suggestions for measures

SWOT analysis is a good tool for structuring information and data prior to the preparation of a market plan, which is not included in this study. SWOT is an abbreviation of “Strengths”, “Weaknesses”, “Opportunities” and “Threats”. In a SWOT analysis questions are put to enable companies and project groups to assess and determine whether a new product e.g. low energy housing will have real possibilities on the market and which are the limitations/barriers obstructing a market establishment. The SWOT analysis is therefore considered to be the right choice of method.

Prior to the elaboration of a market plan one should preferably carry out several different SWOT analyses aiming at a complete foundation for the market plan. A crucial step is to compare the new product with competing products.

The SWOT-analysis is a means to conclude the most important advantages and disadvantages of a product/business idea on the market. Selecting the top few aspects of each category help focusing on a few but important issues to stress in the marketing process (if positive) or improve/plan for (if negative). Focusing questions are:
How can the STRENGTHS of the product be maintained and improved?

How can the WEAKNESSES of the product be minimised?

How can the OPPORTUNITIES for the product be utilized?

How can the THREATS to the product be forestalled and neutralized?

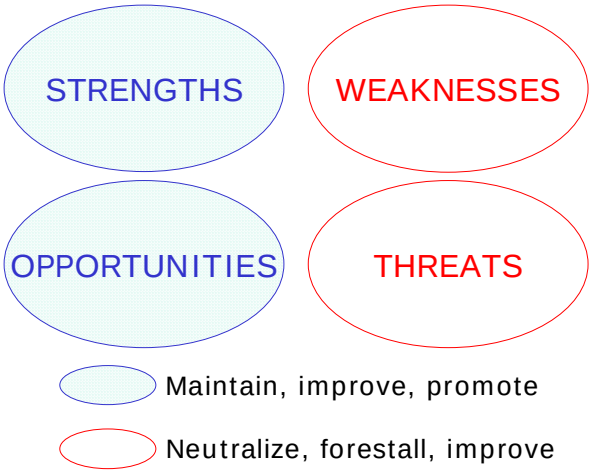

Figure 2.1 SWOT-analysis principle

"Strengths" **and** ***"Weaknesses"*** studies internal resources of the product (in this case a residential low energy building) by comparing it with other products of the same kind (in this case other residential buildings).

Key questions are:

What are the main advantages of low energy residential buildings compared to traditional residential buildings?

What are the main disadvantages of low energy residential buildings compared to traditional residential buildings?

Issues addressed concerns financial, physical, human and technical resources, processes and brand.

"Opportunities" and "Threats" focuses on external resources beyond the immediate control of the manufacturer e.g. opportunities and barriers posed by the surrounding world, such as the market, stakeholders, sociological and behavioural aspects, regulations, political influence etc.

Key questions are:

What are the major opportunities posed by the outside world for low energy residential buildings?

What are the main threats to low energy residential buildings from the outside world?

Issues addressed concerns influence by the industrial structure, stakeholders outside the client – manufacturer supply chain as well as the surrounding world.

Explain the purpose and scope of the work done / the report.

Explain the target group of the presented results.

2.2 Contributions of partners

Each participant organized a meeting with a national group of experts. As a background the Swedish PDS with focus groups was used. Each participant carried out a national SWOT analysis and made suggestions as to how to overcome the barriers.

Each participant wrote their national chapter.

3 RESULTS

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3.1 Sweden

Author: Åke Blomsterberg

3.1.1 Perceived and real problems with low energy residential buildings

Today's traditional new residential building is a building with a building envelope insulated and equipped with a mechanical ventilation system with heat recovery on a level to at least be able to meet the requirements on specific energy use given in the Swedish buildings code (Peuhkuri 2010). If it is an apartment building it is likely to be heated by radiators and the heat is supplied by a district heating system. A one-family house is also likely to be heated by radiators, which are electric or if a heat pump is installed hot water central heating.

The low energy residential building is likely to be a passive dwelling or the like, which means that it is very well insulated and airtight. The passive house is likely to be built according to the performance specifications, issued by the Swedish "Forum for energy efficient buildings" (http://www.energieffektivabyggnader.se/). Space heating can be supplied by the balanced mechanical ventilation system with very efficient heat recovery. If space heating is supplied by the ventilating air the balanced ventilation system includes a heating coil in the supply air, which is either electric or hot water central heating. Solar heating might be used to supply half the energy use for domestic hot water heating (Blomsterberg 2009). Since 2000 some 400-900 dwellings units have been built as passive houses. Other types of low energy houses were also built, but supposedly not so many.

An "expert group" with representatives from developers/property owners/property managers, architects, energy consultants, manufacturers (thermal insulation, heat recovery) (two persons), contractors (heating, ventilation), general contractors (two persons), users, authorities and health organisations, and policymakers discussed and agreed upon which problems should be discussed when dealing with future low energy residential buildings (Blomsterberg 2010).

Table 3.1.1. Description of the expert group.

Developers/owners	• Senior installation manager at a major owner/developer of apartment buildings
Architects	• Architect at a major architect's office
Energy consultant	• Experienced engineer at a major firm of technical consultants
Manufacturer	• Development manager at a major manufacturer of thermal insulation • Salesman buildings projects at a manufacturer of air handling units and ventilation products
Contractors	• Business manager at leading Nordic installation company (heating and ventilation systems) • Environmental manager at international Swedish contractor • Senior technical and environmental manager of Nordic building contractor and property developer
Users/operation managers	• Managing director of medium sized owner of apartment buildings
Authority and health organisation	• Head of department at environmental administration
Policymaker	• Ph.d. student at international environmental institute

Four different focus groups (see table 3.1.2) discussed the problems the expert group had brought up.

Table 3.1.2. Description of the focus groups.

1. Developers/owners	• Senior project leader at major owner/developer of apartment buildings • Senior installation manager at a major owner/developer of apartment buildings • Experienced project leader att major contractor/developer of buildings incl. apartment buildings • Managing director of major property development company
2. Architects/designers/-consultants	• Senior energy consultant • Senior architect at architect's office • Two experienced consultants at major technical consulting firm • Senior architect at a major architect's office • Senior architect at architect's office
3. Contractors/manufacturer	• Engineer at major contractor/developer • Development manager at a major manufacturer of thermal insulation • Product manager at a major manufacturer of thermal insulation • Salesman buildings projects at a manufacturer of air handling units and ventilation products • Senior technical and environmental manager of Nordic building contractor and property developer
4. Users/operation managers	• Researcher (recent ph.d.) on user perception of low energy houses • Environmental and user manager of major contractor • Senior expert at national association of tenants • Managing director of medium sized owner of apartment buildings

The following aspects were considered to have the highest priority (see table 3.1.3):

- Knowledge (according to all focus groups): experience of low energy houses, competence to build low energy houses, information on how to build low energy houses, customer awareness regarding low energy houses, education regarding low energy houses, knowledge of each other's perspective on low energy houses.
- Market (according to the focus group with users): marketing, interest, system perspective, market shares, debate/information, comprehensive view, process.
- Instruments of control (according to the expert group, the focus group with architects/designers/consultants and with users): long term perspective for increased construction of low energy houses, incentive for increased construction of low energy houses, directives related to construction of low energy houses, the existence of "good examples".
- Design (according to the focus group with contractors/manufacturers): the importance of formation when designing low energy houses, customer adaptation when designing low energy houses, conflicts/disagreements when designing low energy houses.
- Technical solutions/concepts (according to the focus group with users): optimization of technical solution, rationalisation of technical solutions, product development and components
- Function and performance (according to the expert group, the focus group with contractors/manufacturers and with users): robustness of systems and products for low energy houses, system and product quality in low energy houses.
- User/behaviour (according to the focus group with contractors/manufacturers and with users): indoor environment in low energy houses, operation and use of low energy houses.
- Costs (according to the expert group, the focus group with developers/owners, the focus group with contractors/manufacturers and the focus group with users): cost estimates for low energy houses, financing of low energy houses.
- Responsibility (according to the focus group with developers/owners): the distribution of responsibility for low energy houses.
- Risks (according to the expert group): economical and building technological risks, risks with untried solutions for low energy houses.

Requirements/regulations are of course also important.

In conclusion the expert group agrees that the following problem areas have the highest priority:

- Instruments of control
- Function and performance
- Costs
- Risks

The problems mentioned above can be perceived or actual problems. For some of the actual problems there might already exist solutions, which for some reason are not used, e.g. lack of knowledge or being too expensive. Some of the perceived or actual problems might be solved with information.

Table 3.1.3. The different groups' (expert and focus groups) assessment of the degree of priority for the different problem areas, presented in ranking order (1 is highest) and average values for each group (from 1 = low degree of priority to 5 = high degree of priority)

Area of problem Degree of priority (ranking)	Experts	Developers/owners	Architects/designers/consultants	Contractors/manufacturers	Users/operations manager
Requirement/regulations	3.9 (3)	4.8 (2)	4.3 (3)	4.8 (2)	4.0 (4)
Knowledge	3.8 (4)	**5.0 (1)**	**4.8 (1)**	**5.0 (1)**	**5.0 (1)**
Market	3.0 (8)	4.5 (3)	4.7 (2)	4.8 (2)	**5.0 (1)**
Instruments of control	**4.2 (2)**	4.5 (3)	**4.8 (1)**	4.6 (3)	**5.0 (1)**
Design	3.1 (7)	4.5 (3)	3.7 (5)	**5.0 (1)**	**4.8 (2)**
Technical solutions/concepts	3.6 (6)	4.5 (3)	4.7 (2)	4.8 (2)	4.8 **(2)**
Function/performance	**4.3 (1)**	4.8 (2)	4.7 (2)	**5.0 (1)**	**5.0 (1)**
User/behaviour	3.9 (3)	4.8 (2)	3.7 (5)	**5.0 (1)**	**5.0 (1)**
Costs	**4.3 (1)**	**5.0 (1)**	4.2 (4)	**5.0 (1)**	3.4 (5)
Responsibility	3.7 (5)	**5.0 (1)**	3.4 (6)	4.0 (4)	4.8 (2)
Risks	**4.3 (1)**	4.0 (4)	3.3 (7)	4.8 (2)	4.3 (3)

The focus groups were asked give their opinion as to how well today's solutions solve different problems (see table 3.1.4).

Within the area of *requirements and regulations* mainly the property owners/developers mean that the definition of the concept low energy house does not work particularly well. Within the area of *knowledge* the lack of experience and education is highlighted. The group architects/consultants point to the lack of information and customer awareness, while the user group mainly highlights the lack of knowledge in information on each other's perspective and customer awareness but also the lack of information and educations.

Regarding the problem area the *market* all groups agrees that there is a lack within the area of market shares of low energy houses. Most of the groups agree that the lack is in the comprehensive view and the process itself regarding the handling of low energy houses by the market. The architect/consultant group mean that most areas dealing with the market for low energy houses is inadequately handled.

How the *instruments of control* for an increased construction of low energy houses are handled today everyone agrees that the issue of incentive could be handled better. Otherwise it is the property owner/developer and architect/consultant groups that consider all aspects of the instrument of control i.e. long term perspective, directive, and showing good examples is poorly handled. Also the user group highlights several aspects of the instruments of control as not functioning.

For the problem area *design* of low energy houses, mainly the property owner/developer point to the conflicts which exist for the design of low energy houses. The user group highlights the issue of customer adaptation as problem when designing low energy houses.

Mainly the property owners/developers perceive problems regarding *technical solutions*, both in connection with product development and components. The user group is mostly dissatisfied with how the optimisation of the technical solutions function today.

For the *function and performance* of low energy houses distrustfulness is highest among the property owner/developer group and highlighted are robustness and quality, even the user group highlight the same issues. The contractor/manufacturer group mean that everything works fairly well.

The problem area regarding *user and behaviour* is highlighted by the property owner/developer and user groups. This is mainly with regard to information and operation and use of low energy houses. Most satisfied with the situation regarding use and behaviour is the group of contractors and manufacturers.

The problem area regarding *costs* the property owner/developer is most dissatisfied with, where the issue of cost estimates for low energy houses is highlighted. Also the group with architects and consultants mean that there are problems related to costs, and highlights the problem of financing.

As to *responsibility* mainly the users group see problems. It is also the group, which more than the other groups see risks with construction of or living in low energy houses. The *risks* are considered to be buildings technology and building services engineering and risks with untried solutions.

Table 3.1.4 Marking of the performance of today's solutions on the different problems with low energy houses (1 = poor and 5 = good/high). Extra bold type means low rating.

Problem area	**Developer-/owner**	**Architect/designer/-consultant**	**Contractor/-manufacturer**	**User/ operations manager**
Requirements and regulations:				
- definitions of low energy houses	**2.0**	2.7	3.2	3.0
- planning monopoly	2.5	2.8	2.8	3.0
Knowledge:				
- experience	**2.3**	2.8	3.6	3.0
- competence	2.5	2.5	4.0	3.3
- information	2.8	**2.3**	3.8	**2.3**
- customer awareness	2.5	**1.8**	3.4	**2.0**
- education	**2.0**	2.5	3.0	**2.3**
- about each other's different perspective	2.5	2.5	2.8	**2.0**
Market:				
- marketing	2.5	**2.3**	2.8	3.7
- interest	3.3	**2.3**	3.6	3.7
- system perspective	**2.3**	**2.3**	2.8	2.7
- market shares	**2.0**	**2.3**	2.4	**2.3**
- debate/information	2.5	2.7	2.8	3.3

- comprehensive view	**1.8**	**2.3**	3.0	**1.7**
- process	**1.5**	**2.3**	2.8	**2.0**
Instruments of control:				
- long term perspective	**1.8**	**1.8**	2.8	**2.3**
- incentive	**2.0**	**1.8**	**2.4**	**1.8**
- directives	**1.5**	**2.0**	2.6	**2.3**
- good examples	**1.5**	**2.2**	3.0	3.3
Design:				
- design/formation	2.8	3.2	4.2	2.7
- customer adaptation	3.0	3.3	3.4	**2.3**
- conflicts	**1.7**	2.8	3.2	3.0
Technical solutions				
- optimization	3.0	3.2	3.4	**2.3**
- rationalisation	2.5	2.8	3.0	2.7
- product development	**1.8**	2.8	3.0	3.0
- components	**2.0**	2.8	3.2	3.0
Function/performance				
- robustness	**2.3**	2.8	4.2	2.7
- quality	**2.3**	3.3	4.0	2.7
User/behaviour				
- indoor environment	2.5	3.8	4.0	3.3
- operation and use	**2.0**	2.7	3.8	**2.0**
- information	**2.3**	2.8	4.0	**1.7**
Costs				
- cost estimates	**1.5**	2.6	3.6	3.0
- financing	2.5	**2.2**	3.0	2.5
Responsibility				
- assignment of responsibility	3.5	3.2	3.6	**2.3**
Risks				
- economical	3.5	3.0	3.6	3.0
- building technology	3.5	3.4	3.6	**2.3**
- building services engineering				**2.3**
- untried solutions	3.5	2.8	3.4	**2.3**

3.1.2 SWOT-analysis

For the SWOT-analysis a passive residential building and a traditional modern residential building were chosen. The reference passive house dwelling fulfils the Swedish specifications for a passive dwelling (see beginning of chapter 3.1.1), which is different depending on climate zone (three different zones).

The potential internal strengths and weaknesses and the potential external opportunities and threats for the low energy dwelling e.g. a passive house dwelling are presented below and then commented. Some issues can appear both as internal strengths and weaknesses or both as opportunities and threats. This can be explained by different aspects of the issue or depending on who you ask.

	Potential internal Strengths		Potential internal Weaknesses
1	Requirements and regulations: Specifications for passive houses	1	Market: Small market
2	Knowledge: Experience of low energy house	2	User/behaviour: Operation and use inadequacies
3	Function/performance: Robustness and quality	3	User/behaviour: Indoor environment imperfections
4	User/behaviour: Indoor environment	4	Costs: Cost estimates and financing problems
5	Energy efficiency	5	Market: Poor marketing
6	Expected low LCC	6	Function/performance: Robustness and quality problems
7	Market: Growing market	7	Requirements and regulations: Confusing specifications for low energy houses
8	Low emission of GHG	8	Knowledge: Inadequate experience of low energy house
		9	Knowledge: Competence to build
	Potential external Opportunities		Potential external Threats
1	Future performance oriented legislation / standards	1	Market: Low interest in low energy buildings
2	Growing LCC awareness	2	Market: Price structure on energy unfavourable
3	The energy performance directive	3	Instruments of control: Missing incentive
4	Instruments of control: good examples	4	Costs: Unclear cost estimates and financing
5	Prognosis for increasing energy costs	5	Knowledge: Inadequate education
6	Low running costs	6	Knowledge: Lacking customer awareness
7	Reputation	7	Knowledge: Inadequate information on how to build
		8	Requirements and regulations: Local planning monopoly
		9	Reputation

Comments

3.1.2.1 Potential internal strengths

1 - Requirements and regulations: Specifications for passive houses

Since June 2009 (supplemented in October 2009) detailed performance specifications, developed and issued by the Swedish "Forum for energy efficient buildings", FEBY, on passive houses exist. The specifications are co-ordinated with the current Swedish building code. The aim is to minimize the demand of supplied power and energy for heating so that the necessary thermal comfort can be obtained using the supply of space heat using the hygienic air flow (Feby 2009). The draft version and the final version of the specifications have so far been applied to several residential buildings.

2 - Knowledge: Experience of low energy houses

There are some examples of studies, where low energy houses built during the last 10-15 years have been evaluated and found to have a good energy and indoor climate performance, better than traditional modern residential buildings (Ruud 2004). During the eighties and nineties several low energy housing projects were performance monitored and evaluated with similar energy and indoor climate results.

3 - Function/performance: Robustness and quality

The passive houses built after 2000 are likely to be more robust and with a better quality than the previous low energy buildings. This is assuming that lessons were learnt from the low energy residential buildings of the eighties and nineties.

5 - Indoor environment

Well designed, built, commissioned and operated low energy houses fulfil the prerequisites for a comfortable and healthy indoor environment.

5 - Energy efficiency

The passive house concept and similar concepts will improve the energy efficiency of residential buildings, which will be a strong point when LCC cost analysis is most likely to be applied in the future and when the energy requirements will be more stringent, thereby a strong point in the marketing to clients.

6 - Expected low LCC-costs

See energy efficiency.

7 - Market: Growing market

Between 2000 and 2010 some 400-900 dwellings units were built as passive houses (Blomsterberg 2009). Other types of low energy houses were also built, but supposedly not so many. The yearly market for dwelling units is approximately 30 000 dwelling units in new construction. There is also a large market in renovation of existing apartment buildings.

8 - Low emission of GHG

Low energy houses contribute to a reduction of the emission of greenhouse gases.

3.1.2.2 Potential internal weaknesses

1 - Small market

The total potential market for low energy house concepts is 30 000 dwelling units per year, which is the yearly production of new dwellings. This limited market will influence the price for the houses, as no large-scale production is possible and there is too little competition on the Swedish market. Some of the good low energy solutions for products e.g. for air tightness are not available on the Swedish market.

Parts of the concepts may be used in existing buildings. However an increased international market may enhance the possibilities.

The low energy concept such as the passive house is sometimes difficult to apply on existing buildings. Most renovations in Sweden today are made with only small changes to the building structure.

2 - User/behaviour: Operation and use

It is often difficult for the user to handle the technical equipment in low energy houses. The instructions to the user are often poor, written for engineers. If no instructions or very poor instructions are given to the users, then there is a risk for poor performance. The user has a strong influence on the performance of a low energy use house. The prediction based on energy simulation is often based on a different user behaviour. As there is no requirement for solar shading low energy houses can become too warm. The specification for passive houses does however include maximum hours the indoor temperature may be above a certain level. Window airing at the wrong time can cause increased energy use. There is no system for tuning and servicing low energy houses in the same manner as a car. The absolutely necessary dialogue from a sustainable perspective between the property owner and the user is often missing. A certain disappointment of the use can occur if the user can't live up to the expected energy savings expected from the technology.

3 - User/behaviour: Indoor environment.

There is an aversion, however limited, to balanced ventilation. One reason is that many inadequate balanced ventilation systems generate disturbing noise. A ventilation system in a low energy house must be very quiet, as the noise from the outside is well reduced thanks to an airtight and well insulated building envelope. The risk for creating an indoor climate in a low energy house, which is not acceptable to the users, is claimed to be rather high. Passive houses may have cold floors. Low energy houses can become too warm, especially in bedrooms upstairs.

4 - Costs: Cost estimates and financing

Low energy houses are claimed to have the same or higher investment cost as traditional modern houses (Blomsterberg 2009). The current used depreciation time of buildings is too short to favour low energy houses. For demonstration projects it is difficult to determine the additional costs, which will not occur in a large scale production. How to share costs for low energy houses between developers, owners, buyers, tenants etc.? If energy is not saved the rent will increase when the energy prices increase.

5 - Market: Marketing

Packaging of many low energy house concepts is poorly done. It is also confusing with the different low energy house concepts/definitions. Design and other important aspects must not be forgotten for low energy houses. Low energy houses must not be for a limited group of persons.

6 - Function/performance: Robustness and quality.

The robustness of low energy houses is not very well known. Low energy houses can be more sensitive to the handling by the users than ordinary houses. There is a shortage of knowledge concerning the quality required for low energy houses. When low energy systems malfunction there is a shortage of qualified persons, who know how to mend. The user interface to low energy systems is often poor.

7 - Requirements and regulations: Specifications for low energy houses.

It is confusing with the different and sometimes unclear definitions of low energy houses. There are several different environmental and energy rating systems for buildings. It is difficult to make a complete comparison between the different low energy house concepts and different environmental and energy rating systems for buildings, because of the varying range of the requirements, the different design of the requirements and the different underlying assumptions (Blomsterberg 2009). It is claimed that the way energy use is calculated for buildings in Sweden favour the attitude of the building trade that “construction is already very good today”. Many developers claim their houses have the same low energy use as passive houses without being passive houses.

8 - Knowledge: Experience of low energy houses.

There is a shortage of feedback from previous experience and from new low energy houses. There is no official energy simulation tool. Too few good examples are presented. There is a belief that low energy houses are more expensive to build than normal new production. On-site problems can’t always be solved.

9 - Knowledge: Competence to build.

Too many prejudices exist from the energy saving measures applied during the eighties. Workmanship for thermal insulation has too low status. Workers can be prejudiced regarding new methods. There is a shortage of indoor climate and energy specialists among contractors, developers and property managers.

3.1.2.3 Potential external opportunities

1 - Future performance oriented legislation / standards

As more and more national and international standards are developing in a more performance oriented manner, the opportunities for the low energy house concepts such as the passive house will be growing over time. The new Energy Performance of Building Directive (2010/31/EU) will affect the existing building regulations. From 1 January 2021 all new buildings, including those to be renovated have to fulfil very high energy performance requirements”.

2 - Growing LCC awareness

Everybody, more or less, is today aware of the benefit of LCC considerations, but very few are applying such considerations in practice. For many developers there is no or only little business connection between producing units and facility management units of the same company. However the general trend over time is favourable for LCC considerations in practice, but the development is rather slow.

3 - The energy performance directive

The European energy performance of buildings directive (EPBD), which was implemented in 2006, will further promote energy efficient systems. The Swedish building code has been overhauled and will be overhauled again in 2011. A Recast of the Directive was adopted in May 2010. The future EPBD will focus on near zero energy buildings.

4 - Instruments of control: Good examples

More and more good examples are expected.

5 - Prognosis for increasing energy costs

The higher the energy cost the more interesting low energy house concepts such as passive houses will be, especially if more stringent energy requirements are enforced and LCC analysis are applied.

6 - Low running costs

The low energy house concept such as the Swedish passive house concept includes good monitoring, little need for adjustment of air flows, low use of energy etc. This will be an advantage especially when LCC analysis becomes more widely used.

7 - Reputation

The low energy houses concepts such as the passive house is expected to be well-reputed in the future. The concept such as the passive house solves many of the energy problems of today's ordinary residential concepts. If the concept lives up to the expectations and is well promoted, then in the long run it should acquire a good reputation.

3.1.2.4 Potential external threats

1 - Market: Low interest in low energy houses

Too little money involved working with residential buildings. There are consultants, who are not interested in designing low energy residential buildings due to simple HVAC technology and limited budgets for residential buildings.

2 - Market: Price structure

The sometimes high fixed part of the price for district heating and electricity can result in not much lower energy costs for low energy buildings than for modern traditional buildings.

3 - Instruments of control: Incentive.

The politicians, cities and municipalities make great demands to show their engagement without knowing the consequences. Some architects/designers/consultants claim that we already build such good houses that there is no incentive to build low energy houses. There is no major drive or action plan for sustainable low energy houses by the government and authorities. On-site produced electricity can't be sold to the electric grid, removing the incentive for plus or zero-energy houses.

4 - Costs: Cost estimates and financing.

There is no incentive from banks, which could require low energy houses, in order to lend money. There is too little competition on the building market in Sweden. Compared with buying a car where the price range is large and depends on the product, the price range of a house depends to a great extent on the location and thereby the cost of the land. The used depreciation time of buildings is too short to favour building low energy houses.

5 - Knowledge: Education

Knowledge of many of the involved parties is limited. This causes an initial threshold for the implementation of new low energy house concepts. Information measures are needed to motivate the stakeholders. Mental Barriers for different parties in the building and facility management process, e.g. developers, clients, consultants, architects, contractors, facility management staff; ("We have never tried this before, we'd better keep to the well-known and well-tried"), ("It is far too complicated; we aim at simple and cheap solutions." etc). The education of architects does hardly include any teaching in energy efficiency and related issues. Many technical consultants are not sufficiently educated in low energy buildings. The knowledge level among politicians is too low. There is not enough education in low energy house concepts. The existing courses in energy efficiency in buildings are not followed by a sufficiently large number of persons.

6 - Knowledge: Customer awareness.

Customers often prioritize the location and are not very interested in low energy houses. Many customers expect high quality including low energy use from new construction they buy. The customers are not very well informed about low energy houses. Many developers associate passive houses with forced air heating, which they don't want. Preconceived ideas about low energy houses exist, which often are not very different from ordinary houses. Many users can lack in interest and motivation.

7 - Knowledge: Information on how to build

There is no list of products for low energy houses. There is a shortage of low energy products on the Swedish market, some exist abroad. No information on reliability of low energy products exist. There is no uniform and impartial information. The professional support of buyers and users is inadequate.

8 - Requirements and regulations: Planning monopoly.

The planning monopoly of the municipalities/cities can result in different interpretations of the building code. Different local restrictions for constructions exist, meaning different

things. To change the detailed local development plan can be difficult and time-consuming. Differences in opinion between different local authorities occur. Lack of competence on local authority levels occurs.

9 - Reputation

The future potential is depending on the outcome of demonstration projects.

3.1.3 Summary and Conclusions

A SWOT-analysis of low energy houses compared with ordinary modern houses, resulted in:

- potential internal strengths: specifications for passive houses, experience of low energy houses, robustness and quality, indoor environment, energy efficiency, expected low LCC, growing market.
- potential internal weaknesses and barriers: small market, operation and use, indoor environment, cost estimates and financing, marketing, robustness and quality, specifications for low energy houses, experience of low energy houses, competence to build.
- potential external opportunities: future performance oriented legislation/standards, growing LCC awareness, the energy performance directive, good examples, prognosis for increasing energy costs, low running costs, reputation.
- potential external threats and barriers: low interest in low energy houses, energy price structure, incentive, cost estimates and financing, education, customer awareness, information on how to build, local planning monopoly, reputation.

Comments regarding the potential internal strengths:

- specifications for passive houses and the like: should be a help in designing and building low energy houses, should be further promoted
- experience of low energy houses: should be valuable for promoting low energy houses
- robustness and quality: should be valuable for promoting low energy houses
- indoor environment: should be valuable for promoting low energy houses
- energy efficiency: strong point when LCC is stressed and the energy requirements have and will become more stringent
- expected low LCC: see energy efficiency
- growing market: should lower the investment costs and ensure new and better low energy components and systems

Comments regarding the potential external opportunities:

- future performance oriented legislation/standards: offers better opportunities for low energy houses
- growing LCC awareness: is beneficial for low energy houses
- the energy performance directive: promotes low energy houses
- good examples: will convince everyone that low energy houses is the way to go
- prognosis for increasing energy costs: the higher the energy cost the more interesting low energy houses will be
- low running costs: advantageous when LCC analysis become more widely used
- reputation: if low energy houses such as passive houses lives up to the expectation and is well promoted, it should acquire a good reputation

To overcome the potential internal weaknesses and barriers the following suggestions are made:

- small market: increase the foreign competition on the Swedish market and the sale of Swedish low energy products/concept abroad i.e. an increased international market

- cost estimates and financing: carry out impartial cost estimates for low energy houses vs. ordinary houses, lobby for increased depreciation time of buildings and develop a model for fair distribution of costs for low energy houses between developers, owners, buyers, tenants etc.
- marketing: lobby for improved packaging of low energy houses adapted to the market
- robustness and quality: create and publish more good examples in a better and more efficient way
- indoor environment: create and publish more good examples
- operation and use: create and publish more good examples, develop usable and user friendly instructions for the users of low energy houses
- specifications for low energy houses: market the Swedish passive house specifications, other relevant specifications and environmental and energy rating systems for buildings. The specifications and rating systems have to be summarized and presented in a manner that non-engineers can understand them (Blomsterberg 2009). Limit the number of specifications and rating systems. Include low energy house requirements in the Swedish building as in the Danish building code.
- experience of low energy houses: create and publish more good examples, see also "cost estimates and financing"
- competence to build: further education of the building trade (e.g. consultants, architects, contractors and construction workers)

To overcome the potential external threats and barriers the following suggestions are made:

- low interest in low energy houses: marketing of well documented good examples explaining the advantages compared with traditional modern houses and that what you expect from a traditional modern house is all fulfilled in a low energy house. The target group is clients and one-family house buyers.
- energy price structure: lobby for changes
- incentive: a major drive or action plan for sustainable low energy houses by the government and authorities
- cost estimates and financing: lobby for banks requiring low energy houses as a condition for house loans
- education: demonstration projects to show the feasibility and information to developers, clients, architects, technical consultants, contractors and users/customers
- customer awareness: relevant information to customers
- information on how to build: information on products for low energy houses and guidelines for construction for consultants, architect, contractors and construction workers
- local planning monopoly: lobby for changes
- reputation: successful demonstration projects

The following has to be fulfilled to ensure that a low energy house is accepted by the occupants:

- Support and good guidelines of use, information and maintenance to occupants about the possibilities and function of a low energy house

- The low energy house must:

✓ be perceived by the occupants as useful

✓ function as expected

✓ give freedom of choice e.g. to override an automatic control of indoor climate

✓ be user friendly

✓ be introduced to the occupants

3.1.4 References

[1] Blomsterberg, Å., 2009. Low energy houses – a study of different concepts. Energy and Building Design, Architecture and the built environment, Lund University. Rapport EBD-R 09/28 (in Swedish).
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3.2 Finland

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3.2.1 Perceived and real problems with low energy dwellings

Today's traditional new dwelling has high technical level including heating system and mechanical ventilation. The average energy demand for space heating and cooling is 80-90 kWh/brm2/a for apartment houses and 90-100 kWh/brm2 for single family houses. We have the concepts of low energy house and passive house in Finland. For a low energy house the energy demand for space heating and cooling is 26-50 kWh/brm2/a and for a passive house it is 15-25 kWh/brm2/a depending on the location. The passive houses are very airtight and well-insulated and that is why a full-sized heating system isn't necessary in them.

The expert group consists of experts, developers/owners, architects/designers/consultants, contractors/manufacturers and users/operations managers (see table 3.2.1).

Table 3.2.1 Description of the expert groups

Experts	• A professor in energy technology • A researcher in energy technology
Developers / owners	• A unit manager of technology and purchase, the company of rented accommodation broker • A researcher at VTT who is the owner of the very low energy house • An expert in HVAC systems at Helsinki municipality / housing production office
Architects / designers / consultants	• Two architects at architect offices • A design manager of the consulting group • A development manager of the building production manufacturer
Contractors / manufacturers	• A development manager at the large building trade company • A development manager at the insulation company • A managing director of the construction company • A vice-chairman of the indoor climate unit at the manufacturer of building and environment technology systems • A technology manager at the manufacturer of ventilation components
Users / operation managers	• A superior of the service at the service company

The answers of experts are based on their own experience or view. Most experts declared that his/her knowledge on low energy/passive houses is good. The expert's view on priority for different problem areas of very low energy houses are presented in table 3.2.2.

Table 3.2.2 The different groups' view on the degree of priority for the different areas of very low energy houses, presented in average values for each subgroup and the entire group (from 1 = low degree of priority to 5 = high degree of priority)

Area	All groups	Experts	Developers / owners	Architects / designers / consultants	Contractors / manufacturers	Users / operation managers
Building regulations	**4,6**	**5,0**	4,3	**4,5**	4,2	**5,0**
Standards	4,1	4,0	4,3	4,0	4,2	4,0
Experience of contractors/manufacturers	**4,7**	**5,0**	**4,7**	**4,5**	4,2	**5,0**
Customer awareness	4,2	4,0	3,3	4,0	**4,6**	**5,0**
Market	3,5	4,0	3,7	3,0	**4,6**	2,0
Design	**4,7**	**5,0**	**5,0**	**4,8**	**4,8**	4,0
Easiness of use and maintenance	4,4	3,5	**4,7**	**4,8**	4,2	**5,0**
Costs	3,9	4,0	3,7	3,8	4,2	4,0
Risks	4,3	**4,5**	4,0	4,3	3,6	**5,0**
Indoor climate	4,3	3,5	4,3	**4,5**	4,4	**5,0**
Comprehensive view	4,3	4,0	**4,7**	4,3	**4,6**	4,0
Images	3,4	3,5	3,3	3,5	3,8	3,0
Quality	**4,8**	**4,5**	**5,0**	**5,0**	**4,5**	**5,0**

The most important areas which each group consider significant are listed below:

- Building regulations: All groups consider building regulations to be at the high or quite high degree of priority.
- Experience of contractors/manufacturers: All groups consider this important. Lack of knowledge, supervision, guidance and control exist.
- Design: Each group consider this a significant area. The problems in design are mainly based on the education/knowledge, the amount of qualified designers and the life cycle viewpoint.
- Quality: Quality is also considered an important area. Filling the requirements of quality and functionality exercises the minds of the experts.

In addition to these areas contractors/manufacturers and users/operation managers consider customer awareness important. Market is considered to be at the high degree of priority by contractors/manufacturers. Easiness of use and maintenance is considered to be at the high level of priority by developers/owners, architects/designers/consultants and users/operation managers. According to the experts and users/operation managers risk management is important. Architects/designers/consultants and users/operation managers consider indoor climate to be at the high degree of priority. Comprehensive view is also considered important by developers/owners and contractors/manufacturers.

The different groups were asked to give their opinion as how well today's solutions solve the different problems. The answers are pulled together in table 3.2.3.

Table 3.2.3 The different groups' view on the different statements concerning low energy houses (1 = I disagree, 2 = I partly disagree, 3 = I have no opinion, 4 = I partly agree, 5 = I agree)

Area	All groups	Experts	Developers / owners	Architects / designers / consultants	Contractors / manufacturers	Users / operation managers
Design:						
- lack of education/knowledge	4,1	4,0	4,3	4,5	4,6	3,0
- too few qualified designers	4,2	4,0	5,0	4,3	4,6	3,0
- rapid change rate of regulations causes problems	3,2	3,0	4,0	3,3	2,6	3,0
- people don't want to pay for design	3,7	4,0	3,7	4,3	3,4	3,0
- designs aren't detailed enough	3,6	4,0	4,3	3,3	3,2	3,0
- there isn't conflicts more than conventional buildings have	3,2	3,0	4,0	2,5	3,4	3,0
- customers have good opportunity to influence on the solutions	2,9	3,0	3,0	3,5	3,2	2,0
- designers don't want to develop new solutions/they use existing solutions	3,9	4,0	5,0	4,3	3,0	3,0
- life cycle viewpoints aren't taken into account early enough	4,2	4,5	4,7	4,8	4,2	3,0
Manufacturing						
- lack of pilot projects	3,6	4,0	3,7	3,5	3,8	3,0
- there are enough suitable components and systems	2,9	3,0	1,7	3,8	4,2	2,0
- supervision on building sites isn't adequate	4,0	4,5	4,3	4,5	3,6	3,0
- lack of knowledge	3,9	4,0	4,7	4,5	3,2	3,0
- guidance and control of work performance isn't adequate	3,9	4,5	4,3	4,0	3,6	3,0
- co-operation of design and manufacturing works well	2,9	2,0	3,0	3,3	3,0	3,0
- price controls public procurement too much	3,6	4,0	3,3	4,0	3,8	3,0
Use and maintenance						
- control potential of building service systems is good	3,9	4,0	3,3	4,0	4,0	4,0
- end user can't use the systems	3,6	4,5	4,0	4,3	3,4	2,0

- building maintenance staff has adequate knowledge of systems, how to use and service them	2,3	2,0	2,0	2,8	2,6	2,0
Quality						
- good indoor climate is easy to achieve	3,8	4,0	3,3	3,0	4,6	4,0
- function level of very low energy houses is good	3,8	4,0	3,0	4,0	4,0	4,0
- interior temperatures are too high in very low energy buildings in the summer	3,1	3,0	4,3	3,0	3,0	2,0
- filling the requirements of quality and functionality is difficult	2,5	3,5	1,7	3,0	2,4	2,0
- energy use passes over the other aspects	3,2	4,0	2,3	3,0	2,8	4,0
- quality assurance operations are good enough	3,3	3,0	2,3	3,0	4,0	4,0
Market:						
- there are enough demand for very low energy houses	2,6	2,0	3,3	3,0	2,6	2,0
- lack of marketing	3,7	3,0	3,7	4,3	3,8	4,0
- discovery of right drivers to the very low energy building (e.g. climate change) haven't succeeded	3,1	3,0	2,7	2,5	3,4	4,0
- there aren't enough incentives for private persons to build low energy/passive house	3,8	3,5	4,0	3,8	2,8	5,0
Costs						
- payback period of the investment is too long	2,7	2,5	3,7	2,3	2,2	3,0
- cost effect of the energy saving is small	3,7	4,0	4,3	3,0	2,0	5,0
- compiling of cost estimate is easy (total economical view)	2,4	2,0	2,3	2,0	3,8	2,0
Images						
- concepts of low energy/passive houses are unclear	4,4	5,0	3,3	4,5	4,0	5,0
- people have wrong images of low energy/ passive houses	3,9	4,0	4,0	3,8	3,6	4,0

The strongest views of the groups are listed below:

Design:

- Lack of education/knowledge: architects/designers/consultants and contractors/manufacturers have a strong view that this is a problem.
- Too few qualified designers: developers/owners and contractors/manufacturers agree with this statement.
- Life cycle viewpoint aren't taken into account early enough: experts, developers/owners and architects/designers/consultants agree with this statement.

In addition developers/owners agree that designers don't want to develop new solutions/they use existing solutions.

Manufacturing:

- Supervision on building sites isn't adequate: this statement is agreed by experts and architects/designers/consultants.
- Lack of knowledge: developers/owners and architects/designers/consultants consider this a significant problem.
- Guidance and control of work performance isn't adequate: experts agree with this statement.

Use and maintenance:

- Control potential of building service systems is good: four of the five groups partly agree with this statement.

Quality: contractors/manufacturers consider that good indoor climate is easy to achieve.

Market: users/operation managers agree that there aren't enough incentives for private persons to build low energy/passive house.

Costs: users/operation managers agree with the statement "cost effect of the energy saving is small".

Images:

- Concepts of low energy/passive houses are unclear: experts, architects/designers/consultants and users/operation managers agree with this statement.
- People have wrong images of low energy/passive houses: this is partly agreed by each group.

3.2.2 SWOT-analysis

The SWOT-analysis of the passive dwelling is compiled. The potential internal strengths and weaknesses and the potential external opportunities and threats for the passive house dwelling are presented below and then commented.

	Potential internal Strengths		Potential internal Weaknesses
1	Good control potential of building service systems	1	Lack of education and knowledge of designers / unqualified designers
2	Good quality of indoor climate	2	Not taking life cycle viewpoint into account early enough
3	Good functioning of very low energy houses and their components	3	Lack of knowledge of contractors and manufacturers
4	Short payback period	4	Difficult use and maintenance of systems?
5	High resale value	5	Inadequate incentives for private persons to build a low energy/passive house
6	Improvement of residential comfort	6	Designers don't want to develop new solutions / they use existing
		7	Supervision on building sites and guidance and control of work performance isn't adequate
		8	Unclear concepts of low energy/passive houses
	Potential external Opportunities		Potential external Threats
1	Reduction of greenhouse gases	1	Weak demand for very low energy houses
2	Long-period cost saving	2	Rising construction costs
3	Higher profitableness when energy price rises	3	Poor adequacy/knowledge of contractors and suppliers
4	Building regulations lead on to the construction of passive houses	4	Moisture in structures
		5	High thickness of external walls is a threat to architecture

3.2.2.1 Potential internal strengths

1 - Good control potential of building service systems

The control potential of building service systems like ventilation and heating system is good. There are simpler systems in a passive house compared with a traditional house.

2 - Good quality of indoor climate

End users usually consider indoor climate of passive houses good. There is not much experience or collected long term indoor climate data from passive houses in Finland because most of the houses are just recently built. In many Finnish passive houses the indoor temperatures have been tolerable even in the summer 2010 which was especially warm.

3 - Good functioning of very low energy houses and their components

There are of course risks in the functioning of constructions but by this day the experiences have been positive. The constructions and systems have been confirmed to be well-workable.

E.g. the moisture damages of structures can be avoided using proper materials and constructions (vapour barriers, ventilation). Also new possibilities can be used, e.g. moisture barriers and condensation of moisture in ventilated floors.

4 - Short payback period

According to the different groups' opinion the payback period isn't too long. The investment cost of a passive house is 5-10 per cent higher compared with a conventional house so that the payback period is approximately six year (Enervent).

5 - High resale value

A passive house saves its resale value better than a conventional house because it has very low energy consumption and its image is good.

6 - Improvement of residential comfort

In addition to energy saving, residential comfort improves due to warm exterior surfaces and designed solar shadings.

3.2.2.2 Potential internal weaknesses

1 - Lack of education and knowledge of designers / unqualified designers

Passive house is a quite new concept in Finland. There have been built some dozens passive houses which is a very low number. Lack of qualified designers is a today's problem but when passive houses will become more common the knowledge increases too.

2 - Taking life cycle viewpoint into account early enough

Each expert group considers not taking of life cycle viewpoint into account early enough to be a problem. This is also a problem among conventional houses. Life cycle of today's new buildings is long so that decisions should be done with extra consideration by the designers.

3 - Lack of knowledge of contractors and manufacturers

Lack of knowledge of contractors is a high risk. Good designs can be destroyed in building stage. Installations of thermal insulations and vapour barriers and the tightening of the envelope should be done with extra carefulness. However, the knowledge of manufacturers is increasing when passive houses are becoming more common.

4 - Poor incentives for private persons to build a low energy/passive house

There aren't enough incentives for private persons to build a low energy/passive house. Because building regulations don't oblige to build passive or low energy houses, low life cycle costs don't seem to be adequate incentive for the most of private persons.

5 - Designers don't want to develop new solutions / they use existing

Because builders don't want to be pay for good designs, it leads the designers to use existing designs. The design of a passive house is usually more expensive than the design of a traditional house because the systems used are partly non-conventional. Generally the dimensioning of the heating system and the solutions used are different than those in conventional houses. Also the use of e.g. solar energy solar shading is quite rare in conventional houses.

6 - Supervision on building sites and guidance and control of work performance isn't adequate

Especially building developers, architects and designers consider this as big problem. The most essential quality assurance operations are listed below (Finnish association of Civil Engineers, RIL):

- air tightness measuring of building envelope
- thermographic survey to find out thermal bridges and local leakage
- measurements for inspection of operation and controls of ventilation system and heat recovery
- measurements of airing efficiency of roof and base floor in some cases to ensure building physical functioning of structures (moisture)
- measurements of indoor impurities in building if needed

8 - Unclear concepts of low energy/passive houses

Building developers, architects and designers consider the concepts used very unclear. This has a link with the lack of knowledge.

3.2.2.3 Potential external opportunities

1 - Reduction of greenhouse gases

The lower the energy consumption is the less greenhouse gas emissions are emitted. Buildings are the one key in the prevention of global warming.

2 - Long-period cost saving

Investment cost of a passive house is 5-10 per cent higher compared with a conventional house. There is a real case in which a traditional wooden single family house concept has been changed a little bit in order that the house fulfils the Finnish passive house requirements. The additional investment costs were only 5 per cent higher compared with the same house with standard solutions. Due to the low energy consumption through the whole life cycle the cost saving compared with a traditional house is remarkable.

3 - Higher profitableness when energy price rises

Rise of energy prices makes passive house even more profitable in the near future. Electricity prices have risen about 30% during last five years (Statistics Finland) and the direction is continuing.

4 - Building regulations lead on to the construction of passive houses

Because of tightened EU directives we have to create new building regulations in Finland. The building regulations force to build energy efficient houses.

3.2.2.4 Potential external threats

1 - Weak demand for very low energy houses

The weak demand may be an obstacle for building of passive houses before the building regulations are tightened.

2 - Rising construction costs

Rising construction costs are one threat for the increase of passive houses.

3 - Poor adequacy/knowledge of contractors and manufacturers

This is a real threat. According to our expert groups the lack of knowledge of contractors and manufacturers exist. In addition, supervision on building sites and guidance and control of work performance isn't adequate. Although big faults haven't been done the risk exist all the time.

4 - Moisture in structures

It has been shown by research that the moisture technical functionality of structures doesn't set limits to improve the insulation level 30-40% compared with the present level (Ministry of the Environment). The risk is mainly caused by careless construction work by contractors. There have been reported moisture and mould problems which have been due to poor design and poor working of technical systems. The real working of critical systems, such as ventilation, should be assured by proper sensors.

5 - High thickness of external walls is a threat to architecture

The thickness of external walls is approximately 50-60 cm. This creates challenges to architecture. Special solutions to windows, for example, must be done. On the other hand, thick walls are common in old masonry buildings, in which the thick walls have not been seen as a problem.

3.2.3 Summary and Conclusions

In conclusion, we can note that there are still a lot of weaknesses but also various opportunities. In the future knowledge will increase and many of today's problems can be solved. Passive houses will also become more common because of the tightening of the building regulations.

<u>The most remarkable strengths: Quality and costs</u>

- Good quality of indoor climate
- Short payback period
- High resale value
- Improvement of residential comfort e.g. by warm envelope and solar shadings

<u>The most remarkable weaknesses: Design, manufacturing, market and images</u>

- Lack of education and knowledge of designers / unqualified designers
- Lack of knowledge of contractors and manufacturers
- Supervision on building sites and guidance and control of work performance isn't adequate
- Poor incentives for private persons to build a low energy/passive house
- Unclear concepts of low energy/passive houses, which disturb consumers

<u>The most remarkable opportunities: Environment and costs</u>

- Reduction of greenhouse gases
- Long-period energy and cost savings

<u>The most remarkable threats: Manufacturing and quality</u>

- Poor adequacy/knowledge of contractors and manufacturers
- Moisture in structures

<u>Comments regarding the potential internal strengths:</u>

There is not much experience or collected long term indoor climate data from passive houses in Finland because most of the houses are just recently built. Yet, the experiences of the year

2010 are positive. According to the expert groups' view the quality of indoor climate is strength of passive houses and the payback period isn't too long. The investment cost is only 5-10 per cent higher compared with a conventional house. This makes the short payback period possible. Passive houses have a high resale value because of the very low energy consumption and a good image. Residential comfort improves due to warm building envelope and solar shadings.

Comments regarding the potential external opportunities:

The most remarkable external opportunities are friendliness to the environment and cost saving. The lower the energy consumption is the lower also the greenhouse gas emissions are. Passive houses have the opportunity to prevent global warming. The low operating costs make the low life cycle costs possible.

Comments regarding the potential internal weaknesses and suggestions how to overcome them:

- Passive house is quite a new concept in Finland so that lack of knowledge exists among the designers, contractors and manufacturers. A proposed decision is updating education level of designers and contractors.
- Construction of passive houses would need more supervision on building sites and guidance and control of work performance. Both volume and quality is needed. Updating education of the supervisors was suggested to overcome the weakness.
- Updating education of the supervisors was suggested to overcome the weakness.
- There aren't enough incentives for private persons to build a low energy/passive house. Positive marketing and familiarizing people with the cost-effective solutions are the suggested proposed decisions.
- The concepts of low energy/passive houses are considered to be unclear. Updating education could be the solution for the professionals. To the others concepts can be brought out through the newspapers or magazines, for example.

Comments regarding the potential external strengths and suggestions how to overcome them:

- Poor adequacy/knowledge of contractors and manufacturers is a real threat. A potential proposed decision is updating education as already mentioned.
- The risk of moisture in structures is mainly caused by careless construction by contractors or by poor/conventional design by designer. The high level of knowledge of design, careful construction and choosing the right materials are the suggested solutions.

3.2.4 References

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3.3 Denmark

Author: Ole Balslev-Olsen, CENERGIA

3.3.1 Perceived and real problems with low energy dwellings

To limit the energy needs for heating, all new buildings must be constructed to meet the energy requirements in the building code. The building code has just been sharpened so the previous level of low energy has been standard and a new low energy standard has been defined.

Energy needs in residential buildings includes heat for space heating and hot water, electricity for pumps, fans and control and energy for comfort cooling. Energy for other purposes as lighting, appliances, IT/computer and TV/entertainment are not covered by the building code although dwelling climate impacts mainly come from these purposes. The maximum energy needs depends on floor area as:

	One family house, 160 m²	Multifamily house (90 m² per flats)
Standard requirement	62.8 kWh/m²year	53.2 kWh/m²year
Low energy class 2015	36.2 kWh/m²year	30.5 kWh/m²year

This study deal with energy standards better than the level of low energy class 2015.

It is expected that the present low-energy standard will be standard in year 2015 and a new low energy standard will be defined (class 2020) and becomes standard in 2020. It is foreseen that the low energy class 2020 will be at the same level as the German passive house standard and similar to the very low energy standard (VLE).

Most dwellings in Denmark are heated by district heating (61 %) and then by natural gas (15 %). Only a small proportion of buildings are heated with oil or electricity. New low energy houses are often heated by heat pumps. In regions with collective heat supply system it is compulsory to be connected except low energy buildings.

In the building code calculation of energy needs the electricity use is multiplied by an energy factor of 2.5. To promote environmental friendly district heating the use of district heating is multiplied by an energy factor of 0.8 (only class 2015).

The expert group includes experts in low energy houses.

Table 3.3.1 Description of the expert group

Expert	Senior energy consultants Researcher in energy efficiency buildings
Developers/owners	Developers of standard low energy houses Developers of multi-storey buildings
Architects/engineers	Senior Architect Senior engineers Energy consultants
Manufactures	Solar heating manufacturer Low energy manufacturer Insulation material manufacturer

The following aspects were considered to be important to expert group:

- The first experience (in particular from Herfølge) shows that the first generation of very low energy houses have problems with not being able to keep the temperature comfortable during winter and suffer from overheating in summer. This has been proven during the extreme weather in 2008 onwards.
- There is still need for more demonstration buildings.
- There is need for documentation of low-energy solutions.
- Follow-ups on very low energy projects are few. It can contribute to knowledge sharing.
- Residents and developers are sceptical of the concept. They select what they know (the safe alternative). There are many myths, rumours concerning very low energy houses. Follow up on existing very low energy projects can perhaps improve the reputation.
- There is need for computer programs to design and calculations in the early design phase.
- The present design software doesn't calculate the performance of compact units with sufficient accuracy.
- Housing developing companies marketing very low energy which is false marketing because no one behaves better than standard low energy houses (BR10 low energy class 2015).
- Small innovative companies often find it difficult to market products for low energy solutions.
- It is necessary to focus on developing a wide range of low energy products.
- Estimated energy demands will never match the actual consumption. 1) Often the room temperature is more than 20 degrees. 2) The efficiency, effectiveness, etc. used in the calculations are too optimistic (not in line with reality). 3) User behaviour varies from project to project. This applies to the use of the building but also very much dealing with the passive and active technologies. Users lack knowledge about the use of very low energy buildings.

Table 3.3.2 The different groups' assessment of the degree of priority for the different problem areas, presented in ranking order (1 is highest) and average values for each group (from 1 = low degree of priority to 5 = high degree of priority)

Area of problem	Experts	Developers	Consultants	Manufacturers	All experts
Standards and regulations	3,4	4,1	3,7	3,4	3,7
Knowledge	4	4,4	4,1	3,9	4,1
Market	3,5	4,1	3,9	3,5	3,8
Instruments of control	4,3	4,5	4,1	4	4,2
Costs	4,2	4,5	4,3	4	4,3
Technical solutions	3,8	4,7	3,9	3,8	4,1
Functions	4	5	4	3,8	4,2

Table 1.3.3 The different groups' assessment of the degree of priority for the different problem areas (from 1 = low degree of priority to 5 = high degree of priority)

	Experts	Developers	Consultants	Manufactorer
Standards and regulations				
There is no clear definition of VLE beyond the basic low energy definition in the Danish Building code.	3.5	5.0	4.3	4.5
The German Passive House standard is often used in Denmark, although it is not developed for the Danish conditions.	3.3	3.5	3.7	3.0
The traditional low energy standards cover only energy for heating, hot water and a small part of electricity. The remaining electricity is not covered by the building regulation and represents the major climate impacts from the energy use in VLE.	4.0	4.5	3.5	4.5
The Danish standard requires individual regulation of room temperature and it is probably unnecessary and limited the use of compact units with air heating.	3.5	3.5	3.2	3.0
The Building Code takes into account the fuel mix in district heating supply (district heating system with a good environmental profile can give the green light for an inferior insulation of the building envelope)	3.5	4.0	4.3	2.0
Only ordinary low energy standard can be required in new land development areas. It is not possible to require VLE.	4.0	4.5	4.7	4.0
If a building is built as low energy according to the building regulation, the connection to district heating supply is not compulsory. It can have an adverse impact on sustainable development in a new developing area especially in densely populated areas. An environmental friendly collective heat supply system is deselected against an individual electric-based thermal solution (heat pump).	3.5	4.0	3.0	3.0
Developers often want low energy houses to avoid connection to collective heat supply.	2.3	4.0	3.2	3.0

	Experts	Developers	Consultants	Manufactorer
Knowledge				
The first experience (in particular from Herfølge) shows that the first generation of VLE houses have problems with not being able to keep the temperature comfortable during winter and suffer from overheating in summer. This has been proven during the extreme weather in 2008 onwards.	4.8	5.0	4.4	4.5
There is still need for more demonstration buildings.	4.3	4.0	4.0	4.0
There is need for documentation of low-energy solutions.	4.5	5.0	4.5	5.0
Follow-ups on VLE projects are few. It can contribute to knowledge sharing.	4.3	4.5	4.3	4.0
Residents and developers are sceptical of the concept. They select what they know (the safe alternative). There are many myths, rumours concerning VLE houses. Follow up on existing VLE projects can perhaps improve the reputation.	4.5	4.5	4.5	4.0
There is a great knowledge of VLE among experts in the building sector. Among the general consultants who have no practical experience in VLE, the actual knowledge in this area is incomplete.	3.8	3.5	4.2	3.0
Courses in low energy technologies are often optional in the education of consultants. That means there are consultants within the building industry who have no expertise in VLE.	3.3	4.5	4.0	3.0
Several craftsmen can perform various energy initiatives, but there is a need for greater understanding of the solutions that are used among the craftsmen.	4.0	4.5	4.2	4.0
Craftsmen are trained in conducting energy initiatives such as insulation envelope, installing mechanical ventilation with heat recovery, installation of low energy windows and low density membranes, etc. Craftsmen are not trained to conduct an overall assessment of low energy concept related to operating results and running costs.	3.8	3.5	4.3	3.5
There is need for computer programs to design and calculations in the early design phase.	3.0	4.5	3.3	3.5
The present design software doesn't calculate the performance of compact units with sufficient accuracy.	3.8	5.0	3.8	4.0
Market				
VLE is often described in technical journals and in general news. The reference is subjective and the documentation is incomplete.	2.5	4.0	3.3	3.5
Housing developing companies marketing VLE which is false marketing because no one behaves better than standard low energy houses (BR10 lowenergy class 2015).	4.0	4.5	4.2	3.5
Small innovative companies often find it difficult to market products for low energy solutions.	3.3	4.0	4.2	3.0
Municipalities often require a higher energy standard in new housing areas.	3.3	3.0	3.3	3.0
Housing is often marketing on traditional housing qualities - modern kitchen and more and larger bathrooms, extra space and location in the scenic area without public transport. It is still the traditional housing qualities which are demanded.	4.0	4.0	4.2	3.5
It is necessary to focus on developing a wide range of low energy products.	3.7	5.0	4.2	4.5

	Experts	Developers	Consultants	Manufactorer
Instruments and control				
There is no check procedure for the actual use of energy. There is no energy performance guarantee.	4.5	4.5	4.0	4.5
House owners have difficulty in assessing the building performance compared to the target.	4.3	4.5	4.3	4.5
In VLE the heating is often covered by electricity based heat pump, and the monitored energy consumption include the total electricity of the house. There is no specific monitoring of the building energy performance.	3.8	4.5	4.0	3.5
The electricity bill is paid by a payment services and the energy performance of the house is not visible for the house owner.	4.3	4.5	4.0	3.5
Estimated energy demands will never match the actual consumption. 1) Often the room temperature is more than 20 degrees. 2) The efficiency, effectiveness, etc. used in the calculations are too optimistic (not in line with reality). 3) User behaviour varies from project to project. This applies to the use of the building but also very much dealing with the passive and active technologies. Users lack knowledge about the use of VLE buildings.	4.5	4.5	4.3	4.0
Costs				
Contractors have a limited experience in building VLE and therefore increase the cost as a safety action.	4.5	4.5	4.3	4.0
There are not many who use total cost (LCC) when purchased new homes. The extra cost in VLE reduces the operating costs with the possibility to achieve a lower housing expenditure, especially if the total costs include increases in energy prises.	4.0	4.5	4.5	4.0
Lack of knowledge about what is cost effective to improve the energy system of the house.	4.0	4.5	4.2	4.0
Technical solutions				
There are too many restrictions on VLE building that restricts innovative architecture. It goes beyond the comfort of the houses and rectifier future housing market.	3.0	5.0	3.3	3.5
There is still a need for developing various energy efficient solutions such as: air tightness in prefabricated buildings assembled on site, heat pumps and geothermal heat, thermal bridges, windows, lights, PV, and optimization of buildings and installations.	4.0	5.0	4.0	4.5
There is a limited knowledge when it comes to putting together a comprehensive solution, especially when the building is connected to a collective heat supply system.	4.5	4.0	4.3	3.5
Functions				
There is too little focus on indoor air quality and comfort.	4.0	5.0	4.2	3.5
There is no control of the house comfort features.	4.0	5.0	3.8	4.0

3.3.2 SWOT-analysis

For the SWOT-analysis a very low energy house and a traditional modern house were chosen. The modern house fulfils the Danish building regulation and the very low energy house has improved energy performance compared to traditional low energy houses.

The potential internal strengths and weaknesses and the potential external opportunities and threats to the low energy dwelling e.g. very low energy houses are presented below and then commented.

Potential internal Strengths – Great knowledge on very low energy – Trained craftsmen – Low running costs – Positive impact on climate change	Potential internal Weaknesses – No definition of very low energy – Bad experience from very low energy – Sceptical to new concept – Missing design tools
Potential external Opportunities – German Passive House standard – Connections to collective heat supply systems – Improved follow-up – Positive political signals	Potential external Threats – Individual temperature control – False marketing – Environmental friendly collective heat supply system

3.3.2.1 Potential internal strengths

- There will be a great knowledge of very low energy among experts in the building sector.
- Craftsmen are trained in conducting energy initiatives such as insulation envelope, installing mechanical ventilation with heat recovery, installation of low energy windows and low density membranes, etc.
- The extra cost in very low energy reduces the operating costs with the possibility to achieve a lower housing expenditure, especially if the total costs include increases in energy prices.
- Low energy houses reduce CO2 emissions and thus have a positive impact on world climate change.

3.3.2.2 Potential internal weaknesses

- There is no clear definition of very low energy beyond the basic low energy definition in the Danish Building regulation.
- The first generation of very low energy houses have problems with not being able to keep the temperature comfortable during winter and suffer from overheating in summer.
- Residents and developers are sceptical to the new concepts. They select what they know (the safe alternative). There are many myths, rumours concerning very low energy houses. Follow up on existing very low energy projects can perhaps improve the reputation.
- The present design software doesn't calculate the performance of compact units with sufficient accuracy.

3.3.2.3 Potential external opportunities

- The German Passive House standard is often used in Denmark, although it is not developed for the Danish conditions.
- Developers often want low energy houses to avoid connection to collective heat supply.

- Follow-ups on very low energy projects are few. It can contribute to knowledge sharing.
- In general the politicians are favourably disposed towards very low energy.

3.3.2.4 Potential external threats

- The Danish standard requires individual regulation of room temperature and it is probably unnecessary and limited the use of compact units with air heating.
- Housing developing companies marketing very low energy which is false marketing because no one behaves better than standard low energy houses.
- Consideration should be given to the fuels used in district heating, so building code can accommodate less stringent requirements for insulation if the district heating based on renewable energy as surplus power from wind and biomass.

3.3.3 Summary and Conclusions

A SWOT analysis of very low energy houses compared with ordinary modern houses, resulted in:

- Potential internal strength: great knowledge on very low energy, trained craftsmen, low running costs, positive impact on climate change.
- Potential internal weaknesses: no definition of very low energy, bad experience from very low energy, sceptical to new concept, missing design tools.
- Potential external opportunities: German Passive House standard, Connections to collective heat supply systems, improved follow-up, positive political signals.
- Potential external threats: individual temperature control, false marketing, environmental friendly collective heat supply system

In Denmark there is great expertise in low energy buildings and many demonstration projects have been carried out. In general, the quality level is high among craftsmen that can be utilized in connection with an increased use of low energy housing. Further, there is a general positive Policy will towards low energy buildings.

There is currently an increasing pressure from construction industry partners on a continuing tightening of the Danish building regulation. New demonstration buildings with follow-up will help to remove scepticism about low-energy houses.

New low energy solutions are still going to be developed.

Low energy houses have been a topic in the Danish building sector for many years. In 1975 the first 0-energihus was built and since there have been several demonstration projects with low energy houses. There is therefore an extensive knowledge in this field among researchers and craftsmen have experience to perform various energy initiatives in practice. There is thus a long tradition of low energy houses and along with increased energy prices and growing climate problem it is a good starting point for the spread of low energy houses in Denmark.

Several low energy houses have been built under various names as passive house, 0-energy house, housing+, CO2 neutral, Swan label, low energy Class1/Class2015, cradle to cradle, or sustainable construction. Recently it has been shown that several low energy houses do not meet expectations and there is a gap between theory and practice. The building sector therefore call for a common standard, more demonstration projects and improved design tools for low energy houses.

The German passive house model has been marketed successfully in Denmark and it has meant that more houses and larger buildings have been built accordingly to this principle. It

has meant that the development of energy efficient construction details have been accelerated faster and politicians have often highlighted these houses. New studies have shown that the main reason for selecting low energy houses is that they are not forced to use collective supply systems.

In densely populated areas with an eco-friendly collective heat supply there is no need for low energy houses in traditional sense. In these areas it will properly have a greater impact on global climate problems to invest in more energy efficient electrical appliances in the household or perhaps spend resources on energy correct user behaviours.

3.3.4 References

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3.4 Norway

Author: Inger Andresen, SINTEF

3.4.1 Perceived and real problems with low energy dwellings

A conventional new dwelling built according to the technical regulations of 2010 is insulated with 20-25 cm mineral wool in exterior walls, 30 cm in roof and double or triple glazing with wood frame, and has a mechanical ventilation system with heat recovery. For single family dwellings, the heating system typically is direct electric heaters and electric floor heating in bathrooms, and a wood stove. For apartment blocks, there is a requirement that at least 40% of the heating energy load should be supplied by other sources than fossil fuels or grid electricity, unless proven un-economical. Annual specific energy demand is typically 135 kWh/m^2 for a single family house and 120 kWh/m^2 for apartment blocks (including lights and appliances), calculated according to the technical regulation and Norwegian standard NS 3031:2007.

A passive house dwelling is defined in Norwegian standard NS 3700:2010. The standard set requirement with respect to maximum heating energy demand (approx. 15 kWh/m^2/year), heat loss coefficient, maximum U-values and air-tightness for the envelope, and minimum efficiency of the ventilation system. It also requires that a certain amount of the heating energy load should be supplied by other sources than fossil fuels or grid electricity.

Expert group participants

The following results have been obtained from an expert group shown in the table below.

Experts	• A professor in HVAC systems • A professor in energy physics • An associate professor in intercultural studies of energy • A senior consultant at the Norwegian Energy Agency (Enova)
Developers/owners	• 3 developers/owners of passive houses
Architects/designers/consultants	• A senior associate of a large HVAC consulting company • A director of energy and building physics of a large consultant company • A senior architect at a leading architectural company
Contractors/manufacturers	• A director of energy and environment at a national association of construction companies • A chairman of a producer of solar thermal systems • A director of a small supplier of PV and wind power systems • A market director of a leading producer and supplier of facade systems • An R&D manager of a leading construction company • An R&D manager and a market director of a producer and supplier of wood stoves
Users/operation managers	• An R&D manager of a large supplier of total technical solutions and supplier of services for operation and maintenance.

The following aspects were identified to have the highest priority (in order of importance):

- Knowledge: Lack of knowledge about the potential energy and cost savings, the technical possibilities, performance issues, reliability, etc.
- Competence: Lack of competence among architects, consultants, construction companies, installers, craftsmen, and clients.
- Costs: This includes the lack of economic investment strategies that take into account societal costs and life cycle cost. The lack of risk-prone capital.
- Incentives: The lack of economic support mechanisms for R&D, pilot projects, and implementation, and little known or bureaucratic support mechanisms. The lack of incentives that are predictable and stable.
- Market: Small domestic market, different climate than the larger central-European markets.
- Technology: Lack of proven technologies in Nordic climates.
- Structural: The difficulty to introduce new products and services that are to replace well established products and services. This involves changing established user patterns and preferences, fighting traditional strong businesses, e.g. small distributed power suppliers vs. centralized power suppliers. The businesses structure within low energy buildings consists of many small businesses.
- Perceived clean energy supply: the Nordic clean energy supply system is an obstacle for innovations related to low energy buildings, because people do not feel the need to save energy when there is plenty of clean renewable energy available.

The university experts highlighted the need for structured evaluations of low energy buildings in use (user behaviour and user cultures, indoor environment, energy performance). They also

pointed to the lack of knowledge and competence in the building industry. Moreover, they stressed the need for predictable incentives and tighter regulations. Finally they emphasized the need for co-operation within the whole value chain of stakeholders in the building market (producers, contractors, users, consultants, R&D, etc., government).

The developers/owners stressed in particular the lack of competence among consultants, architects and builders, and the lack of proven (certified) technologies.

The architects/designers/consultants highlighted the lack of knowledge about integrated design processes, and lack of competent "environmental" clients. They also stressed the need for appropriate tools to support an integrated design process and whole building energy concepts.

The group contractors/manufacturers stressed the need for standardization as well as the lack of non-bureaucratic and stable/predictable incentives. Some of them also highlighted the lack of competence among installers and consultants.

The operation manager stressed the importance of being involved early in the design process. He also highlighted the need for energy performance contracts.

3.4.2 SWOT-analysis

The following is a summary of a SWOT-analysis with respect to implementing low energy dwellings in Norway.

Potential internal **S**trengths • New Standard for low energy and passive houses • Governmental incentives • Low running costs • Growing market	Potential internal **W**eaknesses • High investment cost • Low availability of proven products • Scepticism to new concepts • Low competence and knowledge
Potential external **O**pportunities • Positive political signals • Growing environmental awareness	Potential external **T**hreats • Changing political priorities • Cheap and environmental friendly energy supply

3.4.2.1 Potential internal strengths

- New Standard for low energy and passive houses: A new Norwegian Standard for low energy and passive house dwellings was introduced in April 2010.
- Governmental incentives: Both the Norwegian state housing bank (Husbanken) and the Norwegian state energy agency (Enova) have recently introduced financial incentive programs for low energy and passive houses.
- Low running costs: The low running costs of these buildings are positive for users who are afraid of increased energy prices.
- Growing market: The interest and market for low energy and passive houses is steadily growing, a few has been implemented, and several hundred dwellings are in the planning phase.

3.4.2.2 Potential internal weaknesses

- High investment cost: Investment costs are perceived as most important for most builders, and LCC analyses are seldom performed.
- Low availability of proven products: Few products are available on the domestic market, in particular with respect to energy supply systems for low energy and passive houses.
- Scepticism to new concepts: People are questioning the indoor environment, robustness, and reliability.
- Low competence and knowledge: Still lack of knowledge among consultants, builders and decision-makers.

3.4.2.3 Potential external opportunities

- Positive political signals: The government has signalled that the passive house standard will be obligatory for all new buildings from 2020.
- Growing environmental awareness: A general growing interest in green solutions among companies, and end-users.

3.4.2.4 Potential external threats

- Changing political priorities: With changing political leadership, the signalled priorities may change.
- Cheap and environmental friendly energy supply: Depending on the market development and political priorities, Norway may have environmental friendly energy supply (hydropower and wind) and low energy prices in many years to come.

3.4.3 Summary and Conclusions

A SWOT-analysis of low energy houses compared with ordinary modern houses, resulted in:

- potential internal strengths: a new standard for low energy and passive houses have been introduced, there are governmental incentives for low energy and passive houses, the passive houses have low running costs, and the market for such housing is growing
- potential internal weaknesses and barriers: high investment costs, low availability of proven solutions, scepticism to new concepts, and low competence and knowledge
- potential external opportunities: positive political signals about legislation, growing environmental awareness
- potential external threats and barriers: changing political priorities, cheap and environmentally friendly energy supply

Comments regarding the potential internal strengths:

- the new standard could be used as a useful tool to performance verification of new dwellings and pave the way for improved legislation
- the governmental incentives could spur the market development
- the low running cost could be marketed as a positive selling point
- the increased market could be used to spur the development of improved and more cost-effective products, thus reducing the investment cost

Comments regarding the potential external opportunities:

- the positive political signals could be actively used to promote a more rapid market development
- The growing environmental awareness could be used in the marketing of concepts and products

To overcome the potential internal weaknesses and barriers the following suggestions are made:

- the high investment cost could be recalculated into total LCC budget, showing the total economy of the project
- The low availability of proven solutions could be overcome by the market growth, and partly imports from other countries
- The scepticism to new concepts could be overcome by verifying products and concepts through demonstration projects and field/lab testing
- The low competence and knowledge could be overcome by information and educational actions

To overcome the potential external threats and barriers the following suggestions are made:

- the changing political priorities are not easy to deal with, but could be lessened by lobbying and information activities
- The cheap and environmentally friendly energy supply should not be an obstacle to low energy housing, but the relationship between buildings and supply should be explained and exploited in a positive way.

Overall, the main obstacles for a large scale implementation of low energy buildings seems to be related to the lack of knowledge and competence, and the lack of cost-effective and proven solutions. However, the market shows a positive development, and the political and public interest in this area is growing.

3.4.4 References

[12] NS 3031:2007. ”Beregning av bygningers energiytelse. Metode og data”. Standard Norge, Oslo.

[13] NS 3700:2010. “Kriterier for lavenergihus og passivhus – boligbygninger”. Standard Norge, Oslo

3.5 Poland

Author: Szymon Firlag, NAPE

3.5.1 Perceived and real problems with low energy dwellings

Polish market of low energy residential buildings is just started to develop. We are at the beginning of a long journey from standard to energy efficient buildings. Polish regulations make provision for two alternative ways of fulfilling energy requirements. The first method is prescriptive and consists of a list of detailed requirements for different building components. The second method has a performance character and defines permissible values of specific non-renewable primary energy use EP, expressed in kWh/(m^2year). Residential buildings designs according to regulations are consuming too much energy and are far away from very low energy standard. New multifamily or single-family buildings are equipped with natural ventilation and the U-value of the external walls should be lower than 0,3 W/m^2K. Most of the multifamily buildings are likely to be heated by radiators and the heat is supplied by a district heating system. The single-family buildings are heated mainly by radiators or floor heating and the heat is being supplied from own heat source like, gas boiler.

Unfortunately there are no official requirements for low or very low energy buildings, what causes lot of problems. The market of low energy building is developing mainly in area of single-family buildings. Such buildings are better insulated, the U-value of external walls is usually lower then 0,2 W/m^2K and are equipped with mechanical ventilation system with heat

recovery. Most of the multifamily buildings are likely to be heated by low temperature radiators or floor heating and the heat is supplied by condensing gas boiler or heat pump.

An "expert group" with representatives from developers/property owners/property managers, architects, energy consultants and auditors, manufacturers (thermal insulation), users and auditors discussed and agreed upon which problems should be discussed when dealing with future low energy dwellings (Firląg 2010).

Table 3.5.1. Expert group participants

Experts	• Former employee of the Ministry of Infrastructure, in department of buildings • A doctor at Technical University Warszawa, working at Faculty of Environmental Engineering
Developers/owners	• Owner and user of very low energy single family building
Architects/designers/consultants	• A senior architect with experience in sustainable planning, an R&D manager
Energy consultants/auditors	• A doctor in buildings physics, eco-building • A senior energy auditor and adviser
Contractors/manufacturers	• A regional director of company producing insulation materials
Editor	• Editor of technical magazine "Energia i Budynek" devoted to energy conservation in buildings
Users/operation managers	• An property manager of multi-family building and office building

The following aspects were considered to be important according to expert group (see table 3.5.1):

- State policy: the is no pro-energy efficiency policy of the Polish government or support system, the new regulations are not promoting energy savings in buildings – mild regulations,
- Architecture, design: lack of client needs for analysis and optimization of the design in regard to energy efficiency in the early stage, higher cost of the design and longer time of designing,
- Market: the banks are not interested in financing low energy buildings and people are looking for cheap not necessarily energy efficient flats and homes, it does not pay developers to build in energy efficient way
- Construction stage: small professionalism, technical knowledge of the contractors, they have almost no experience and are not opened for new solutions,
- Society: lack of public awareness for the need of energy saving, tastes that are not conducive to energy-saving solutions, such as love for balconies,
- Building materials: lack of specialists in warehouses, consultants from commercial companies which can help in choosing the best solution – the decision of building a low energy house is being taken sometimes very late, that is on the stage of construction, lack of quality control of construction materials,
- Costs: the energy efficient solutions are more expensive than standard ones and the payback time of such additional invitations is quite long, the savings resulting from the applied energy efficient solutions are not immediate,

- Operation: users do not know that well-designed and constructed low energy building provides a better quality of the indoor environment; most of the users have habits, such as opening windows, which can cause additional energy losses in building with mechanical ventilation.

The problems mentioned above can be perceived as actual problems. For some of them solutions might already exist, which for some reasons are not used, e.g. due to lack of knowledge or information. But the bigger problem which is lack of pro-energy efficiency policy must be solved on the government level. The experts divided into different groups decided which of the problems are most important and should be solved in the first order (see table 3.5.2).

Table 3.5.2. The assessment of the expert group participants (divided in subgroups) of the degree of priority for the different problem areas, presented in ranking order (1 is highest) and average values for each group (from 1 = low degree of priority to 5 = high degree of priority)

Area of problem	Experts, energy consultants, editors	Develop-ers/owners, property managers	Architects	Manufactur-ers
State policy	**4,8 (1)**	**4,7 (1)**	**5,0 (1)**	**5 (1)**
Architecture, design	3,4 (3)	3,0 (5)	**5,0 (1)**	**5 (1)**
Market	3,6 (2)	4,3 (2)	**5,0 (1)**	4 (2)
Construction stage	3,2 (4)	3,0 (5)	1,0 (4)	3 (3)
Society	3,2 (4)	3,7 (4)	4,0 (2)	4 (2)
Building materials	2,2 (5)	3,0 (5)	1,0 (4)	3 (3)
Costs	3,6 (2)	4,0 (3)	1,0 (4)	4 (2)
Operation, exploitation	3,4 (3)	4,0 (3)	2,0 (3)	3 (3)

The problem areas were supplemented by the sub-areas and keywords, expressed in words and sentences. After that the interview guide was created and assessed by the discussion participants. The weighting (ranking) which was necessary in order to get the common opinion of the expert group as to which issues are most important respectively least important among these discussions in the workshops. The results of the ranking are shown in the table 3.5.3.

Table 3.5.3. The different groups' assessment of the degree of priority for the different problem sub-areas and average values for each group (from 1 = low degree of priority to 5 = high degree of priority)

Area of problem	Experts, energy consultants, editors	Develop-ers/owners, property managers	Architects	Manufactur-ers
State policy				
- lack of appropriate regulations to identify which building is low or very low energy building - no official standards	4,2	4,3	1,0	5,0
- lack of subsidies, support programs, state aid	4,0	4,0	1,0	4,0
- lack of preferential loan	3,2	3,7	1,0	2,0
- lack of deliberate government policy which creates awareness of the people, lack of pro-efficiency policy	3,6	4,7	1,0	5,0
- local governments do not want to finance energy-efficient solutions	2,4	4,0	1,0	4,0
- defective energy certification system	4,2	4,3	5,0	5,0
- subsidies for heating, instead of saving	2,8	4,7	4,0	5,0
- lack of effective control, a small criminal responsibility e.g. for lack of energy certificate	3,0	3,7	1,0	4,0
Architecture, design				
- higher cost of the design	2,6	2,7	5,0	4,0
- long design time	2,2	1,7	1,0	3,0
- long process of obtaining a building permit	2,2	2,7	3,0	3,0
- make customer aware of low energy buildings	3,6	4,3	1,0	4,0
- no ready-made, verified house designs	2,8	4,3	1,0	5,0
- decision on low energy building taken too late - during the construction process	4,2	3,7	5,0	4,0
Market				
- too cheap energy	2,6	3,0	2,0	3,0
- lack of support from banks	2,6	4,7	5,0	5,0
- marketing rules	2,6	3,7	4,0	4,0
- housing hunger, undermine demand-supply relationship	3,8	3,0	5,0	5,0
- high demand for cheap homes	3,8	4,0	4,0	4,0
- customers looking for opportunity	3,4	2,3	5,0	3,0

- it does not pay developers to build in energy efficient way	4,6	3,7	5,0	5,0
Construction stage				
- inadequate professionalism and technical knowledge of the contractors	3,8	3,7	1,0	3,0
- multifamily buildings - construction tradition, such as the use of natural ventilation and high temperature heat sources do not favorable low energy solutions	3,8	3,3	1,0	4,0
- contractors have almost now experience and are not opened for new solutions	3,4	3,7	1,0	2,0
- lack of professional supervision	4,0	3,7	5,0	4,0
Society				
- lack of awareness	4,2	4,3	5,0	4,0
- tastes shaped by the popular magazine that are not conducive to energy-saving solutions, such as love for balconies	3,4	2,7	5,0	3,0
- low ecological awareness - particularly about the need of energy saving	2,4	4,0	1,0	4,0
Building materials				
- no ready-made system solutions - unavailability of appropriate materials	2,0	4,0	1,0	3,0
- lack of specialists in warehouses, consultants from commercial companies	2,4	3,7	1,0	5,0
- product information provided mainly by traders who want to sell their products	3,6	3,0	3,0	4,0
- low quality of building materials	2,6	3,3	1,0	4,0
- lack of quality control of construction materials	2,4	4,0	5,0	4,0
Costs				
- high design costs and long payback times	3,6	4,0	1,0	4,0
- the savings resulting from the applied energy efficient solutions are not immediate,	3,4	4,7	5,0	5,0
in order to reduce cost of heating cheap sources of energy are selected - coal solves the problem	3,8	3,7	1,0	4,0
Operation, exploitation				
- heating costs too low compared with other costs associated with the operation of buildings	2,4	3,0	1,0	3,0
- the actual consumers do not pay for	2,8	3,0	5,0	3,0

energy they used, because of flat fees				
- user requirements other than optimum conditions for technical system operations	2,8	1,7	5,0	3,0
- systems must be serviced and operated in an appropriate way which is not always liked by users	3,4	2,7	2,0	3,0
- users habits, such as opening windows	4,4	3,3	5,0	4,0
- users do not know that low energy building provides a better quality of indoor environment	3,8	4,0	5,0	4,0

The experts, energy consultants and auditors, editors consider that the main problems exist in the area of

- state policy: “lack of appropriate regulations to identify which building is low or very low energy building - no official standards”, “defective energy certification system”,
- architecture, design: “decision on low energy building taken too late”,
- market: “it does not pay developers to build in energy efficient way”,
- society: ”lack of awareness”,
- operation, exploitation: “users habits, such as opening windows”.

Developers, owners, property managers consider that the main problems exist in the area of

- state policy: “lack of appropriate regulations to identify which building is low or very low energy building - no official standards”, “lack of deliberate government policy which creates awareness of the people, lack of pro-efficiency policy”, “defective energy certification system”, “subsidies for heating, instead of saving”,
- architecture, design: “make customer aware of low energy buildings”, “no ready-made, verified house designs”,
- market: “lack of support from banks”,
- society: ”lack of awareness”,
- costs: “the savings resulting from the applied energy efficient solutions are not immediate”.

Architects consider that the main problems exist in the area of

- state policy: “defective energy certification system”,
- architecture, design: “higher cost of the design”, “decision on low energy building taken too late”,
- market: “lack of support from banks”, “housing hunger, undermine demand-supply relationship”, “customers looking for opportunity”, “it does not pay developers to build in energy efficient way”,
- construction stage: “lack of professional supervision”,
- society: “lack of awareness”, “tastes shaped by the popular magazine that are not conducive to energy-saving solutions, such as love for balconies”,
- building materials: “lack of quality control of construction materials”,

- costs: “the savings resulting from the applied energy efficient solutions are not immediate”,
- operation, exploitation: “the actual consumers do not pay for energy they used, because of flat fees”, “user requirements other than optimum conditions for technical system operations”, “users habits, such as opening windows”, “users do not know that low energy building provides a better quality of indoor environment”.

Manufacturers consider that the main problems exist in the area of

- state policy: “lack of appropriate regulations to identify which building is low or very low energy building - no official standards”, “lack of deliberate government policy which creates awareness of the people, lack of pro-efficiency policy”, “defective energy certification system”, “subsidies for heating, instead of saving”,
- architecture, design: “no ready-made, verified house designs”,
- market: “lack of support from banks”, “housing hunger, undermine demand-supply relationship”, “it does not pay developers to build in energy efficient way”,
- building materials: “lack of specialists in warehouses, consultants from commercial companies”,
- costs: “the savings resulting from the applied energy efficient solutions are not immediate”,

In conclusion, most groups agree that the biggest problems are in the area of problems is the state policy.

3.5.2 SWOT-analysis

For the SWOT-analysis a single family passive house (Firląg 2007). and a traditional modern house had to be chosen. The reference passive house fulfils the PHI specifications for a passive standard.

The potential internal strengths and weaknesses and the potential external opportunities and threats for the low energy dwelling e.g. a passive house dwelling are presented below and then commented.

	Potential internal Strengths		Potential internal Weaknesses
1	Operation, exploitation - low energy consumption	1	Operation, exploitation - users habits, such as opening windows
2	Operation, exploitation - high quality of internal environment	2	Architecture, design - make customer aware of low energy buildings
3	Cost - low explanation costs	3	Costs - the savings resulting from the applied energy efficient solutions are not immediate
4	Low emission of GHG	4	Architecture, design - no ready-made, verified house designs
5	Architecture, design - solar architecture	5	Architecture, design - decision on low energy building taken too late
		6	Architecture, design - higher cost of the design

		7	Operation, exploitation - user requirements other than optimum conditions for technical system operations
		8	Operation, exploitation - users do not know that low energy building provides a better quality of internal environment
	Potential external Opportunities		Potential external Threats
1	Market – increase of energy prices	1	State policy - lack of appropriate regulations to identify which building is low or very low energy building - no official standards
2	State policy – higher requirements in regard to energy efficiency	2	State policy - lack of deliberate government policy which creates awareness of the people, lack of pro-efficiency policy
3	Market – low energy house is trendy	3	State policy - defective energy certification system
4	Building materials – lower prices of high quality materials	4	State policy - subsidies for heating, instead of saving
		5	Market - it does not pay for developers to build in energy efficient way
		6	Market - lack of support from banks
		7	Market - housing hunger, undermine demand-supply relationship
		8	Market - customers looking for opportunity
		9	Society - lack of awareness
		10	Society - tastes shaped by the popular magazine that are not conducive to energy-saving solutions, such as love for balconies
		11	Building materials - lack of quality control of construction materials
		12	Building materials - lack of specialists in warehouses, consultants from commercial companies

Comments

3.5.2.1 Potential internal strengths

1 - Operation, exploitation - low energy consumption

Low energy buildings are consuming much less energy for heating, preparation of DHW. The energy is also being used in more efficient way – lower conversion or transport losses, and low temperature heating sources can be used.

2 - Operation, exploitation - high quality of internal environment

Because of higher quality of thermal insulation, better windows and lack of thermal bridges we have higher temperature of internal surfaces. It has a positive influence on thermal comfort. Mechanical ventilation ensures better air exchange and low content of pollutants in internal air.

3 - Cost - low explanation costs

Lower energy consumption causes that expiation costs of low energy building are lower than in standard building. It is very important because of constant increase of energy prices.

4 - Operation, exploitation - Low emission of GHG

Lower energy consumption causes that GHG emission of low energy building is lower than in standard building. It is very important because buildings are responsible for about 40 % o total energy consumption. Promotion of low energy buildings is an element of fight against the greenhouse effect.

5 - Architecture, design - solar architecture

Designs of low energy buildings are using usually elements of solar architecture e.g. most of the windows are oriented of south side and internal zoning. These features are making low energy buildings more attractive.

3.5.2.2 Potential internal weaknesses

1- Operation, exploitation - users habits, such as opening windows

Users may not be ready to live in low energy buildings. Some of their habits, such as opening windows can cause additional heat losses and disrupt the work of mechanical ventilation. In result energy consumption of the building can be much higher then calculated.

2 - Architecture, design - make customer aware of low energy buildings

Customers very often do not know what a low energy building is, and how it differs from a standard one.

3 - Costs - the savings resulting from the applied energy efficient solutions are not immediate

Achievement of low energy standard requires an additional investment for thicker insulation, better windows, mechanical ventilation with heat recovery and high efficient heat source. Unfortunately SPBT (Simple Payback Time) of such investments is usually longer then ten years.

4 - Architecture, design - no ready-made, verified house designs

It is very difficult to make a low energy building from ready-made designs which are very popular on the market. A the same time it is possible to by ready-made design of low energy building but the quality is sometimes poor and the design is not adapted to local conditions.

5 - Architecture, design - decision on low energy building taken too late

Investors are taking the decision on low energy building very often too late, that is after obtaining a building permit or even after starting the construction. In such situation it is very

difficult to change the design, add additional insulation or find the place for mechanical ventilation system.

6 - Architecture, design - higher cost of the design

Making a good, individual design of low energy buildings takes much longer and costs higher than a standard one.

7 - Operation, exploitation - user requirements other than optimum conditions for technical system operations

Very often in one building we have two heating systems – radiators and floor heating. Even low temperature radiators require much higher temperature of supply water than floor heating. This situation causes that heat sources like heat pumps or condensing boilers are not working as effectively as they could.

8 - Operation, exploitation - users do not know that low energy building provides a better quality of internal environment

Only some of the people know that properly design and constructed low energy building provides better quality of internal environment than standard one. This advantage is not being used in promotion of low energy building.

3.5.2.3 Potential external opportunities

1 - Building materials – lower prices of high quality materials

Continuous development of technology causes that new material and products are available on the market. They have usually better thermal properties and higher efficiency, e.g. windows. New technologies are of course very expensive but after couple of years they are becoming cheaper and becoming standard solution.

2 - Market – low energy house is trendy

Living and having a low energy house can be trendy. Some of the investors want to be distinguished from others and boast about their house. Having a low energy house is a good way of achieving this goal.

3 - State policy – higher requirements in regard to energy efficiency

On 19 May 2010, a recast of the Energy Performance of Buildings Directive was adopted by the European Parliament and the Council of the European Union in order to strengthen the energy performance requirements and to clarify and streamline some of the provisions from the 2002 Directive it replaces. According to the recast from 31 December 2020 new buildings in the EU will have to consume 'nearly zero' energy and the energy will be 'to a very large extent' from renewable sources. Public authorities that own or occupy a new building should set an example by building, buying or renting such 'nearly zero energy building' as of 31 December 2018. In this situation requirements in regard to energy efficiency should be change also in Poland.

4 - Market – increase of energy prices

It is certain that energy prices will increase in the future. We only do not know how big the average increases will be. Building a low energy house is a very good way of prepare for future changes.

3.5.2.4 Potential external threats

1 - State policy - lack of appropriate regulations to identify which building is low or very low energy building - no official standards

Unfortunately polish regulations specify the requirements for energy efficiency only in regard to standard buildings. There are no official requirements for low, very low or passive buildings. This situation causes that nobody knows what exactly means a low energy building and how it differs from a standard one. Because there are no official standards a house only with solar collectors can be called a low energy house.

2 - State policy - lack of deliberate government policy which creates awareness of the people, lack of pro-efficiency policy

Government policy does not lead to increase of energy efficiency in buildings or encouraged to save energy. There are no programs of promoting low energy buildings, subsidies or preferential credits. The government is not interested in developing this kind of market or raising the awareness of the people. This happens although membership in EU and international obligations.

3 - State policy - defective energy certification system

As a result of EPBD directive system of energy certification was introduced in Poland. The system does not work properly and have almost no influence on building market. Since there are no energy classes (most of the UE countries have them) it is very difficult to find if the building uses a lot of energy or a little energy. The energy certificate is not being verified and can be made by a person which was included in building process. In the result there is no relation between result visible on the certificate and the price of the real estate.

4 - State policy - subsidies for heating, instead of saving

In some situation there are subsidies for covering high heating cost instead of subsidies for modernization of the building.

5 - Market - it does not pay for developers to build in an energy efficient way

Developers want to achieve the highest profit possible. All additional investments do not pay because people are looking for cheap flats and there is almost no connection between energy efficiency and the prices. That is way developers are constructing buildings which are only fulfilling the minimum requirements.

6 - Market - lack of support from banks

There are no preferential credits for people how wants to build a low energy house. The banks do not see that lower operation costs of the house allow to pay higher loan instalment.

7 - Market - housing hunger, undermine demand-supply relationship

In Poland there are not enough flats and houses on the market. In regard to other EU countries more people are living on smaller space. That is why it was passable to sell almost “everything” what had for walls. The energy consumption is not important.

8 - Market - customers looking for opportunity

Nowadays customers are looking mainly for cheap flat or houses. After the building boom there are many flats or houses which can be buying occasionally. Unfortunately they usually have low quality and will be problematic to explain.

9 - Society - lack of awareness

Only 10 – 20 % o people know what exactly a low energy building is. Probably even less know what mechanical ventilation with heat recovery is and how to use it. For a majority low energy building is a house with heat pump and solar collectors.

10 - Society - tastes shaped by the popular magazines that are not conducive to energy-saving solutions, such as love for balconies

Typical houses in Poland have rather complicated shape, pitched roofs with dormers and balconies. Such solutions are not conducive to energy-saving e.g. a lot of thermal bridges and making the construction more complicated. This in turn affects the cost of building and causes that the money is not spent effectively,

11 - Building materials - lack of quality control of construction materials

In some areas there is no quality control of construction materials e.g. insulation materials. In a consequence real thermal proprieties of the material can be much worse then declared. Use of such material can cause that design U-vales of walls, roofs, slabs will not be achieved.

12 - Building materials - lack of specialists in warehouses, consultants from commercial companies

Decision of building a low energy house is being taken very often very late. The investor does not know what to do in such situation and is looking for a help in warehouses, shops, storehouse. Unfortunately knowledge of people working there is not much and they can not help the clients. In some situations the product information is provided mainly by traders who want to sell their products.

3.5.3 Summary and Conclusions

A SWOT-analysis of low energy houses compared with ordinary modern houses, resulted in:

- potential internal strengths are in areas: operation, exploitation, cost, architecture, design
- potential internal weaknesses are in areas: operation, exploitation, cost, architecture, design
- potential external opportunities are in areas: building materials, state policy, market
- potential external threats are in areas: building materials, society, market, state policy

Comments regarding the potential internal strengths:

- operation and exploitation: low energy buildings in regard to standard consume less energy and are more environment friendly; at the same time they provide high quality of indoor environment what should be highlighted,
- cost: one of the biggest advantages of low energy buildings are lower operating costs,
- architecture, design: thanks to detailed design low energy buildings have better quality and attractive architecture.

Comments regarding the potential external opportunities:

- building materials: because of larger penetration of the market and higher sale the high quality materials and products for low energy buildings will become cheaper,
- state policy: as a result of EPBD recast the requirements in regard to energy efficiency will be probably increased,
- market: market trends and increase of energy prices can caused raised popularity of low energy buildings.

To overcome the areas of potential internal weaknesses the following suggestions are made:

- operation and exploitation: we should inform the users about the advantages of low energy buildings e.g. better indoor environment, and teach them how to use the house or flat, this education should take place not only on national level but it also should be also a task of an architect or energy consultant,
- cost: thanks to optimization of the design and construction solution the total cost of a low energy building can be only slightly more expensive for a standard one, we should analyse whole construction cost and not only parts of them, what's more higher costs should be connected with better quality and higher standard of living,

- architecture, design: decision of building a low energy building should be taken as early as possible - architect's role is crucial, more expensive, individual design enables better adaptation to the location of the building and can reduce construction costs, ready-made design should be always verified by an architect or an energy expert and adopted to local conditions.

To overcome the areas potential external threats the following suggestions are made:

- State policy: we should try to change the state policy, it is not easy but we can try to start with implementation of official standards for low energy buildings, there should be government programs of promoting low energy buildings, subsidies or preferential loans, the system of energy certification should be reviewed and modified by introducing e.g. energy classes of buildings, more money should be spend on thermo-modernization program,
- Market: the regulations regarding minimal requirements for energy efficiency of the new buildings should be tightened, we should encourage banks to credit low energy buildings with better conditions, we should define what is the best energy standard in Polish conditions and make it also cost-efficient, new energy certification system should be more legible (energy classes),
- Society: we should raise the ecological awareness of people, this applies in particular to need of energy saving, part of new eco-style of living should be a low energy building,
- Building materials: there should be more restrictive regulations regarding quality control of construction materials, there should be some education programs form sales managers, traders.

Polish market of low energy residential buildings is just started to develop. We are at the beginning of a long journey from standard to energy efficient buildings. If we want to succeed we must try to overcome the barriers that inhibit the development of low energy buildings. One of the biggest barriers is lack of pro-efficiency state policy.

3.5.4 References

[14] Firląg, Sz., 2010. PDS study with expert groups on low energy houses in Ponad. Working document, NAPE, Warszawa.

[15] Firląg, Sz., 2007. Pierwszy certyfikowany dom pasywny w Polsce, Energia i Budynek nr 5/2007.

3.6 Latvia

Author: Agris Kamenders, RTU

3.6.1 Perceived and real problems with low energy dwellings

It would be fair to say that there are no more than 5 buildings in Latvia, which have been built with low energy consumption in mind.

Latvian building code that regulates energy efficiency of new and refurbished buildings is not promoting the idea of low energy buildings. Building that is built according to Latvian building code consumes around 70 to 120 kWh/m^2 year for space heating.

There is no official definition on low energy buildings in Latvia. There have been no governmental incentives of promoting low energy buildings. However new governmental program for low energy buildings from Ministry of Environment is on the way. Budget of support is about 10 million EUR and support for one project is from 55% to 80% of the additional costs what is needed to reach low energy building standard. This enables to forecast

an increase in share of low energy buildings in Latvia in the next two years. Specifically in this program very low energy building are gathered into three different categories: under 15 kWh/m^2 year, from 15 to 25 kWh/m^2 year, from 25 to 35 kWh/m^2 year.

Expert group participants

The following results have been obtained from an expert group shown in the table below.

Developers/owners	• Project manager from ESCO who invest in residential buildings
Architects	• Architect from one of the most well-known architect's office in Latvia • Architect, low energy building designer and members of Latvia passive house association
Energy consultant	• Experienced consultant from engineering consulting company • Latvian energy auditor association representative
Manufacturer	• Consultant and salesman of air handling units (Paul) and pro clima products.
Contractors	• Technical manager of building contractor and property developer
Users/operation managers	• Representative from Association of Management and Administration of Latvian Housing
Authority and health organisation	• Professor from institute of Energy system and environment
Policymaker	• Deputy State secretary of Environment from Ministry of the environment. • Representative from Ministry of environment

The main perceived and real problems with low energy buildings are:

- Higher investment costs and more time for design;
- It is very hard to reach low energy standard for single family houses in Latvian climate;
- At the moment relative cheap energy sources available (wood logs) and it is cheaper to pay for space heating than to build low energy buildings;
- Quality of construction work is often low to build low energy buildings, lack of expertise and work supervision;
- There are very few best practice samples for low energy buildings;
- In average knowledge of architects, energy auditors and construction workers is too low for building low energy buildings;
- Average Latvian does not know what is low energy building;
- Perception of average inhabitant of building - if it is warm in my building then there is no need of insulation. Lack of mental link of room temperature and comfort to energy bill

3.6.2 SWOT-analysis

Potential internal **S**trengths	Potential internal **W**eaknesses
• Better comfort with lower operation costs; • Higher quality of materials and technologies used; • Good potential to increase of fully cover heat consumption with RES; • Lower risks of condensation in building envelope; • Professional organizations and individuals tend to be open to new information due to a down-turn in the building industry. • New engineering and architect networks with similar goals emerge.	• Higher investment costs • Compact forms, specific orientation and design principles • Mechanical ventilation system is needed • It is technically challenging to reach very low energy building requirements for single family houses in Latvian climate • Opinion that in Latvian climate it is not possible to build low energy buildings • Lack of knowledge's how to build and reach necessarily quality – airtightness, thermal bridges free construction details, HVAC, etc. • Due to lack of knowledge, some pilot projects may fail and result in negative feedback • Lack of good and useful materials for low energy buildings in local market (windows, compact ventilation units, doors etc.) • Operating costs usually are not considered when building a house
Potential external **O**pportunities	Potential external **T**hreats
• Growing interest in low energy and "green" buildings • Building market demand on more quality in building industry; • Possible co-financing from Ministry of Environment for low energy buildings (International Green Investment Scheme) • New technologies (HVAC, windows, doors etc.) and better standardize solutions for low energy buildings • Increase in gas and electricity prices is forecasted • Changes in Latvian building code on building energy performance are under consideration • Public procurement procedures can be improved with the application of low-energy and sustainability criteria such as the Green Label Purchase principles. • Activity in construction market is low	• No governmental support • Big construction companies against low energy buildings. Building monopoly • Offers with lowest price win in public procurement • No specialized local training and education possibilities for engineers and architects; • Many buildings are heated with help of biomass, which is quite cheap • Building market decline. There is no market demand and consumer understanding about low energy buildings (the rich build big villas, where the look of building is the only issue, and the poor do not build anything (or the cheapest possible option)) • Small market of new-built residential buildings, therefore any changes in types of building being built are

and market participants have more time for learning.	slower • Producers of building materials promote their materials saying that the thickness of it is big enough to go without heat insulation

3.6.2.1 Potential internal strengths

- Better comfort with lower operation costs

In pasts several years due big construction boom many buildings were built in a poor quality. Indoor comfort and operation costs are becoming increasingly important in Latvia. More and more people know that low energy buildings can provide high quality indoor climate with lower operation costs. However lack of information on the subject is still widespread.

- Higher quality of materials and technologies used

To reach low energy building performance in Latvia careful design and very good building materials should be used.

- Good potential to increase of fully cover heat consumption with RES

Renewable energy use in buildings is very important. In buildings with high energy consumption, renewable energy source can cover only part of the energy consumption compare to low energy buildings.

- Lower risks of condensation in building envelope

Thermal bridge free construction minimize condensation risks in envelope also ensure that inner walls surface will not have low temperature witch also dramatically reduce mould problems.

- Professional organizations and individuals tend to be open to new information due to a down-turn in the building industry[1]

During big construction boom the current business as usual model ensure a high returns and it was no time for innovation and no time for developing new strategies. But now new solution and offers from construction sector is needed also increasingly demand good quality

- New engineering and architect networks with similar goals emerge.

In past two years in Latvia new engineering and architect networks with similar goals emerge like Passive house Latvia, Latvia association of energy auditors, Latvian energy efficiency association and Green houses.

3.6.2.2 Potential internal weaknesses

- Higher investment costs

Costs of erecting low energy buildings are higher than for buildings that are built according to building code.

- Compact forms, specific orientation and design principles

Low energy buildings have to be built according to specific design principles. These principles collide with existing design principles where buildings are built with difficult shapes (many corners, edges, balconies and other building solutions, which enhance thermal bridges and decrease the compactness of building).

- Mechanical ventilation system is needed

Need for mechanical ventilation creates need for new technologies that till now are not widely used in Latvia. Also a need for highly trained and experienced ventilation engineers is created.

- It is technically challenging to reach very low energy building requirements for single family houses in Latvian climate

Latvia is situated in the North-East of Europe. The winters are colder than in the central part of Europe where the low energy building market is more developed and where the definition of low energy buildings is well known.

- Opinion that in Latvian climate it is not possible to build low energy buildings

There are many so called experts, which are saying that it is not possible to build low energy buildings in Latvian cold climate. They agree that it is possible in Germany but Latvian climate is more severe than in Germany. These expert "prove" this fact by showing energy consumption data of existing buildings, which is about 10 times the low energy building energy consumption.

- Lack of knowledge's how to build and reach necessarily quality – airtightness, thermal bridges free construction details, HVAC, etc.

The number of trained architects, building engineers, HVAC professionals may not be sufficient to keep up with demand.

- Due to lack of knowledge, some pilot projects may fail and result in negative feedback

Existing low energy building stock in Latvia is very small. The lack of knowledge in building low energy buildings can result in poor construction work quality. The resulting negative feedback can significantly decrease the overall growth of low energy building market.

- Lack of good and useful materials for low energy buildings in local market (windows, compact ventilation units, doors etc.)

The local building material market mainly consists of products, which barely pass the building code requirements. This is a result of them being cheaper than the better materials needed for building low energy houses.

- Operating costs usually are not considered when building a house

Only financial aspect considered while choosing what building to build is the construction costs. Operational costs are not taken into account and this makes low energy buildings not attractive to consumers.

3.6.2.3 Potential external opportunities

- Growing interest in low energy and "green" buildings

More and more customers require higher quality, environmentally-friendly and healthy buildings. EU common goals are to reduce CO_2 emissions and promote energy from RES, low energy buildings is very important and could contribute a lot to reach these goals.

- Building market demand on more quality in building industry

In the past few years many building of very poor quality have been built. Building owners have a lot of problems with low indoor quality and height payment due to high energy consumptions.

- Possible co-financing from Ministry of Environment for low energy buildings (International Green Investment Scheme)

New financing mechanisms will be available for low energy buildings and we can predict that in the foreseeable future new low energy buildings will be build.

- New technologies (HVAC, windows, doors etc.) and better standardize solutions for low energy buildings

Local market demands more better materials and solutions what is needed for low energy buildings. More and more specialized solutions and components are available in market.

- Increase in gas and electricity prices is forecasted

Energy becomes more expensive every year and at the moment there is no reason to believe that energy will be cheaper in foreseen future.

- Changes in Latvian building code on building energy performance are under consideration

Building code should be revised at least one time in five years and currently changes in Latvian building code on building energy performance are under consideration.

- Public procurement procedures can be improved with the application of low-energy criteria such as the Green Label Purchase principles

In public procurement lowest price is the most important criteria and very often the quality of work is lost. Green Label Purchase principles allow the introduction of higher quality requirements.

- Activity in construction market is low and market participants have more time for learning.

While the activity in construction market is low market participants have more time for learning and more time to find new market niches.

3.6.2.4 Potential external threats

- No governmental support

Public bodies do not have the appropriate expertise to evaluate better building standards although they tend to have the final word over what professional energy and building experts can and cannot do. Municipalities and state bodies are not experienced in dealing with sustainable procurement procedures such as the Green Label Purchase standard – the lowest price principle is still widely used. Information about sustainable building legislation is often sparse and unclear. Existing energy efficiency standards in Latvian building code are not attractive for low energy building. Public bodies do not coordinate activities in the sustainable building field and there are often unnecessary duplications such as with development plans, while, at the same time, state support for low energy building is lacking. Many small NGOs act with similar goals, but have access to limited resources. [1]

- Big construction companies against low energy buildings. Building monopoly

It is more convenient for construction companies to build low quality buildings without any requirements from clients. Clients who want to build low energy buildings know that the construction work quality is essential, which is not the case with regular buildings.

- Offers with lowest price win in public procurement

Very often the only criteria in public procurement, is the lowest price. In case of new buildings it means that low energy buildings are losing to regular buildings.

- No specialized local training and education possibilities for engineers and architects;

The quality of education is quite low. Often studies are based on old books and training materials. This results in "old knowledge" for new engineers and architects.

- Many buildings are heated with help of biomass, which is quite cheap

Many buildings are heated with such cheap and widely available fuels like biomass. If the biomass boiler is working properly then the costs for space heating are quit low. Biomass boilers also are cheap. This makes low energy buildings less attractive because inhabitants are interested in low payments and not in low energy consumption. For many households (mainly situated outside cities) biomass in form of wood logs is available for free.

- Building market decline. There is no market demand and consumer understanding about low energy buildings (the rich build big villas, where the look of building is the only issue, and the poor do not build anything (or the cheapest possible option))

There is very small middle-class in Latvia. There are people with high income and the main part is the low income society. The high income part of society is interested to build their buildings bigger, better looking, more expensive (because the building you live in shows your ranking in society). The low income part of society can't afford to invest more money in building their houses and are forced to choose the cheapest option, which is to build buildings that barely comply with the building code or even do not comply with the building code.

- Small market of new-built residential buildings, therefore any changes in types of building being built are slower

Market of new-built buildings is quite small. Therefore the changes in building market are taking longer. New-built single family houses mainly are concentrated in small communities around the big cities and are usually built by one company according to one architectural design. New-built apartment buildings are more scattered and are found in the biggest cities. The last economic crisis (still on-going) has practically stopped the new-built building market.

- Producers of building materials promote their materials saying that the thickness of it is big enough to go without heat insulation

Producers of such materials as aerated concrete are promoting their material by saying that no additional heat insulation is needed and this is a good way how to save money during construction process. Sadly Latvian building code has such low requirements that producers of building materials are not lying.

3.6.3 Summary and Conclusions

There is lack of knowledge and experience between professionals about low energy buildings. How to reach necessary quality in construction site what is needed for low energy buildings is crucial question. Only few low energy buildings have been built in Latvia and it is not enough to create necessary experience and skills between building professionals. At the moment there is lack of HVAC engineers who are ready to support low energy buildings idea. Energy prices are still relatively low and low energy building economic benefits are hardly foreseen.

However new professional organizations like Passive house Latvia has been emerged with supports low energy building idea. Very soon support from ministry of environment is expected and in near two years new low energy buildings will be built. Hopefully these projects will allow gaining new experiences and knowledge what is needed to support low energy idea. Client demands for better quality and better indoor comfort requires organizations to offer better solutions and higher quality.

A SWOT-analysis of low energy houses compared with ordinary modern houses, resulted in:

- potential internal strengths: better comfort with lower operation costs, higher quality of materials and technologies used, good potential to increase of fully cover heat consumption with RES, lower risks of condensation in building envelope, professional organizations and individuals tend to be open to new information due to a down-turn in the building industry, new engineering and architect networks with similar goals emerge.
- potential internal weaknesses and barriers: higher investment costs, mechanical ventilation system is needed, it is technically challenging to reach very low energy building requirements for single family houses in Latvian climate, opinion that in Latvian climate it is not possible to build low energy buildings, lack of knowledge's how to build and reach necessarily quality – airtightness, thermal bridges free construction details, HVAC, lack of good and useful materials for low energy buildings in local market (windows, compact ventilation units, doors etc.), operating costs usually are not considered when building a house
- potential external opportunities: growing interest in low energy and "green" building, building market demand on more quality in building industry, possible co-financing from Ministry of Environment for low energy buildings (International Green Investment Scheme, new technologies (HVAC, windows, doors etc.) and better standardize solutions for low energy building, increase in gas and electricity prices is forecasted, changes in Latvian building code on building energy performance are under consideration, public procurement procedures can be improved with the application of low-energy and sustainability criteria such as the Green Label Purchase principles, activity in construction market is low and market participants have more time for learning.

- potential external threats and barriers: no governmental support, big construction companies against low energy buildings, building monopoly, offers with lowest price win in public procurement, no specialized local training and education possibilities for engineers and architects, many buildings are heated with help of biomass, which is quite cheap, building market decline. There is no market demand and consumer understanding about low energy buildings (the rich build big villas, where the look of building is the only issue, and the poor do not build anything (or the cheapest possible option)), small market of new-built residential buildings, therefore any changes in types of building being built are slower, producers of building materials promote their materials saying that the thickness of it is big enough to go without heat insulation

Comments regarding the potential internal strengths:

- Growing interest on LCC and growing interest in green technologies are helping to promote low energy building idea. The strong technical and engineering background of building professionals allows for the quick absorption of knowledge on new technologies and building principles.
- Professional organizations tend to be open for new niches in building market. A new professional networks and associations emerge like passive house Latvia

Comments regarding the potential external opportunities:

- Possible co-financing from Ministry of Environment for low energy buildings (International Green Investment Scheme). We can predict that in near future that several low energy buildings will be built.
- Changes in Latvian building code on building energy performance are under consideration. That's also helps to raises discussion on low energy building status in Latvia.

- Public procurement procedures can be improved with the application of low-energy and sustainability criteria such as the Green Label Purchase principles

To overcome the potential internal weaknesses and barriers the following suggestions are made:

- In the future LCC costs have to be taking in a count and methodology has to be described in national legislation.
- New and better low energy building components should be offered in Latvian market, better and cheaper windows and air handling units are very important for Latvian market.
- Building professional should learn and gain more experience about low energy building and about methods how to reach necessary quality on the construction site.
- Good and bad low energy building examples should be analysed from other Nordic countries.

To overcome the potential external threats and barriers the following suggestions are made:

- It should be documented and scientifically proved that low energy building are better option for CO_2 savings that traditional building. Than it should be widely discussed with policy makers like with Ministry of environment.
- Initial investment costs should be reduced with help of smart and creative design.
- Overall knowledge and awareness on low energy buildings should be raised.
- Guidelines for construction for consultants, architect, contractors and construction workers
- Clear and transparent calculation methods should be approved by state.

The following has to be fulfilled to ensure that a low energy house is accepted by the occupants:

- Good explanation on low energy building strengths and better indoor climate

- Explanation on mechanical ventilation maintenance and functions.

- The low energy house must:

✓ ensure better comfort with lower operation costs

✓ reach expected energy consumption and indoor quality

✓ should be nice looking and building must be of high quality

✓ be user friendly

3.6.4 References

[16] Kursisa, A., 2010. Promotion of low energy and Passive House standard in Latvia. Successful PR strategies, Conference Proceedings: 14th international passive house conference 2010, Passiv house institut, 351 - 357.

3.7 Estonia

Author: Helen Hirv and Ago Siiner, UT

3.7.1 Perceived and real problems with low energy dwellings

Traditional new dwelling in Estonia (up to 2009) is a dwelling with a building envelope not so well insulated (U-value usually 0,25 W/m^2*K and worse) and equipped with extract air ventilators and fresh air valves for ventilation without heat recovery and uses heat pump, natural gas or wood for heating. The national regulations for building energy demand are not very stringent (“Energiatõhususe miinimumnõuded”

http://www.riigiteataja.ee/ert/act.jsp?id=13215584) so the will for building an energy efficient house must come from the client himself. Apartment buildings and row houses are heated via central heating or independently using natural gas. It is likely to be heated by radiators and the heat is supplied by a district heating system.

A clear rise in the interest towards energy efficiency and low energy buildings can be detected after the economic crisis and real estate development slow-down. New buildings built after 2009 use more and more balanced ventilation system with heat recovery and more attention has been drawn to insulation issues.

A meeting with representatives from developers/property owners/property managers, architects, manufacturer, contractors, authorities and policymakers discussed and agreed upon which problems should be discussed when dealing with future low energy dwellings.

Table 3.7.1. Description of the expert group.

Developers/owners	• Head of one of the main Estonian real estate development companies.
Architects	• Two architects from the major Estonian architectural companies
Manufacturer	• Head of development of the biggest Estonian prefabricated house manufacturer
Contractors	• Environmental manager of a major building contractor and real estate development company in Estonia
Authority	• Municipality representative from the Estonian county that was the first to implement passive house technology to reconstruct a public building
Policymaker	• Head of Department of Ministry of Economic Affairs, responsible for implementing energy efficiency policies.

The following points were brought out to have the highest priority (see table 3.7.2):

- Standards and regulations: Possibility of over-regularisation, lack of unified system among the EU member states, standards not accepted and not implemented.
- Knowledge: experience of low energy houses, competence to build low energy houses, information on how to build low energy houses, customer awareness regarding low energy houses, education regarding low energy houses, knowledge of each other's perspective on low energy houses.
- Market: Closely related to consumer awareness, was brought out that interest is clearly rising, but there are very few examples at the moment. Many big developers have already completed the planning phase of big apartment buildings where energy efficiency measures have been implemented and have started the sales on the paper.
- Instruments of control: long term perspective for increased construction of low energy houses, incentive for increased construction of low energy houses, directives related to construction of low energy houses, the existence of "good examples".
- Technical solutions/concepts: lack of information among regular consumers in the field of energy efficient components, among architects in the field of general design solutions and among contractors in the field of detailed solutions and quality control opportunities during construction.
- End User: indoor environment in low energy houses, operation and use of low energy houses, lack of practice in economic planning.

- Costs: construction costs, maintenance costs etc. have been a big issue among consumers and clients, and this is caused by general lack of knowledge and information.
- Risks: economical and building technological risks, risks with untried solutions for low energy houses.

There is not much difference in the opinion of different people in the expert group mainly because the whole subject is quite new and all the problems/areas mentioned are about equally important when considering the development of low energy housing. Of course there are some minor differences in the approach towards some problems according to professions.

The problems mentioned above can be perceived or actual problems. For some of the actual problems there might already exist solutions, which for some reason are not used e.g. due to lack of knowledge or the solutions being too expensive. Some of the perceived or actual problems might be solved with information.

Table 3.7.2. The different peoples´ assessment of the degree of priority for the different problem areas is presented with the values for each group (from 1 = low degree of priority to 5 = high degree of priority)

Area of problem	The expert group	Developers/owners	Architects	Manufacturers	Contractors	Authority and health organisation	Policy-maker
Standard/regulations	4.2	5	4	3	4	4	5
Knowledge	5.0	5	5	5	5	5	5
Market	4.3	5	4	5	4	5	3
Instruments of control	4.8	5	4	5	5	5	5
Technical solutions/concepts	4.5	5	4	5	4	5	4
End User	4.7	5	5	4	5	4	5
Costs	5.0	5	5	5	5	5	5
Risks	4.3	5	4	4	3	5	5

3.7.2 SWOT-analysis

For the SWOT-analysis a passive dwelling and a traditional modern dwelling had to be chosen. Since in Estonia there is no passive house dwellings as such built at the moment, we chose a kindergarten project instead which was renovated using passive house compatible components (windows, ventilation system, and insulation).

The potential internal strengths and weaknesses and the potential external opportunities and threats for the low energy house are presented below and then commented.

	Potential internal Strengths		Potential internal Weaknesses

1	Energy efficiency	1	Standards and regulations: Specifications for passive houses
2	Incentives: support for energy efficient building	2	Knowledge: Experience of low energy houses
3	Market: Growing market	3	User/behaviour: Operation and use
4	Usability: Indoor comfort	4	Knowledge: Competence to build
5	Cost: lower operational costs	5	Planning: competence/standards
	Potential external Opportunities		Potential external Threats
1	Future performance oriented legislation / standards	1	Standards and regulations
2	Growing LCC awareness	2	Market
3	The energy performance directive	3	Local policies/Incentives
4	Prognosis for increasing energy costs	4	Reputation
5	Low running costs		
6	Reputation		

3.7.2.1 Potential internal strengths

1 - Energy efficiency

Low energy concept will surely be a strong argument in the future for the client/customer.

2 - Incentives: support for energy efficient building

Support from local authorities for implementing energy efficiency measures can further rise the interest of the clients towards passive- and low energy housing.

3 - Market: Growing market

It can be seen already during 2009 and 2010 that interest toward very low energy building concepts is growing fast among developers, architects and end users. Although there is some discussion about the equilibrium between the investment costs increase and the “feasibility” simple information is available and it has to be communicated to the necessary parties.

4 - Usability: Indoor comfort

Increased comfort levels (less draught, less temperature fluctuations, increased natural light levels etc.) that come with the increased quality of the low energy and passive houses is surely an important argument.

5 - Cost: lower operational costs

This is a very important strength that increases the wealth of the inhabitants as well as the independence of the country.

3.7.2.2 Potential internal weaknesses

1 - Standards and regulations: Specifications for passive houses

Since 2009 there have been regulations limiting the new and renovation projects´ total energy (including hot water consumption and electricity of appliances) demand and stating that it has to be calculated if components of certain quality are not used. The minimum standard that has to be achieved during new construction or big scale renovation is not very stringent at the moment. National regulations do not yet consider a passive house standard as such. There are interest groups who are talking about developing an Estonian own national passive house standard which, according to climate analysis would not exactly be necessary. So there is potential for some time consuming and unnecessary discussion on the subject which may result in more complicated standards or regulations.

2 - Knowledge: Experience of low energy houses

Since re-establishment of Estonian sovereignty there has not been considerable research and development in the field of building energy efficiency etc. The first real low energy houses were built during 2007 and 2008; first public building was finished in 2009. No monitoring data of low energy houses exists before that, very few good local examples and building experience.

3 - User/behaviour: Operation and use

Lack of knowledge leads to thoughts like low energy housing has windows you cannot/should not use, you don´t have fresh air because the house doesn´t “breathe”, if electricity goes off you won´t be able to do anything, the ventilation system produces “bad air” etc. This is caused by lack of unified information also from the national organisations.

4 - Knowledge: Competence to build.

There is strong prejudice among building contractors that somehow their work is being compromised or by spreading new knowledge how to improve building quality their way of doing things is jeopardised or they are accused of something. The other option is that the attitude towards other solutions (increased insulation, building airtightness, ventilation system) is negative because it is considered not important or having very minimal influence on the building energy demand (especially among private house building contractors, bigger constructions usually involve people who are more professional and better informed). Also potential of not achieving the planned energy efficiency because of changes made to the project during construction because of “better” or cheaper solutions that again “do not affect the overall performance that much”.

5 - Planning: competence/standards

Very low energy housing whether dwelling or public building need more investments during planning in order to achieve minimum extra costs during building. This is quite hard to get through to architects and clients if virtually no experience in the field exists and examples can only be brought from abroad. There are two main problematic points which are extra

time and costs during planning. This especially applies for bigger constructions where many different parties are involved in the process.

3.7.2.3 Potential external opportunities

1 - Future performance oriented legislation / standards

As more and more national and international standards are developing in a more performance oriented manner, the opportunities for the low energy house concepts such as the passive house will be growing over time.

2 - Growing LCC awareness

Everybody, more or less, is today aware of the benefit of LCC considerations, but very few are applying such considerations in practice. For many developers there is no or only little business connection between producing units and facility management units of the same company. However the general trend over time is favourable for LCC considerations in practice, but the development is rather slow.

3 - The energy performance directive

The European energy performance directive, which sets even more ambitious goals for the future, will further promote energy efficient systems.

4 - Prognosis for increasing energy costs

The higher the energy cost the more interesting low energy house concepts such as passive houses will be, especially if more stringent energy requirements are enforced and LCC analysis are applied.

5 - Low running costs

The low energy house concept such as the passive house concept includes good monitoring, little need for adjustment of air flows, low use of energy etc. This will be an advantage especially when LCC analysis becomes more widely used.

6 - Reputation

Low energy housing developments which are built and monitored for performance give good examples and thus good reputation to the low energy, passive house and zero-energy concepts. This establishes a new standard for dwelling indoor comfort and running costs.

3.7.2.4 Potential external threats

1 - Standards and regulations: over-regularization

Potential of over-regularization. This problem has already been mentioned by our architects. Biggest problem is not the potentially very strict goals but the long and difficult documentation and different standards within EU member countries which is not efficient in the sense of uniform development.

2 - Market: economic slow-down

Further slowdown of the economy locally and globally which results in no or very limited construction of new and renovation of old dwellings. This gives no opportunity for the low energy and passive house technologies to spread.

3 - Local policies/Incentives: wrong decisions

Potentially wrong decisions made during the process of implementing the EU general directives, potential of applying support schemes that do not give comparatively reasonable effect and do not deal with the problem as a whole.

4 - Reputation: bad examples

Potential drawbacks among consumer interest when controversial and potentially confusing information on energy demand figures and indoor climate quality is provided.

3.7.3 Summary and Conclusions

A SWOT-analysis of low energy houses compared with ordinary modern houses, resulted in:

- potential internal strengths: Energy efficiency, Support for energy efficient building, Growing market , Indoor comfort, Lower operational costs
- potential internal weaknesses: Specifications for passive houses, Experience of low energy houses, Operation and use, Competence to build, competence/standards.
- potential external opportunities: Future performance oriented legislation / standards, Growing LCC awareness, The energy performance directive, Prognosis for increasing energy costs, Low running costs, Reputation.
- potential external threats: Standards and regulations, Market, Local policies/Incentives, Reputation.

Comments regarding the potential internal strengths:

- Energy efficiency – the original argument to choose a low-energy building instead preferring old solutions.
- Incentives: support for energy efficient building – if there will be any this is for some people an argument to choose energy efficient solutions.
- Market: Growing market – the market grows both in the area of low energy housing and the demand for new dwellings is also increasing. So a good opportunity to implement the new technologies.
- Usability: Indoor comfort – good argument for marketing
- Cost: lower operational costs – good argument for marketing.

Comments regarding the potential external opportunities:

- Future performance oriented legislation / standards – this is a push towards wider spread of energy efficient building.
- Growing LCC awareness – see above.
- The energy performance directive - see above.
- Prognosis for increasing energy costs – this increases the amount of people who feel the cost of energy in their budget and this in turn makes them more interested in how to avoid the increased costs.
- Low running costs – see above.
- Reputation – good reputation of passive- and low energy houses from other countries give a good starting position.

To overcome the potential internal weaknesses and barriers the following suggestions are made:

- Standards and regulations: Specifications for passive houses – strong emphasis on the definition of the low energy and passive houses in order not to confuse parties involved and not to spend too much energy and resources for working out solutions that already exist.
- Knowledge: Experience of low energy houses – state structures should provide sufficient and understandable information on the subject, solutions etc.
- User/behaviour: Operation and use – also a question of sufficient information that comes from a trusted source
- Knowledge: Competence to build – documented solutions from good examples from Estonia, seminars etc. for spreading the knowledge from other countries, translated information etc.
- Planning: competence/standards – the costs of the building during the whole life cycle have to be understood by all parties. In Estonia the general practice is to invest about 5% into planning of the total building cost. In Austria this is more like 15% so there is a big difference and this has to be understood why it is reasonable to invest more time/money during planning.

To overcome the potential external threats and barriers the following suggestions are made:

- Standards and regulations: over-regularization – more simple regulations. This is a potentially big problem and there is no simple solution, a lot of standardisation should be made among countries in the EU.
- Market: economic slow-down – the government can do a lot in this issue e.g. by supporting renovation projects in big housing blocks – this gives the inhabitants more free money (less money spent on heating), gives work and finally makes the state more independent from fuels so this is a good plan in the long term. There are good examples of this type of action e.g. in U.K.
- Local policies/Incentives: wrong decisions – this can be avoided by involving adequate people in the process and decision-making.
- Reputation: bad reputation – good examples should be chosen of course.

3.7.4 References

No References, the information is based solely upon meetings and questionnaires filled by representatives of the abovementioned structures.

3.8 Lithuania

Author: Arturas Kaklauskas, VGTU

3.8.1 Perceived and real problems with low energy dwellings

Traditional new residential dwelling is a building with a building envelope insulated and natural ventilation. The energy performance class may not be: lower than C for new buildings; lower than D for existing buildings with a floor area exceeding 1000 m² after renovation. The single family dwellings are heated mainly by radiators or floor heating and the heat is being supplied from own heat source like, gas fired boilers, solid fuel boilers or heat pumps. The multifamily buildings are heated by radiators and the heat is supplied by a district heating system.

A passive house dwelling is not defined in Lithuanian standards. Off-the-record, Lithuanian construction industry researchers and practitioners have agreed that a passive house (nonofficial passive house standards) is a building which meets the following requirements:

- The aggregate annual energy demand for heating and ventilation cannot exceed 15 kWh/m².
- The annual energy consumption for water heating, indoor air heating and ventilation cannot exceed 50 kWh/m².
- Air permeability coefficient $n_{50} \leq 0.6$ (at a pressure of 50 Pa, the loss of air in the premises does not exceed 0.6 of the total volume).
- The total annual energy consumption cannot exceed 120 kWh/m².

Only two passive single-family homes have been recently constructed in Lithuania yet. Only the design calculations are available; the precise data is not available.

Expert group participants

Experts	• A professor in HVAC systems • A deputy director of housing and urban development agency • A deputy director of construction and housing department of ministry of Environment of the Republic of Lithuania • A managing director of Lithuanian builders association
Developers/owners	• A director of medium development company • A director of Lithuanian real estate development association • A investment director of real estate investment group
Architects/designers/consultants	• A designer at design company • A senior energy consultant • A director/architect of small architecture company
Contractors/manufacturers	• A director of a producer of solar thermal systems • A manager at medium construction company • A director of medium construction company • A deputy director of medium construction company
Users/operation managers	• A operation manager at building engineering systems company

An “expert group” with representatives from experts, developers/owners, architects/designers/consultants, contractors/manufacturers, users/operations manager, and policymakers discussed and agreed upon which problems should be discussed when dealing with future low energy dwellings. The following aspects were considered to have the highest priority (see table 3.8.1).

An “expert group” (experts, developers/owners, architects/designers/consultants, contractors/manufacturers, users/operations manager, and policymakers) considers all areas of more or less equal importance.

Table 3.8.1. The different groups' assessment of the degree of priority for the different problem areas, presented in ranking order (1 is highest) and average values for each group (from 1 = low degree of priority to 5 = high degree of priority)

Area of problem	Experts	Developers/owners	Architects /designers/ consultants	Contractors/ manufacturers	Users/operations manager
Certification/standard/regulations	3,7 (5)	4,0 (4)	4,1 (3)	4,3 (3)	3,5 (5)
Knowledge	4,5 (2)	3,6 (5)	3,8 (5)	4,5 (2)	4,0 (4)
Market	4,0 (3)	4,5 (2)	4,0 (4)	4,0 (5)	4,2 (3)
Design	3,2 (6)	3,3 (6)	4,3 (2)	3,6 (6)	3,2 (6)
User/behaviour	3,9 (4)	4,4 (3)	3,7 (6)	4,1 (4)	4,6 (2)
Costs	**4,8 (1)**	**4,7 (1)**	**4,5 (1)**	**4,7 (1)**	**4,8 (1)**

The subgroups were asked give their opinion as to how well today's solutions solve different problems (see table 3.8.2).

Table 3.8.2. Marking of the performance of today's solutions on the different problems with low energy houses (1 = poor and 5 = good/high). Extra bold type means low rating.

Problem area	Developer-owner	Architect-designer-consultant	Contractor-manufacturer	User-operations manager
Certification, standards and regulations:				
- administrative procedures and permits	2,0	2,7	2,4	2,7
- public procurement procedures		2,9	2,3	2,3
- certification of houses		3,1	3,2	3,3
- certification specialists		1,3	1,9	2,1
- certification of products		2,9	3,1	3,2
Knowledge, education, training, empowerment, ICT:				
- experience	2,1	2,2	2,8	1,6
- competence	2,1	2,1	2,9	2,8
- information	2,5	1,9	3,1	1,4
- customer awareness	2,1	1,4	2,5	1,5
- education	1,9	2,0	2,4	1,6
Market:				
- marketing	2,1	1,9	2,3	3,7
- market shares	1,6	1,8	2,1	2,7
- good examples	1,1	1,7	2,6	3,5
- comprehensive view	1,2	1,9	2,5	1,6
Design:				
- customer adaptation	2,6	2,9	2,9	2,6
- integrated design	1,9	2,4	2,1	2,2
- conflicts	1,3	2,4	2,8	2,6
- optimization	2,6	2,8	2,9	2,7
- rationalisation	2,1	2,2	2,6	2,5
User/behaviour				
- indoor environment	2,1	3,3	3,4	3,1
- operation and use	1,7	2,3	3,3	1,7
- information	1,9	2,4	3,5	1,6
Financial mechanism, costs				
- cost estimates	1,2	2,2	3,1	2,6
- land	1,7	1,9	1,8	2,2
- design and technical solutions	1,6	1,8	1,9	2,1
- financing	2,1	1,8	2,5	2,6

3.8.2 SWOT-analysis

For the SWOT-analysis a passive dwelling and a traditional modern dwelling had to be chosen.

The potential internal strengths and weaknesses and the potential external opportunities and threats for the low energy dwelling e.g. a passive house dwelling are presented below and then commented.

	Potential internal Strengths		Potential internal Weaknesses
1	Certification/standard/regulations: Energy certification of buildings	1	Certification/standard/regulations: Lithuanian Law on Construction and Technical Construction Regulations are not tailored to passive houses
2	User/behaviour: Decreasing operational costs	2	Certification/standard/regulations: Time-consuming administrative and public procurement procedures
3	Costs: Dropping price of the land	3	Certification/standard/regulations: The Energy Performance of Buildings Directive
4	Costs: Decreasing construction costs	4	Certification/standard/regulations: Certification of specialists and products
5	Costs: Expected low LCC-costs	5	Knowledge: Minimal information
		6	Knowledge: Experience of low energy houses
		7	Knowledge: Competence to build
		8	Knowledge: Bachelor and master degree programmes
		9	Knowledge: Users have lacking knowledge
		10	Knowledge: Newspapers, radio, TV and web portal are not active
		11	Knowledge: Needs of users and contractors
		12	Knowledge: Fragmentation of education
		13	Knowledge: Lifelong learning
		14	Small market and not large scale construction
		15	Design: integrated design of the lifecycle of the building
		16	User/behaviour: Indoor environment
		17	Costs: Rather big construction costs
		18	Costs: Land costs and plot ratio
		19	Costs: Professionals are not encouraged to design rational passive houses
		20	Costs: Tax credit schemes and specific loans

	Potential external Opportunities		Potential external Threats
1	Certification/standard/regulations: Future standard, regulations and procedures will be more appropriate for passive house	1	Knowledge: Priority
2	Knowledge: Competence and knowledge of stakeholders will increase	2	Costs: Rather big construction costs
3	Knowledge: Bachelor and master degree programmes	3	Costs: Land costs and plot ratio
4	Knowledge: integrated lifelong learning of stakeholders	4	Costs: Professionals are not encouraged to design rational passive houses
5	Market: Growing market and large scale construction	5	Costs: Tax credit schemes and specific loans
6	Design: integrated design of the lifecycle of the building		
7	Costs: Prediction for increasing energy costs		

3.8.2.1 Potential internal strengths

1 - Certification/standard/regulations: Energy certification of buildings
From year 2009 all buildings should have Energy certificate according to Lithuanian Construction technical regulation on Energy performance of buildings STR 2.01.09:2005. Lithuanian Construction technical regulation on Energy performance of buildings is linked with EU documents: prEN 15217:2005 „Energy performance of buildings. Methods for expressing energy performance and for energy certification of buildings“ and prEN 15203:2005 „Energy performance of buildings. Assessment of energy use and definition of ratings“.

2 - User/behaviour: Decreasing operational costs
Optimisation of building operation costs is increasingly relevant in Lithuania. People choose warmer housing and are interested in the newest solutions related to engineering systems.

3 - Costs: Dropping price of the land
The price of the land has been dropping during last two years.

4 - Costs: Decreasing construction costs
The construction costs have been dropping during last two years.

5 - Costs: Expected low LCC-costs

3.8.2.2 Potential internal weaknesses

1 - Certification/standard/regulations: Lithuanian Law on Construction and Technical Construction Regulations are not tailored to passive houses

Lithuanian Law on Construction and Technical Construction Regulations are not tailored to passive houses. The passive houses were designed on the basis of Finish, Swedish and German experience.

2 - Certification/standard/regulations: Time-consuming administrative and public procurement procedures

Administrative and public procurement procedures are too slow. In particular, the time necessary for obtaining decisions, permits, certificates and such from public authorities are too slow for the commencement of large-scale public projects.

3 - Certification/standard/regulations: The Energy Performance of Buildings Directive

The Energy Performance of Buildings Directive is not yet fully concerted with related already existing Lithuanian building standards and norms.

4 - Certification/standard/regulations: Certification of specialists and products

Certification of specialists in low energy design and construction is not performed yet. Certification of low energy products is not sufficient.

5 - Knowledge: Minimal information

There are minimal information, where low energy houses have been evaluated and found to have a reasonable energy and indoor climate performance.

6 - Knowledge: Experience of low energy houses

There is a shortage of feedback from previous explicit and tacit knowledge and from new low energy houses. There is no official energy simulation tool. Too few good examples are presented. There is a belief that low energy houses are more expensive to build than normal new production. On-site problems can’t always be solved.

7 - Knowledge: Competence to build

The tenants´ association does not always have the necessary competence. The real estate management is often not involved. Too many prejudices from the energy saving measures from the eighties exist. Workmanship for thermal insulation has too low status. Workers can be prejudiced regarding new methods. There is a shortage of indoor climate and energy specialists among contractors, developers and property managers.

8 – Knowledge: Bachelor and master degree programmes

The passive house and low energy design theory is not enough introduced in Lithuanian bachelor and master degree programmes.

9 – Knowledge: Users have lacking knowledge

Users have lacking knowledge to allow them to assess (pluses (comfort, low noise, economic efficiency) of such houses) low energy building. As a result low energy buildings stay an unknown and demand fails to grow.

10 – Knowledge: Newspapers, radio, TV and web portal are not active

Media not enough delivering knowledge and not stimulating interest for passive homes and not motivate professionals and decision makers.

11 – Knowledge: Needs of users and contractors

Scientists are inadequately learned of the needs of users and contractors. It proves complicated for architects, designers and contractors to keep up to date with regards new energy saving products, materials and systems.

12 – Knowledge: Fragmentation of education

Education is faced with a fragmentation problem. Each profession (owners, users, developers, architects, designers, consultants, contractors, manufacturers, users, real estate and facilities managers) mostly get very narrow knowledge in own field.

13 – Knowledge: Lifelong learning

There not enough financials incentives (call for project, subsidies, energy labels, etc.) for developing lifelong learning (web portal, seminars and workshops, technical publications presenting the codes, case studies) for passive houses.

14 – Market: Small market and not large scale construction

The limited market will increase the price for the passive house. Currently it is not possible to apply the concept of large scale production. Therefore, during not large scale construction is not possible:

- to reduce non-productive effort of all types;
- to reduce labour and construction costs;
- to increased rate of production;
- to reduce construction period.

15 – Design: integrated design of the lifecycle of the building

Different stakeholders not enough perform integrated design of the lifecycle of the building.

16 - User/behaviour: Indoor environment

Low energy houses can easily become too warm. Lithuanian people like to have fireplaces and saunas in their individual houses. However, none of the passive houses have them yet. Theoretical considerations show that fireplaces and saunas might cause lack of the air or excessive heat in a passive house. Supposedly, a separate room which must be fully or considerably insulated from the remaining part of the building should be allocated to the sauna.

17 - Costs: Rather big construction costs

The price of equipment (e.g. recuperators) and structural solutions (e.g. windows) is rather big (considering the salaries and the saved energy). The savings, in relation to the investments, are small

18 – Costs: Land costs and plot ratio

Taxes on land were not reduced if the building is a passive building. The land is not sold at a lower price if the buildings to be built are passive constructions. The plot ratio can is not higher in case of passive construction.

19 – Costs: Professionals are not encouraged to design rational passive houses

The building designers' and architects' fees are not planned in such a way to reward them for designing buildings that have a low maintenance and lifecycle costs. There are not available subsidies for developing research on the energy consumption of the considered buildings, on the most rational energy sources to be used by the considered buildings.

20 – Costs: Tax credit schemes and specific loans

VAT level for a list of equipment increasing energy efficiency in the domestic sector (efficient boilers, insulation and energy meters, etc.) is too high. There are not in place tax credit schemes, in which the owner of a real estate buying an energy saving or a renewable energy equipment gets a refund on the income tax. Also there are not in place specific loans which could be granted with the chance to deduce interest rates totally or partly from the income tax. The banks are not used a specific building loan to fund energy savings.

3.8.2.3 Potential external opportunities

1 - Certification/standard/regulations: Future standard, regulations and procedures will be more appropriate for passive house
Administrative and public procurement procedures will be more effective. The Energy Performance of Buildings Directive will be fully concerted with existing Lithuanian building standards and norms. Certification of specialists and products will be improved.

2 - Knowledge: Competence and knowledge of stakeholders will increase
Competence and knowledge of stakeholders (owners, users, developers, architects, designers, consultants, contractors, manufacturers, users, real estate and facilities managers) are expected to increase.

3 – Knowledge: Bachelor and master degree programmes
More and more the passive house and low energy design modules are expected in Lithuanian bachelor and master degree programmes.

4 – Knowledge: integrated lifelong learning of stakeholders
More and more the integrated lifelong learning of stakeholders (owners, users, developers, architects, designers, consultants, contractors, manufacturers, users, real estate and facilities managers) are expected.

5 – Market: Growing market and large scale construction
The growing market and large scale construction will decrease the price for the energy saving house.

6 – Design: integrated design of the lifecycle of the building
More and more the integrated design of the lifecycle of the building by different stakeholders are expected.

7 - Costs: Prediction for increasing energy costs
The higher the energy cost the more interesting passive houses will be.

3.8.2.4 Potential external threats

1 - Knowledge: Priority
Users usually prioritize the location and construction costs and are not very interested in low energy houses.

2 - Costs: Rather big construction costs
The savings, in relation to the investments, are small.

3 – Costs: Land costs and plot ratio
Taxes on land were not reduced if the building is a passive building. The land is not sold at a lower price if the buildings to be built are passive constructions. The plot ratio can is not higher in case of passive construction.

4 – Costs: Professionals are not encouraged to design rational passive houses
The building designers' and architects' fees are not planned in such a way to reward them for designing buildings that have a low maintenance and lifecycle costs. There are not available subsidies for developing research on the energy consumption of the considered buildings, on the most rational energy sources to be used by the considered buildings.

5 – Costs: Tax credit schemes and specific loans
VAT level for a list of equipment increasing energy efficiency in the domestic sector (efficient boilers, insulation and energy meters, etc.) is too high. There are not in place tax credit schemes, in which the owner of a real estate buying an energy saving or a renewable energy equipment gets a refund on the income tax. Also there are not in place specific loans which could be granted with the chance to deduce interest rates totally or partly from the income tax. The banks are not used a specific building loan to fund energy savings.

3.8.3 Summary and Conclusions

A SWOT-analysis of low energy houses compared with ordinary modern houses, resulted in:

- Potential internal **strengths**: energy certification of buildings, decreasing operational costs, dropping price of the land, decreasing construction costs, expected low LCC-costs.
- Potential internal **weaknesses**: Lithuanian Law on Construction and Technical Construction Regulations are not tailored to passive houses; time-consuming administrative and public procurement procedures; the Energy Performance of Buildings Directive is not yet fully concerted with related already existing Lithuanian building standards and norms; certification of specialists and products is not sufficient; minimal experience of low energy houses; low competence to build; the passive house and low energy design theory is not enough introduced in Lithuanian bachelor and master degree programmes; users have lacking knowledge; media not enough delivering knowledge and not stimulating interest for passive homes and not motivate professionals and decision makers; scientists are inadequately learned of the needs of users and contractors; fragmentation of education; lifelong learning; small market and

not large scale construction; integrated design of the lifecycle of the building; indoor environment; rather big construction costs; bad land costs and plot ratio; professionals are not encouraged to design rational passive houses; tax credit schemes and specific loans are not favourable.

- Potential external **opportunities**: future performance oriented legislation/standards, administrative and public procurement procedures will be more effective, the Energy Performance of Buildings Directive will fully concerted with existing Lithuanian building standards and norms, certification of specialists and products will be improved, competence and knowledge of stakeholders will increase, more and more the passive house and low energy design modules are expected in Lithuanian bachelor and master degree programmes, integrated lifelong learning of stakeholders will be performed, growing market and large scale construction, integrated design of the lifecycle of the building, prediction for increasing energy costs.
- Potential external **threats**: priority, rather big construction costs, professionals are not encouraged to design rational passive houses, tax credit schemes and specific loans.

Comments regarding the potential internal **strengths**:

- Energy certification of buildings: should be a help in designing and building low energy houses.
- Decreasing operational costs: should decrease operational costs. People choose warmer housing and are interested in the newest solutions related to engineering systems.
- Dropping price of the land: should decrease the price of the land.
- Decreasing construction costs: should decrease construction costs.
- Costs: Expected low LCC-costs.

Comments regarding the potential external **opportunities**:

- Future performance oriented legislation/standards: Future standard, regulations and procedures will be more appropriate for passive house.
- Directive, standards and norms: Administrative and public procurement procedures will be more effective. The Energy Performance of Buildings Directive will be fully concerted with existing Lithuanian building standards and norms. Certification of specialists and products will be improved.
- Competence and knowledge of stakeholders: Competence and knowledge of stakeholders (owners, users, developers, architects, designers, consultants, contractors, manufacturers, users, real estate and facilities managers) are expected to increase.
- Bachelor and master degree programmes: More and more the passive house and low energy design modules are expected Lithuanian bachelor and master degree programmes.
- Integrated lifelong learning: Integrated lifelong learning of stakeholders (owners, users, developers, architects, designers, consultants, contractors, manufacturers, users, real estate and facilities managers) are expected.
- Market: Growing market and large scale construction.
- Design: integrated design of the lifecycle of the building.
- More and more the integrated design of the lifecycle of the building by different stakeholders are
- Costs: Prediction for increasing energy costs.

To overcome the potential internal **weaknesses** the following suggestions are made:

- Regulations: Lithuanian Law on Construction and Technical Construction Regulations should be tailored to passive houses.
- Administrative and public procurement procedures: Time-consuming administrative and public procurement procedures should be shortening.
- Directive: The Energy Performance of Buildings Directive should be fully concerted with related Lithuanian building standards and norms.

- Certification: Certification of specialists and products should be amendment.
- Feedback: Feedback from previous explicit and tacit knowledge should be increased. Official energy simulation tool should be developed.
- Low competence to build: Publish more good examples.
- Bachelor and master degree programmes: introduction the passive house and low energy design theory in Lithuanian bachelor and master degree programmes.
- Users have lacking knowledge: Publish more good examples.
- Newspapers, radio, TV and web portal are not active: Publish more good examples.
- Needs of users and contractors: Publish more good examples.
- Fragmentation of education: diminish fragmentation of education.
- Lifelong learning: develop financials incentives (call for project, subsidies, energy labels, etc.) for developing lifelong learning (web portal, seminars and workshops, technical publications presenting the codes, case studies) for passive houses.
- Small market: An increased international market.
- Integrated design of the lifecycle of the building: Development of integrated design of the lifecycle of the building.
- Indoor environment: Publish more good examples.
- Rather big construction costs: Publish more good examples.
- Land costs and plot ratio: Taxes on land should be reduced if the building is a passive building. The land should be sold at a lower price if the buildings to be built are passive constructions. The plot ratio should be higher in case of passive construction.
- Professionals are not encouraged to design rational passive houses: Encourage of professionals to design rational passive houses.
- Tax credit schemes and specific loans are not favourable: Introduction of favourable tax credit schemes and specific loans.

To overcome the potential external **threats** the following suggestions are made:

- Users usually prioritize the location and construction costs and are not very interested in low energy houses: Marketing of well documented good examples.
- The savings, in relation to the investments, are small: Marketing of well documented good examples.
- Taxes on land were not reduced if the building is a passive building; the land is not sold at a lower price if the buildings to be built are passive constructions; the plot ratio can is not higher in case of passive construction: Lobby for changes.
- Professionals are not encouraged to design rational passive houses: Lobby for changes.
- Tax credit schemes and specific loans: Lobby for changes.
- Tax credit schemes: Lobby for changes.

3.8.4 References

4 OVERALL SUMMARY AND CONCLUSIONS

4.1 Perceived and real problems with low energy residential buildings

In all the participating countries very low energy residential buildings have been built since the millennium and are being built. In Denmark, Norway, Sweden and Finland several very low energy residential buildings have been built, but it is still only a small part of the total market for new construction of residential buildings. These countries have an official definition or standard for very low energy buildings, mainly passive houses. The other participating countries i.e. Poland, Latvia, Estonia and Lithuania have only a few built low energy residential buildings. They don't yet have any official definition or standard for low energy residential buildings such as passive houses.

The PDS expert groups in each participating country have discussed and agreed upon which problems should be discussed when dealing with future low energy residential buildings. Several problem areas were considered to have the highest priority. It is very difficult to say which problem areas are the most important ones. What can be stated is that most of them have to be overcome, if more low energy buildings are to be built. 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. However, it is equally important to solve both types of problems.

Four problem areas are common for all of the participating countries (all the individual problems are not the same):

Market area problems are mostly real problems e.g. low awareness among customers and low demand for low energy houses (see also Jarnehammar 2008), inadequate marketing (not adapted to the customers), insufficient incentives for private persons, too few and wrongly presented good examples, small national market, difficult to finance the construction of low energy buildings and low profitability to build low energy buildings (see also Jarnehammar 2008), negative and incorrect debate/information in media concerning low energy buildings, small low energy product companies.

Requirements/regulations area problems are mostly real problems e.g. time-consuming administrative procedures for the construction of low energy buildings, defective energy certification, no or unclear definitions of very low energy houses, local planning monopoly making it difficult to build low energy buildings..

Knowledge area problems are mostly real problems e.g. bad or inadequate experience/feedback of low energy houses, inadequate competence to build, low customer knowledge, inadequate education regarding low energy houses, inadequate knowledge of potential energy and cost savings for low energy buildings, inadequate knowledge of technical possibilities, not enough research & development, too few good examples.

Costs area problems can be real or perceived problems e.g. high costs for construction and maintenance, incorrect cost estimates not showing the real and true costs, difficult to finance the construction of low energy houses, too short time horizon used for bank loans and cost estimates. If the investment cost is supplemented with a life cycle cost analysis, then in many cases the cost problem is not a real problem but only perceived as a problem.

Six problem areas are common for only some of participating countries:

Problems related to instruments of control are e.g. inadequate financial incentives for construction of low energy buildings, too weak energy requirements. These are real problems.

Design problems are e.g. inadequate design/formation, inadequate customer adaptation, conflicts/disagreement in design work, mostly using existing solutions. These are real problems.

Problems with technical solutions/concepts are e.g. inadequate optimization of costs and performance of low energy buildings, inadequate product development resulting in poor products, missing low energy components, difficult 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.

Function/performance problems are e.g. inadequate robustness and quality of low energy solutions and products. In most cases these are not real problems, but to some extent perceived problems, as on most markets good low energy products for most applications are available (Blomsterberg 2011).

Problems related to user/behaviour are e.g. indoor environment problems, inadequate operation and use, missing information e.g. no dialogue between the developers and the users/tenants to arrive at a well-functioning low energy building. These problems can be real or perceived e.g. there are passive houses with no indoor environment problems, good operation and use (Janson 2010).

Problems related to risks are e.g. economic risks for the developer of low energy buildings, building technological and building services engineering risks with e.g. untried solutions, which could result in poor performance. These problems can be real or perceived e.g. there are passive houses, where these problems do not exist (Janson 2010).

Other problem areas are:

- Responsibility e.g. unclear assignment of responsibility between manufacturer, buyer, seller, owner and tenant.
- Policy e.g. no energy efficiency policy.
- Construction e.g. lack of experience (see knowledge above).
- Society e.g. inadequate public awareness.
- Building materials e.g. inadequate quality control, inadequate knowledge.
- Incentive e.g. lacking for private persons.

One might expect a difference in problems between the countries with several very low energy residential buildings and the countries with only a few, but it doesn't seem to be the case. The magnitude of some of problems is likely to be different. There is of course a difference in number and level of good examples mentioned under market, knowledge and instruments of control.

The non-technological problems/barriers are mainly within the following areas: market, requirements/regulations, knowledge, costs, instruments of control, responsibility, policy, society and incentives i.e. many problems are non-technological.

The problems mentioned above can be perceived or actual problems. For some of the actual problems solutions might already exist, which for some reason are not used, e.g. lack of knowledge or being too expensive. Some of the perceived or actual problems can be solved with information.

4.2 SWOT-analysis

A SWOT analysis of low energy residential buildings was carried out for all the participating countries. The analysis was based on different traditional buildings and slightly different ideas of very low energy buildings, depending upon the country. Some of the **potential internal strengths** of low energy residential buildings are valid for several of the participating countries and by these countries also considered to be important:

- good indoor environment
- low running costs
- high energy efficiency
- low life cycle cost
- growing market.

Potential internal strengths which are mentioned only by one or two countries are: specifications for passive houses, good robustness and quality, low emission of GHG (greenhouse gases), good support/incentive for low energy houses, good experience of low energy houses, good control of heating and ventilation, high resale value, attractive architecture, energy certification. All of these strengths should be relevant for all of the participating countries, although not prioritized by all countries.

Common **potential external opportunities** for low energy buildings, which are considered important in many participating countries, are:

- future stringent performance oriented legislation/standards
- increasing energy costs
- low running costs
- expected good reputation.

Potential external opportunities which are only mentioned by one or two countries are: growing LCC awareness, the energy performance directive, good examples, low emission of GHG (greenhouse gases), low energy building materials, national directives and growing environmental awareness.

Common **potential internal weaknesses** of low energy residential buildings, which are considered important in many participating countries, are:

- insufficient competence to build
- lacking robustness and quality
- indoor environment problems
- operation and use problems
- bad experience of low energy houses
- planning and designing mistakes.

This can easily unnecessarily give low energy buildings a bad reputation, which can be difficult to overcome. However some of these weaknesses e.g. lacking robustness and quality, indoor environment problems, operation and use problems can occur in traditional buildings as well, but must always be solved.

Potential internal weaknesses which are only mentioned by one or two countries are: small market, unclear or lack of specifications for low energy houses, no life cycle perspective,

lacking incentives, existing solutions used and not new low energy ones, high construction/investment costs, inadequate certification/standard/regulations, inadequate availability of products and inadequate cost estimates and financing.

The important **potential external threats** to low energy residential buildings differ from country to country. Some important threats exist in at least two of the participating countries:

- low interest in low energy buildings
- inadequate customer awareness
- inadequate knowledge of construction.

Other potential external threats are**:** unfavourable energy price structure, lack of incentives, inadequate information on how to build, local planning monopoly, bad reputation, increased construction costs, moisture problems in construction, architectural challenges, no official standards, subsidies for high heating costs, lack of support from banks, lack of quality control on building materials, changing political priorities and cheap and environment friendly energy supply.

Some issues can appear both as internal strengths and weaknesses or both as opportunities and threats. This can be explained by different aspects of the issues or difference in opinion and perspective.

4.3 Overcoming barriers to implementation of low energy dwellings

Several suggestions were made on how to overcome the **potential internal weaknesses** of low energy dwellings. Many of the suggestions differ from country to country. Overcoming the weaknesses can be divided into different categories methods, knowledge, market, requirements/standards and incentives.

Some suggestions were highlighted by several countries:

Methods:

- Introduce and apply LCC-analysis, which was mainly highlighted by the Baltic States and Poland. This will during design show the long term advantage of low energy buildings compared with traditional buildings.
- Develop common specifications for low energy houses. Ideally the specifications are European, but at least national. This will simplify for the developers.

Knowledge:

- Feedback from previous experience of low energy buildings. It always makes sense to learn from previous mistakes and success. Low energy buildings were built already in the eighties as demonstration projects.
- Update educational level of designers and contractors on low energy buildings.
- Introduce low energy house design at universities. Some universities have already done it. An ongoing Intelligent Energy Europe project is promoting Master and Post Graduate Education and Training in Multidisciplinary Teams IDES-EDU.

Market:

- Publish more good examples of low energy residential buildings, which was mainly highlighted by the Baltic states. The information on the good examples has to be relevant and from a reliable source. For this purpose a standardized way to measure and compare energy efficiency is needed (Jarnehammar 2008).

- Increase the size of the market for low energy products and import from and export to other countries. This will increase the competition and result in more, better and cheaper low energy products.

Suggestions made by only one or two countries are:

- Methods: develop integrated life-cycle design concepts, develop usable and user-friendly instructions for the users of low energy houses, certify low energy specialists and products and improve design tools.
- Knowledge: increase competence and knowledge by information and educational actions targeted at designers and developers, update educational level of construction supervisors, inform the users on low energy buildings and educate architects to design low energy houses.
- Market: verify low energy products and concepts through demonstration projects and field/lab testing, market low energy houses, increase the number of and quality of low energy houses, impartial cost estimates for low energy houses vs. ordinary houses, improve packaging of low energy houses adapted to the market and market relevant low energy specifications and energy rating systems for buildings.
- Requirements/standards: tailor construction regulations for low energy houses and include low energy house requirements in the national building code.
- Incentives: develop financial incentives for the construction of low energy buildings, fair distribution of costs for low energy houses between stakeholders and lobby for increased depreciation time of buildings.

To overcome the perceived or actual **potential external threats** to low energy dwellings several suggestions were made. Many of the suggestions differ from country to country. The threats can also be divided into the same different categories as the weaknesses.

Some suggestions were highlighted by several countries country:

Market:

- Marketing of well documented good examples of low energy houses. See also above under overcoming weaknesses.

Incentives:

- Political lobbying and information activities regarding sustainable and energy efficient construction.
- Lobby for tax credits and specific loans for low energy houses.

Other individual suggestions are:

Methods: Improve the quality control of low energy building materials.

Knowledge: Update the educational level of designers, contractors, manufacturers, sales managers and inform developers, clients, architects, technical consultants, contractors and users/customers on low energy buildings.

Market: Promote low energy houses, raise awareness, change the price structure for energy, inform on products for low energy houses and guidelines for construction.

Requirements/standards: Implement national standards for low energy houses, create more simple regulations and take into account the use of primary energy.

Incentives: Introduce favourable loans for low energy houses, governmental support for low energy houses and require low energy houses as a condition for house loans.

4.4 Conclusions

There are several barriers (of which many are non-technological) to implementation of very low energy residential buildings in Northern Europe. However many of these barriers must be overcome and should not be impossible to overcome in order to increase the number of low energy residential buildings. Many of the found barriers and suggestions on how to overcome them are similar in other studies (Jarnehammar 2008, Blomsterberg 2005). It requires some difference in methods and concepts compared to the ones used in central Europe due to differences in climate, building market and traditions. . To increase the awareness, knowledge and market it is crucial to have reliable and convincing information on low energy buildings preferably from good examples i.e. to build and present more successful low energy house projects in Northern Europe. In addition the presentations have to be based on trustworthy performance monitoring and evaluation as to energy, indoor environment and cost performance. The evaluation has to be based on a standardised way to measure and compare performance. In the Nordic countries some hundred very low energy houses have been built, but only a few of them have been impartially and reliably performance monitored and evaluated and well documented. For Poland and the Baltic states very few low energy houses exist, so more successful demonstration projects are needed.

To promote low energy residential buildings in Northern Europe it is important to maintain, improve and market the strengths (such as good indoor environment, low running costs, low LCC, growing market), minimise the potential weaknesses (such as poor performance due to insufficient competence, lack of robustness and quality, poor operation and use, mistakes in planning and design). It is also important to make use of the opportunities (such as future stringent performance oriented legislation/standards, increasing energy cost, low running costs and expected good reputation) and forestall and neutralize the potential threats (low interest in low energy buildings, inadequate knowledge). A national strategy towards making very low energy buildings the standard for new buildings should be developed (Jensen 2009) based on the findings in this study. To increase the market European legislation/standards/specifications for low energy buildings should be more harmonized.

To ensure that a low energy house is accepted by the occupants, guidelines of use for the occupants, information on the possibilities and function of a low energy house to the occupants are required. The low energy house must be introduced to the occupants, function as expected, be user-friendly, ensure good comfort, deliver expected energy savings and supply good living conditions. To succeed with these ambitions a dialogue has to be created between occupants of low energy buildings and developers/building owners. Bearing this in mind marketing plans on different levels must be developed.

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. There will be general and national suggestions.

5 REFERENCES

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6 APPENDICES

6.1 Appendix 1. Instructions for expert meeting for PDS of low energy housing

Agenda

1. The national Northpass project leader welcomes the participants and presents the Northpass project
2. The discussion leader presents the PDS method
3. Presentation round – the expert participants at the meeting introduce themselves
4. Let's start today's meeting.

   - instructions for the discussion/dialogue

   - everyone is allowed ten minutes of thinking with a notepad and a pencil

THINKING MINUTES AND COFFEE IS PUT ON THE TABLE

5. List of speakers
6. Conclusion – what will happen with the collected information?
7. The national project leader explains the continuation with focus groups (All the Northpass participants are encouraged to continue with focus groups, it is however not compulsory)
8. Thank you for this time!

The meeting – **How do you do it?**

Preparations

- Choose an experienced discussion leader and a secretary (good listener), who will write down problems brought up (see flipcharts below).
- Prepare nameplates to be but in front of each participant on the table to facilitate for the discussion leader and participants.
- Put up flipcharts, where each problem brought up can be written down. The flipcharts are put up so that everyone can see what is written.
- As the flipcharts are full they are put away i.e. the whole time it should be possible to see all the flipcharts. This way the participants can always see noted problems and digest the problems.
- **Notepads and pencils** are put on the table in front of each chair, so that prepared thoughts can be written down and be ready when the person in question is called upon to speak.
- **Coffee and gladly cakes** are prepared to be ready to be consumed after everyone has written down their problem pictures on their notepads.
- **PC and projector** are ready for the power point introduction.

The meeting itself

- Aim

The meeting is similar to a Workshop which is controlled from the start by the discussion leader. The idea behind focussing only on problems is that human beings are more creative and detailed when looking for problems, while "no news is good news" and is expressed in more general terms. Human beings are also "trigged" by each other, when they are allowed to

complain in a group, which also makes the problems more nuanced and looked at from different perspectives. But this phenomena requires a stringent and active discussion leader, who interrupts as soon as the new problem is clarified enough to avoid dwelling again and again on the same thing or that different solutions are brought up.

- List of speakers

The list of speakers is made bearing in mind which of the persons in the group from experience tend to dominate discussions, and therefore should be placed later on the list. The ones who usually not are so verbal/talkative and less experienced speakers should be placed among the first speakers, but no the very first. These persons might otherwise think that the problems they have in mind have already been said, even if they have a different perspective on the problem. It is exactly these different nuances we are interested in.

- Discussion of a problem

The one talking reads (no power point presentations are allowed) from his notes the problems he/she sees, simultaneously it is written on the flipchart which everyone can see. If anyone wants to add his view on the problem, he/she is allowed to do so, BUT as soon as he/she starts talking about other things, the person who was talking in the first place is allowed to continue. As soon as solutions are brought up say: ”thank you, but now you are trying to talk about solutions and in the first place we want to find problems” – solutions we will discuss another time.

If there has been a long discussion or story, to arrive at the problem or if you can not really see what the problem is, the discussion leader tries to interpret and formulate the problem. Then the discussion leader asks whether that is correctly understood? The problem is written on the flipchart.

Before the word is given to the next speaker ask if the person in question is ready – is there anything else? Everyone one will be given the possibility to sum up at the end of the meeting. Then continue according to the list of speakers.

- Final round

When everyone has had the opportunity to present problems, then everyone (one at a time) is asked if they want to add something, **avoid** asking in general terms if anyone wants to add something. At the end all participants fill out the form “Information on meeting participants.”

<u>Conclusion</u>

Follow the agenda and inform about what will happen with the material i.e. that the problems brought up during the meeting will be structured according to area of problem and an interview guide will be developed from this. This interview guide will be e-mailed to the meeting participants. They will be asked to rank according to scale from 1 to 5 the importance of each individual problem from their own perspective.

When everyone has returned the interview guide with the problems ranked, then the view of interdisciplinary group of which problems in general are the most important ones and which might be specific for one or some experts/disciplines will be presented.

Thank all the participants and tell them they can follow the project!