BUILD UP Skills – Sweden Roadmap:
Building Skills for Energy-Efficient Buildings

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Front cover images

Top row
Left: Ronny Graskopf
Right: Elektriska Installatörsorganisationen EIO (Association for Swedish Electrical Contractors)

Bottom row
Left: Association of Plumbing and HVAC Contractors, photo: Colourbox
Right: The Swedish Construction Federation

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Further information

More details on BUILD UP Skills "Sweden" can be found at www.energimyndigheten.se – search “buss”

More details on BUILD UP Skills can be found at www.buildupskills.eu

More details on the IEE programme can be found at http://ec.europa.eu/intelligentenergy

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1 Summary

Build Up Skills is part of Intelligent Energy Europe (IEE) – an EU programme that supports energy efficiency and renewable energy. *Build Up Skills* Sweden (BUSS) is the Swedish part of a wider EU project being carried out in all 27 EU countries plus Norway, Switzerland and Macedonia.

Build Up Skills is a direct outcome of the EU's energy and climate objective of a 20 per cent energy efficiency improvement in buildings by 2020, in respect of both new construction and renovations. Therefore the need for training and supplementary training in the construction industry is great throughout Europe and the entire construction sector needs to shift towards more energy-efficient construction.

In order to succeed, construction workers and installation engineers need enhanced skills in energy-efficient construction and renovation and the installation of renewable energy. The focus of the IEE activity is on construction industry professionals, and therefore purchasers and project managers are only indirectly covered by the requirement analysis. An important part of the activity is preparing a Roadmap and platform for supplementary training and enhancement of the skills of everyone who works at construction sites.

BUSS project stakeholders represent a broad cross section from the building sector and the authorities concerned. The project consortium (project group) is mandated to take charge of the project as a whole. The reference group participates in the work with analyses of the current situation, identification of skills requirements, obstacles and the development of roadmaps. The project group is responsible for the work with analyses of the current situation, identification of skills requirements, obstacles and the development of roadmaps. The steering group acts as advisor to the project group and controls the project's overall focus. The steering group also actively supports the dissemination and implementation of the measures presented in the roadmap. A list of participating stakeholders is presented in appendix 1.

Build Up Skills is divided into two parts:

- **Pillar I:** National survey and preparation of a road map.
- **Pillar II:** The development of new or existing courses and training programmes for supplementary training based on the national roadmap.

Pillar I of the project began in November 2011 and will be concluded in April 2013.

Pillar II will build on the results presented in the national roadmap. A new EU call for this part of the project would provide eligibilities for funding from the IEE for establishing or developing courses and supplementary training programmes. Implementation of the roadmap is predicated on the granting of funding.

The roadmap indirectly covers every participant in building projects, from purchasers and consultants to the professionals at the construction site. The stated activities refer to supplementary training and the reinforcement of the skills of everyone who works at the construction site such as construction workers, systems installers and their management. Part of the skills enhancement is planned to take place through improved communication between project participants. Supplementary training applies to the construction of energy efficient buildings and learning to install renewable energy systems in low-energy building

renovations. In Sweden the project also includes a review of basic training as this is considered to support the enhancement of skills within all of these areas.

Another important element is the information input required for groups that take critical decisions regarding a building's energy performance in the early stages of the construction process, i.e. purchasers, architects, building consultants, builders and installation company project managers.

The roadmap consists of three types of activities:

1. Skills enhancement for skilled workers and supervisors.
2. Changes to the industry's vocational training.
3. Assurance including information activities to e.g. purchasers.

1. In the case of skills enhancement for the existing workforce at a construction site the plan proposes the following main activities:

- The creation of basic training for everyone involved in low energy construction projects to increase understanding of why renovations or new constructions must be energy-efficient, and to achieve an understanding of the big picture at the individual level. The training will be combined with the requirements specified by the client side, and the setting up of an industry-wide register of individuals who have completed the training.
- Skills enhancement through improved communication within a project where those working at construction sites are given opportunities for dialogues with others involved in the project. This is done to improve knowledge within the technology area and to gain an understanding of how different technologies affect each other and link together during renovation/new construction and in a building's future energy efficiency life cycle.
- Easily accessible installation instructions for products with low impact from materials suppliers – skills enhancement “just in time”.

2. Regarding basic vocational training in upper secondary schools and vocational training schools the plan proposes:

- Changed and/or supplemented policies combined with an overhaul of textbooks and teaching aids along with supplementary training of vocational teachers.
- In regard to training for prospective managers at vocational schools, compulsory requirements are proposed for energy-related content to be introduced in consultation with the industry.

3. In conclusion, follow-up and quality assurance of the activities proposed in the roadmap will be necessary, as will coordination of the responsibilities and actions of stakeholders and national authorities. As mentioned by way of introduction, the majority of the proposed activities are contingent upon external funding. Implementation of the roadmap is predicated upon a guarantee of funding.

The roadmap also includes proposals for stakeholders in the different activities. It is hoped that stakeholders sign undertakings that specify their individual commitments. There is no obstacle to further stakeholders' joining in connection with implementation.

2 Introduction

EU's energy and climate targets for the years 2020 and 2050 require major investments from the European construction industry. One important activity in these efforts is to raise the level of skills in this sector of the labour market, which has led the EU Intelligent Energy Europe programme to initiate a project area called *Build Up Skills*. It has been running for 18 months from the start in November 2011 and involves 30 European countries where each country runs its own project based on its own specific conditions.

Fact box

The EU's climate work and activities to meet its energy needs form part of the European 20-20 strategy of smart, sustainable growth for all.

The strategy has three overall goals for 2020: to reduce greenhouse gas emissions by 20%, to obtain 20% of all energy from renewable sources and to cut energy consumption by 20% (all compared to 1995).

The EU is on track when it comes to emissions and renewable energy, but energy saving lags behind. The Commission therefore wishes to step up efforts all the more while taking the opportunity to define its long-term vision for a competitive, carbon dioxide efficient society.

(EU Commission website)

Sweden's Second National Energy Efficiency Action Plan states that housing and commercial premises are expected to contribute almost half – 24 TWh – of the total energy savings of 54 TWh in 2016.

This roadmap affects every participant in building projects, from purchasers and consultants to the professionals at construction sites. The operators involved all need to do their fair share thus allowing ambitions within the EU to significantly reduce energy consumption to be realized. Because of limitations within *Build Up Skills*, the stated activities refer primarily to supplementary training and the enhancement of skills of everyone at the construction site such as construction workers, systems installers and their management. Supplementary training applies primarily to the construction of energy-efficient buildings and the installation of systems for renewable energy and low-energy building renovations. In Sweden the project also includes a review of basic training as this is considered to support the improvement of skills within all of these areas.

Throughout the entire process, from analyses of the current situation and requirements to workshops carried out with skilled workers and supervisory staff, these groups have shown only to have a limited effect on a building's ultimate energy performance. The crucial decisions are made at earlier stages. Purchasers, architects, building consultants, construction and installation company planners have significantly greater influence. For a building to achieve the sought-for characteristics it is important that people active at the site perform their work in the best way and with the right informations at hand. The roadmap was created based on these important conditions and all proposals are thus made limited to activities aimed at those working on construction sites.

The roadmap is presented as a platform for skills enhancement and changes in the regular school system based on an analysis of the current situation performed earlier (WP2; Blomsterberg, 2012a) and complemented by a requirements analysis (WP 3; Blomsterberg, 2012b, Dehlin & Engvall 2012, Dehlin 2012). At a later stage the workpackage 5 will define the measures for ensuring implementation in Sweden.

Seen from a European perspective the Swedish construction industry workforce has a relatively high level of training. However, there are few formal skills requirements for employment in the industry. This brings opportunities for greater mobility but also the risk of untrained labour establishing itself in the Swedish construction industry. However, investigations made within the project show that formally trained skilled workers and supervisors with experience of energy-efficient construction see no overall requirement for further competence in the form of more formal skills enhancement. It is rather a case of significantly improving communications between everyone involved in the project and providing instructions for the correct performance of work. There is also a feeling that an increased willingness can be created through motivational information activities such as short training courses.
While policy documents for training skilled workers in upper secondary schools in Construction & Civil Engineering, Electricity & Energy, and HV, Sanitation & building services programmes will provide a certain level of support for training in energy-efficient construction, there will probably be a need for definition and training of vocational teachers to safeguard this type of training content.

The reports prepared during the Build Up Skills project and which form the basis of this roadmap are summarized in Chapters 3 and 4. Chapter 5 describes the results of the workshops carried out, while Chapter 6 presents the measures the roadmap proposes in order to improve competence and supplementary training within energy-efficient building for construction workers. In conclusion, Chapter 7 summarizes the measures, activities and undertakings proposed, and presents an estimated budget for the implementation of the roadmap.

The report is 90 per cent financed by the EU programme Intelligent Energy Europe – IEE.

3 The Swedish Construction Industry and Vocational Training for Energy-Efficient Buildings

The energy and climate targets for 2020 will require major investments in the building sector e.g. by raising professional competence. An analysis of the current status in the construction sector and an overhaul of existing and planned training regarding energy efficiency improvements in buildings was presented in the (Blomsterberg, Å 2012a) situation analysis.

Annual construction industry sales, i.e. new investments in construction, amounted to SEK 266 billion in 2010, equivalent to 8 per cent of GDP. The most important operators in the construction industry are proprietors/administrators, consultants/architects, contractors and manufacturers; most of the above are represented by various industry organizations. In all, there are around 83,000 companies in the construction sector, of which the majority are small companies with a maximum of four employees. During 2010, 305,000 people were gainfully employed within the construction industry, equivalent to

around 7 per cent of total employment. Most people employed within the construction industry are trade union members. Undeclared work exists within the construction sector, but is estimated to constitute less than 4 per cent of total construction investments. The number of individuals working at construction sites who are able to influence how energy-efficient buildings turn out once they are completed or refurbished is around 100,000. Some of them may also influence renewable energy systems.

Many believe that activity within the construction industry will continue to increase in the years ahead, which probably means that the number employed within the sector will also rise. In addition to this there will also be major recruitment needs to fill the vacancies caused by retirement. According to a forecast from the Swedish Public Employment Service there will be a shortfall in the following occupations within 5-10 years: sheet metal workers, insulation installers, bricklayers, roofers, woodworkers/carpenters, plumbing & HVAC fitters and electrical fitters, to name but a few who contribute to energy-efficient construction.

Consultants and executives within the construction sector workforce are relatively well educated. However, the sector is fragmented to a certain degree into various construction segments and organizations. Internationalization is noticeable in the increasing number of foreign artisan construction companies and foreign labour at Swedish construction sites, but to what extent is unknown. Internationalization is also noticeable in the increasing ease by which construction materials are imported and the increasing number of low-price builders' merchants who have set up shop in Sweden.

The proportion of low-energy buildings under construction is still low – on average below 2 per cent or 350 apartments per year, and in the case of business premises 0.25 per cent, or 8 units per year over the past 10 years. However, this proportion is expected to climb in the years ahead; in 2007 for example, 7 per cent of new home constructions were low-energy buildings. The number of apartments renovated each year amounts to around 24,000, of which the proportion with significantly improved energy performance is extremely low. However, many construction sector operators are counting on more stringent energy-efficiency requirements, both from the authorities and purchasers.

In 2010, energy consumption in buildings amounted to 166 TWh, equivalent to around 40 per cent of the total national energy consumption of 411 TWh. The Swedish Parliament has resolved that Sweden must reduce its energy consumption in homes and business premises by 20 per cent by the year 2020, and by 50 per cent by 2050. While there are currently very few state subsidies for energy-efficient construction, some grants are available for the installation of solar cells and panels. There are some regional stimulus schemes for low-energy buildings within municipal and county administrative board plans, and in local environmental programmes. A number of proprietors/administrators are already constructing low-energy buildings or performing low-energy renovations.

An active energy policy has been pursued over a considerable period in respect of information, financial and normative controls. The result, thus far, is that the total energy consumption for heating and hot tap water in buildings has not changed significantly despite an increase in floor space. New buildings have lower energy consumption than old buildings, but the total floor space has increased. On the other hand, electricity consumption, especially in business premises, has increased since the 1970s.

According to the EU directive on the energy performance of buildings, all new buildings must achieve nearly Zero-Energy-Building (nZEB) level by December 31, 2020. The government has drawn up a paper based in part on documentation from the Swedish Energy Agency, in which today's nZEB are in principle

defined as those that fulfil the current energy standards (BBR), established by the National Board of Housing, Building and Planning. Regulations will be made successively more stringent, with a checkpoint scheduled for 2015. A number of promotional actions to facilitate implementation of nZEB requirements are proposed, such as more demonstration projects and skills enhancement activities for key groups.

There currently exists no strategy for vocational training aimed at achieving the energy and climate goals. The most important educators for skilled workers in the construction industry are upper secondary schools, independent training organizations and vocational training schools. No training programme currently includes energy-efficient buildings to any significant extent. On the other hand there are formulations that are able to provide scope for such training in upper secondary school syllabuses. There are also a few vocational training school courses with a special focus on energy-efficient construction being set up.

A degree of supplementary training is provided in-house by construction companies, through The Swedish Construction Federation, within industry organizations and under the auspices of installers and builders merchants. However, supplementary training courses contain limited content regarding energy efficiency improvements and renewable energy for buildings. On the other hand, the industry has experience from previous training activities, such as the the National Board of Housing, Building and Planning 'build-to-live dialogue' which included training in energy-efficient construction. The Passive House Centre, which is a joint project between Region Västra Götaland and Alingsås municipality currently holds two-day courses in passive house construction for construction workers with 20-25 course participants each year.

Basic training for skilled workers needs to be supplemented in regard to low-energy buildings and energy efficiency improvement. The first step is to train the trainers. There are around 1500 professional teachers of the relevant subjects in upper secondary school construction-related programmes, of whom a proportion should also be able to work in supplementary training. The Passive House Centre has taken an initial step in its 'Training the Trainer' programme.

The majority of occupations within the construction industry require supplementary training in regard to low-energy buildings, renovation to low-energy buildings and renewable energy use. In principle, all relevant construction industry occupations should undergo supplementary training. In order for all new construction and renovation work to meet future low-energy requirements, around 100,000 builders and installers will need supplementary training over a period of eight years. A first analysis shows an acceptable supplementary training course length to be 1-3 full days. This will require an estimated minimum of 500 teachers/instructors. The training requirement is based on constant annual rates of new construction and renovation. When extensive renovation of the so-called 'million programme' housing begins in earnest the need for labour and supplementary training will increase even more.

Adding skills to basic training and supplementary training will not only provide a broad, general understanding of energy-efficient construction, but also an understanding of the contribution an individual's work makes and how it affects the work of others. More advanced training linked to the individual's trade will be required for certain categories. Follow-up of training should most suitably be the remit of the relevant training board. An important condition for ensuring a building's energy efficiency is to establish requirements and demand their inclusion in plans made by architects and energy-efficiency project managers.

Potential obstacles to the implementation of training are such factors as economic (who will fund?), institutional (who is responsible for, and will provide, the training?), cultural (foreign labour), social (motivation, incentives), lack of time, too little new construction and too few low-energy renovations. Major demand for energy-efficient buildings would help to surmount such potential obstacles. A step in this direction has be taken by the Swedish Energy Agency client groups (BELOK and BEBO) by promoting successful, energy efficient, demonstration buildings.

Fact box

- In 2010, 305,000 people were employed in the construction industry of whom around 100,000 skilled workers will need supplementary training.
- Around 83,000 companies operated in the construction industry in 2010, the majority of which consisted of small companies with less than four employees.
- Basic training in upper secondary schools should be supplemented and further supplementary training at the vocational training schools and training companies is needed to provide a broad, general basic knowledge of energy-efficient construction, low-energy renovation and renewable energy sources. Additionally, more advanced skills linked to a skilled worker's trade are needed.
- Around 1,500 professional teachers are required for the basic training of skilled workers, and at least 500 teachers/instructors within supplementary training will be affected.
- Potential barriers to the implementation of training include social, cultural and economic factors and the fact that low-energy buildings and low-energy renovation takes place to a relatively small extent. However, demand for energy-efficient construction will rise in the future, which increases the need for a qualified body of skilled workers in the construction industry.

4 Needs and shortcomings in the construction industry

4.1 Skills requirement and obstacles for achieving 2020 targets

Here is a summarized analysis of the skilled labour requirement for the construction of a low-energy house (Blomsterberg, 2012b) and a list of the problems that typically arise at construction sites for low-energy houses (Dehlin & Engvall, 2012).

It is advantageous to apply a five-step strategy (Dokka & Hemstad 2006) when planning low-energy buildings and low-energy renovations of existing buildings. The choice of construction solutions and their execution at the construction site are of great importance in meeting requirements as planned. This requires competent project planners and proficient execution at the site. The five steps are:

1. Reducing heat losses (and the need for cooling).

Reducing heat losses is achieved by four main measures; creating a compact building with a small surface area in relation to its volume, ensuring that the building envelope is well-insulated and airtight, limiting heat loss due to ventilation by selecting an appropriately sized ventilation system, the use of heat exchangers and by avoiding elevated room temperatures thus reducing the need for mechanical cooling.

2. Reducing electricity consumption

The next step is to minimize all electrical use for technical installations, lighting, office equipment and household appliances. This is achieved by selecting efficient fans, pumps, lighting, office equipment and household appliances (above all freezers, refrigerators and washing machines) and by making sure that these are only used when they are genuinely needed through demand control. In the case of fans and pumps, pressure drops must also be minimized.

3. Using solar energy, including daylight.

After these steps a building should have a low energy requirement, which will make it worthwhile to evaluate the possibilities of using passive house solar energy. Solar radiation through windows can provide a contribution to heating, especially during the spring and autumn. However, it is important to avoid high indoor temperatures during the summer by also ensuring adequate sun screening.

4. Controlling and displaying energy consumption

Even a very well insulated, airtight building with heat recovery will in all probability have a limited heating demand. This heating must be supplied by a heating system that is able to deliver and distribute the small amounts of heat needed, ensure that no heat is wasted and preserve thermal comfort. This places demands on the design and control of the heating system. The system should also show the temperature and energy consumption divided among suitable sub-items.

5. Replacing the remaining energy requirement with renewable energy.

The final step is to select energy sources that minimize emissions of greenhouse gases and the use of primary energy.

The principal idea is first to reduce the energy requirement and then supply the outstanding energy requirement with renewable energy to the greatest possible extent. It is important to always ensure good thermal and visual comfort. In the case of low-energy renovations, consideration must be given to the conditions dictated by the existing building, which among other things means avoiding moisture and mould problems and giving consideration to preservation aspects. Practical execution at the construction site and skilled workers have great impact on a building's quality.

General recommendations for the new construction of low-energy buildings and energy efficiency renovations that can be used as an aid when formulating requirements for procurement have been prepared by the client groups for housing (www.bebostad.se) and commercial premises (www.belok.se) which is the collaborative networks between the Swedish Energy Agency and Sweden's property owners.

To take stock of the problems that may occur at buildings sites in connection with the construction of energy-efficient buildings, a number of problem detection study (PDS) meetings were held. The meetings used focus group discussions to capture the problems construction workers consider to be associated with

the construction of low-energy buildings. Different problem areas and aspects associated with the construction process have been formulated with the aid the problems discussed. The problems were later evaluated and graded by focus group participants by means of a survey.

A total of four focus group meetings were held – an initial meeting with a group of experts/specialists whose participants had different skills and perspectives, two meetings with teams that build housing and one with a team that builds offices. All of the participants have experience in low energy building construction, which does not apply to the profession in general.

Even though the difference in problem area evaluations was small between the focus groups, certain nuances were discernible. The expert group highlighted the need for advances in the areas of dialogue, information and the project planning phase. The office-construction team also highlighted the project planning phase, closely followed by the opinion that products, building materials and prefabricated components should be developed. The housing teams pointed out that work environment issues are given far too little attention in the production of low-energy buildings. The housing teams also especially underlined the need to develop work operations within the production and logistics areas. In the opinion of the participants the overall outcome points to the need to develop the dialogue, information and project planning phases when building low-energy buildings. A need to develop products, building materials, production and logistics also emerged.

It is above all heavy lifting in connection with the construction of low-energy buildings that presents a problem regarding work environment and physical ill health, e.g. when fitting windows. Stress and frustration were exemplified by the problems connected with achieving the precision required in an airtight building while working against the clock. The participants also felt that the lack of development and training can cause stress and frustration, while a feeling of inadequacy can result from too many new demands being placed on an individual during low-energy building construction

Designs and drawings should be completed at the project planning stage, which is not always the case today. This is where designers need better 'site knowledge' so that drawings are more practical and easily interpreted on site. It is often the case today that a project's theoretical designs and drawings are impractical in the real world, and problems must often be solved on site. Project planners and designers also need more knowledge about airtight integrity requirements, primarily when it comes to penetrations and pipe runs. Developments are also needed on the product side, where difficulty is currently experienced in getting help to choose the right product. It should also be easier to assess whether products from different suppliers will work together. The suppliers themselves should develop a greater understanding of the need for timely deliveries as the sequence of operations is extremely important.

Energy efficiency is not the only requirement in construction today, but also general environmental and quality requirements. Compliance with these requirements is supervised through contractor self monitoring and verification systems. This means that individuals must always know which operators precede and follow their own operation. All quality assurance work demands precision, as shortcomings in e.g. airtight integrity are more noticeable in low-energy buildings as clearances are so small.

Everyone who participated in the study agrees that it is important for advances to be made in information and dialogue in low-energy building construction. Problems with internal information within companies are typified by the lack of information increasing the farther down the hierarchy one goes. Another aspect mentioned was the lack of interest on those occasions when information was provided and meetings held.

This becomes a problem when every operator needs the same initial information so they all understand why things are done in a certain way. Meetings for all concerned parties are therefore very important so that everyone involved understands the special requirements for achieving airtight integrity. Installation instructions also need to be developed so that they are more easy to understand and contribute toward designs' meeting airtight integrity requirements. In general, feedback must improve and be more accessible. Traditional tried-and-tested knowledge and experience must be put to use and adapted to new contexts. Evaluations of installation solutions or entire projects are unusual today.

General questions regarding finances and the difficulty of staying within budget for low-energy buildings were also raised, but finances are simultaneously impacted by the need to fulfil other environmental and quality requirements. Delays are more normal when constructing low-energy buildings than traditional ones, partly because of hold-ups while products are selected and partly because of the time it takes to find new solutions while work is in progress. All of these delays ultimately affect piece-work rates, stress and frustration in equal measure.

To summarize we can say that supplementary training for everyone involved in low-energy building workplaces may be necessary in respect of the interpretation of drawings, low-energy products, construction methods for low-energy buildings e.g. airtight integrity, environmental and quality requirements and the necessary logistics. The failure to provide time to learn new working methods can create feelings of inadequacy and raise stress and frustration levels. We should also consider how piece-work rates function in this context, as precision and new solutions mean that constructing low-energy buildings takes more time.

4.2 Skills enhancement requirement

The purpose of the needs analysis (Dehlin, 2012) was to provide a picture of the current skills enhancement requirement at construction sites regarding the production of low-energy buildings and low-energy renovations of existing buildings, as well as structural obstacles and possible solutions to meet requirements.

It was based on literature studies and surveys carried out to better understand requirements and possibilities for construction workers to undergo supplementary training in low-energy/ passive house construction or low-energy renovations. The survey was aimed at individuals with connections to construction sites who have experience, knowledge or opinions about energy-efficient construction or renovation.

One fundamentally important result from the survey – supported by equivalent studies in BUS Norway, BUS Latvia and the PDS study – was the ability to recognize a distinct requirement for skills - enhancement among construction workers operating in low-energy construction or renovation. The survey study, which has produced results based on good statistical documentation, also shows a general desire to participate in skills enhancement. Possible obstacles mentioned by construction workers are mainly poor awareness of training opportunities, while white collar workers felt costs, time and the lack of a requirement for supplementary training may represent a barrier for further education. Another general conclusion drawn from the survey is that an appropriate time and place for supplementary training (for a basic training course in low-energy construction or renovations) is one day at the place of work or other venue close to the home district.

We must view things from a broader perspective in areas where survey respondents consider construction workers to be in need of enhanced skills. The very definition 'construction worker' embraces a great number of different professional groups who carry out a broad range of tasks and operations at a construction site. It is therefore difficult, based on the results of the survey, to produce a definitive list of the areas where construction workers need to enhance their skills. However, in the case of both low-energy construction and renovation we can confirm that there are very few who feel there is no need for skills enhancement, and that the major part of respondents feel that a basic “General course in low-energy construction/renovation, energy-efficient installations, renewable energy sources and systems" is necessary.

Areas in need of skills enhancement in new construction and renovation can be linked directly to the “defining characteristics of a low-energy building”, i.e. “the building must be designed so that the demand for energy supplied during operations is low; adapt the building envelope and ventilation to minimize heat losses, supplement remaining demands with renewable energy. The respondents from the construction worker side emphasised operations that cover the envelope of a building; thermal bridges, insulation, insulation materials, frame supplements with heat insulating materials, General knowledge on energy-efficient designs and airtight integrity. A major proportion also wish to learn more about how their own work impacts that of other professional categories. What follows refers directly to a building's installations, systems and settings such as FTX, control and monitoring systems, heat pumps, heat distribution and lighting.

We should point out that the special focus on design and its component materials is almost certainly due to the fact that more than half of the respondents to the survey for construction workers were carpenters and concrete workers. The areas that include the building’s installations would probably have received the same level of response had more of the respondents belonged to the two other professional categories (electrical, controls and plumbing & HVAC with 14 per cent and 19 per cent respectively).

White collar worker perception of the areas where it is especially important for construction workers to receive supplementary training in respect of low-energy construction and renovations more than likely originates from the high proportion of project managers, supervisors, consultants (construction), resident engineers and the lack of e.g. “installation coordinators”. White collar workers confirm construction worker opinions, but with a certain variation and a little more focus on installations and their settings. They also pointed out the need for supplementary training in moisture proofing, the exploitation of solar energy and communication using construction documentation specific to the job in hand. Here, too, the majority conception is a requirement for more general knowledge about low-energy renovation and how an individual’s work impacts that of others.

Construction workers’ own wishes for supplementary training complement general opinions regarding the areas where skills enhancement is considered necessary. The carpenter and concrete worker group’s opinions regarding new construction and renovation are very similar and follow the same pattern as general opinions concerning which areas should be covered by skills enhancement. It was fundamental general knowledge about low-energy construction and low-energy renovations, work operations and fields that focus specifically on a building’s envelope such as energy efficiency design, and specific work operations to avoid cold bridges, air leaks and achieving good insulation. Equivalent questions to the Electricity and Controls group also brought similar answers for new construction and renovation, made up of work operations and areas that included installations and dimensioning, fitting, controls and

adjustments of same, renewable energy sources and – especially – general knowledge about low-energy construction and low-energy renovation. Answers from the ”plumbing & HVAC including ventilation and sheet metal” group did not differ worth mentioning from those of new construction and renovation. A major proportion sought more general knowledge about low-energy construction, renovation and energy-efficient installations, and around half were interested in learning more about how to dimension systems. This was followed by more knowledge of systems and installations plus their fitting, controls and settings.

Meeting these training requirements will very probably require significant resources. A major part will take place via the compulsory training at upper secondary and vocational training school level, given that their current set-ups have sufficient flexibility to adapt. There will also be local and company-related activities and training courses in support of individual projects, new materials, methods, systems and installations. What will probably take up most resources will be providing construction workers currently in work with basic training in low-energy construction and low-energy renovation.

5 Outcomes from workshops with skilled workers and supervisor

In addition to the conclusions drawn in the previous subproject (WP; refer to 3.2) "Requirement for skills enhancement in the production of low-energy buildings and existing buildings" (Dehlin, 2012 and Dehlin & Ekvall, 2012), three workshops were organized as an introduction to work on the roadmap. The participants were constructionworkers, electricians, and plumbing & HVAC engineers and supervisors. The objective was to create a priority list covering the training requirement for existing personnel at construction sites.

Selecting workshop participants

A total of three workshops were held; two in Stockholm with participants from central Sweden, and one in Gothenburg as energy-efficient construction enjoys special attention in this region. In order to achieve a more widespread geographical acceptance of the need for energy efficiency training of existing site personnel, companies, industry associations and workplaces in Västra Götaland, Stockholm, Dalarna, Örebro and Uppsala County were contacted.
Around 80 people in companies large and small within construction, electrical and plumbing & HVAC were contacted by email, telephone and personal meetings to recruit participants. Because the construction industry already works under time constraints it is difficult to free up people for one day. The major construction companies were positive about sending personnel when asked, but daily needs at the site took precedence in many cases. Course applicants dropped out at short notice which meant that the total number of participants in the three workshops was 28, of whom 21 represented Stockholm, Dalarna, Örebro and Uppsala County.
Overall, participated skilled workers from construction, plumbing & HVAC and electrical and lead fitters, supervisors and project managers from construction, plumbing & HVAC, cooling and electrical.

Selecting workshop methods

Over the years a number of workshops have been held under the auspices of the Swedish Construction Federation (BI) with the chosen method, which is considered suitable for the BUSS WP4; Innotiimi Opera method.

The Opera method is a systematic meeting and process tool that creates participation, clear objectives and robust commitment in a rapid, creative process. The method is especially effective for rallying individuals around an important issue, and getting everyone to contribute to the whole while also drawing out the group's collective standpoint on an issue. Creativity is combined with structure, and participation with recognized principles for activity-based training in a very democratic process in which everyone has one vote, regardless of position or title.

Description of the Opera method.

Experience tells us that to attract individuals unused to meetings to a workshop or work meeting, the day should not include too much sitting and one-way communication. The Opera process is unique with new meetings, discussions and a combination of sitting and standing activities.

The method begins with an explanation of the programme and the issue in question must be formulated such that the risk of misinterpretation is eliminated. ONE question at a time; an open-ended, non-leading question is posed verbally and written up clearly on a whiteboard or flipchart, visible for all participants throughout the whole process.

O = On-the-spot, personal ideas. Participants are each given 3 minutes in which to write down their ideas, in silence, on a sheet of paper. If participants have difficulty getting started the time can be extended 'invisibly' by two minutes. The short time available means that participants 'do not have time' to formulate politically correct answers or 'expected' answers.

P = Paired thinking. The operator/workshop leader has already divided the participants into pairs with coordinators as; gregarious together, shy together, not from the same company together and unofficial leaders together. Because participants do not already know each other it is important to achieve the right dynamics in the dialogues. A pair may now, based on proposals from both of them, select the four best proposals. This is done against the clock and the pair must each write down their proposals on sheets of paper. Every pair uses the same colour pens so that no proposal attracts more or different attention than others.

E = Exposure. In no particular order, pairs may come to the Opera board on the wall and set up their proposals one by one and very briefly explain their thinking. Other participants may not discuss or comment the proposals during their presentation. For one hundred per cent dedication pairs presents two proposals each to the other participants.

R = Ranking. Each pair now declares which four proposals on the board they consider to be the most important answers to the question. Pairs jot this down on notepaper; they may seek help from the coordinators. This activity is also against the clock. Some of the proposals may be very similar, but four proposals must be picked and one of them may be from the pair's own proposals. Because each pair may not select more than one proposal, they remain open and constructive in regard to proposals prepared by others. Once the pairs are ready, one person from each pair approaches the board, and on a given signal they mark their chosen proposal with a cross. Participants usually take their selection seriously. Each pair makes its choice from its own standpoint without pressure from any influence within the overall group of participants.

A = Arrange. The operator/workshop leader, with the aid of the participants, now arranges the posted proposals so that is easier to see thematic wholes. Non-prioritized proposals are taken down before rearrangement begins, but are included as non-prioritized proposals in the report and may be used later. The operator/workshop leader allows the participants to calmly reflect over how best to group proposals and, based on verbal proposals, change their position on the board until everyone in the group is satisfied. Then the group is asked to come up with proposals for thematic headings and a certain degree of repositioning may take place. The groups' overall prioritizing emerges on the exposure board and the operator/workshop leader places the thematic groups in order of priority. The group now has a clear, well-arranged picture of its joint thinking and proposals for solutions/responses to the issue concerned.

Once they are able to see the outcome, a spontaneous free discussion takes place and participants become committed to, and take responsibility for, measures created on the basis of the proposals. More detailed discussions often arise based on one theme or another, and participants get to air their misgivings and worries about the risks that can occur if a proposal becomes reality. This takes place more often in the second round, i.e. Question 2, when participants form different pairs and begin to feel more at home in the group.

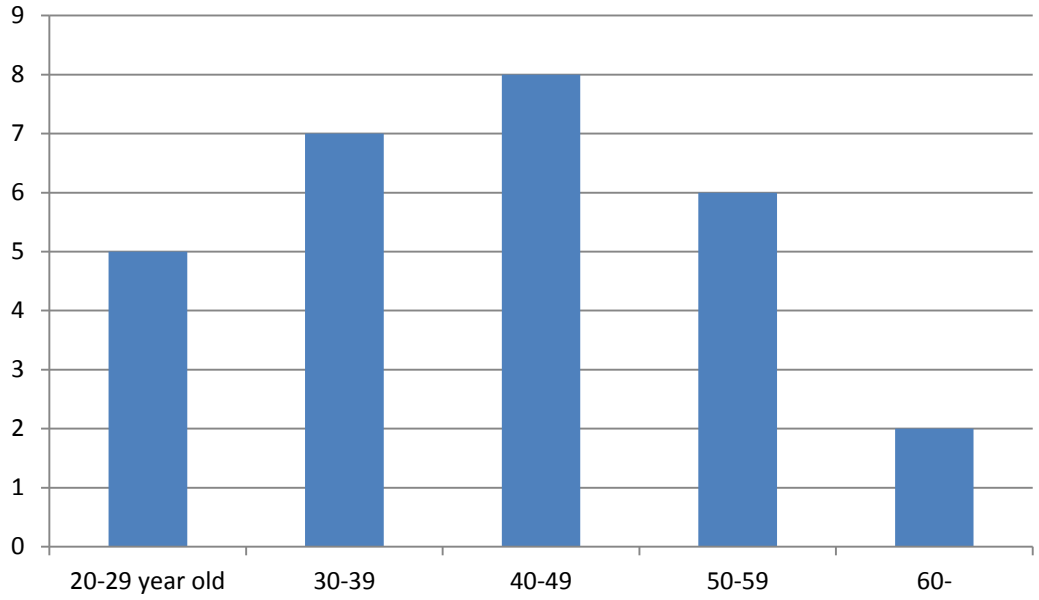
Documentation

Each workshop outcome is reported in Excel format with thematic headings with the proposals arranged in the group's order of priority; see appendix.

Outcome

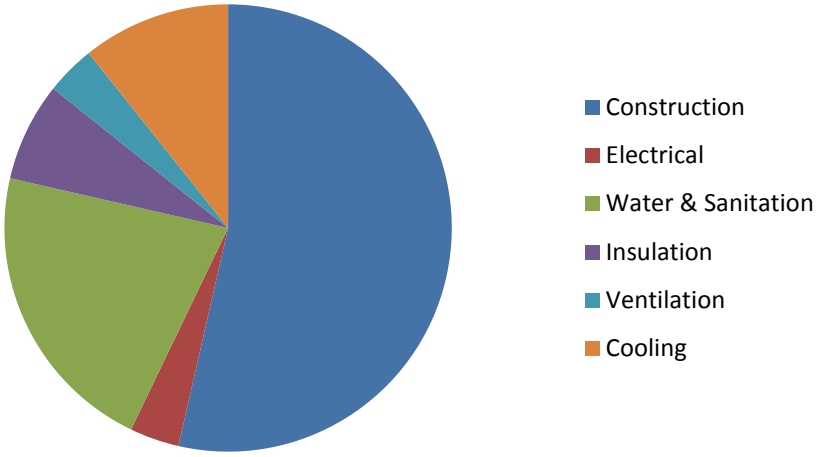
Outcomes from the Stockholm and Gothenburg workshops, which were made up of people with experience of energy-efficient construction, are summarized below. The outcome also includes a Stockholm workshop, where people with no experience of energy-efficient construction act as control group.

The average age of workshop participants was 41. Accordingly, it was many years since participating skilled workers underwent vocational training in upper secondary/vocational training school. However, several of the younger participants had quite recently completed education as technicians or engineers and worked in supervisory roles.



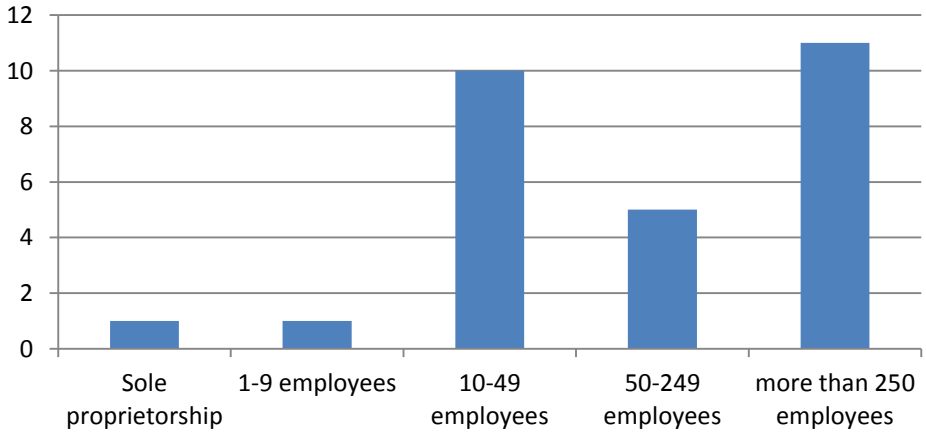
5-1 Chart showing age distribution of workshop participants.

Documentation regarding the composition of workshop participants was made in collaboration with the Swedish Construction Federation, Swedish Association of Plumbing and HVAC Contractors and the Association for Swedish Electrical Contractors, (Elektriska Installatörsorganisationen EIO). The distribution of the various construction industry operational areas represented in the workshops is shown in the pie chart on the next page.



5-1 Chart showing workshop participant distribution by industry segment.

The ambition was to find participants from both large and small companies. For obvious reasons the smallest companies were not represented to any great extent, but the spread must be considered good from companies sized 10 employees or more.



5-2 Chart showing workshop participant distribution by company size.

Systematizing outcomes: In connection with the report, participants weighted the responses that emerged from the exercises. Headings were then jointly established. The figures in brackets further down indicate the strength of a priority measured by the number of selected alternatives. Outcomes here are reported per question – not per location – followed by a summary and a conclusion.

Workshop Question 1: HOW can we best carry out skills enhancement in low-energy construction?

Prioritized responses from the work groups.

Priority 1. The importance of everyone undergoing a common basic training, and that such training should be provided to every relevant occupational group and should contain both theoretical and practical exercises. Some occupational groups have very limited effect on a building's performance in terms of energy, e.g. painters. Certification training/courses were also taken up as proposals.

5-3 Photography workshop. Participants consider priorities in small groups. Photo: BI

Priority 2. Feedback between project planning and production. including skilled workers, regarding:

- Execution
- Climate
- Energy consumption
- Function

This creates commitment and involvement say participants. Sharing both good and bad experiences is an important part of lifelong learning. Working to achieve individual understanding through training/knowledge of life-cycle costs, the EU's 20-20 and 50-50 goals creates awareness and awakens a desire to learn more, say participants.

Better understanding between different occupational groups is necessary to improve collaboration during the construction process. One concrete proposal is to "include solutions in the drawing" and make sure every employee concerned understands. I.e. make sure that the entire project group from client, architects and technical consultants to site-related categories – both supervisory and skilled workers – take part in the project briefing.

Under the Feedback heading, Work Planning and Follow-up were given high priority. Participants feel that project follow-up with feedback also to consultants and designers is crucial for skills enhancement in low-energy construction.

Information/documentation regarding execution/production emerged as an important part of skills enhancement since a system for this is lacking at construction sites, say participants.

The proposals are:

- Simple, standardized installation instructions.
- The installation instructions must be easily accessible on site.
- More clear, straightforward information at sites.
- Training and directions in material handling.
- Training and directions in execution.

Skills enhancement support functions alongside text and images might include short films with installation instructions made easily accessible through a common internet portal. An important condition is that sites have internet access and computers/tablets in order to search for solutions in real time when an operation must be completed.

Workshop Question 2: <u>HOW can we motivate skilled workers/supervisors to enhance their low-energy construction skills?</u>

Participants were very involved and had many proposals right from the beginning regarding various forms of wage compensation, but none of these were prioritized by the group in the final phase of the process.

Headings were created based on the determined proposals for activities. They are presented here in order of priority:
The figures in brackets show how participants voted on the significance of the response concerned.

(11) *Commitment* – create understanding and explain why, show outcomes/performance, fun courses & kick-off.
(9) *Requirements* – proper conditions within projects, sufficient time to do job properly, authority requirements.
(7) *Development* – the same training for everyone creates a shared view, maintain professional pride through development.
(6) *Training* – ensure training increases understanding & interest; industry standard course certificate/certification.
(4) *Information* – point out the green advantages, achieve performance feedback through certificates.
(3) *Compensation/reward* – bonuses/premiums, competition ”energy follow-up”.
(2) *Development of materiology* – development of new technologies, new construction methods.

In their discussions, the group lacking experience in energy-efficient construction (the control group) arrived at the following conclusions for the levels society, employer and individual. Angles of approach that did not emerge previously are gathered below under a new heading, "Motive". The figures in brackets show how participants voted on the significance of the response concerned.

Motive

(8) *community level* – status boost, trendy
(4) *employer level* – opportunities to
- make money
- change
- advance career

(2) *individual level* – carrots in the form of
- assignments
- pay
- responsibility
- position

Summary

There is a curiosity and commitment regarding future energy-efficient construction. In this case skills enhancement wishes consist of two parts – information and instruction.

In the case of skills enhancement for the existing workforce at a construction site the plan proposes following principal activities:

- Short courses/information: Designing short courses that create an overall understanding and shared view of energy efficiency is considered to be of the utmost importance by everyone. Information regarding such things as life-cycle perspectives, the EU's 20-20 and 50-50 goals create awareness and awakens a desire to improve one's skills. Participants also emphasized that a lack of knowledge causes stress, while shared experiences – both good and bad – form an important part of lifelong learning. The training created should be based on requirements specified by the client side, and an industry-wide register of individuals who have completed the training should be set up.

- Better understanding between different occupational groups is necessary to achieve improved cooperation/collaboration. Participants also feel that project follow-up with feedback even to consultants and designers is crucial for skills enhancement. Improved communication within a project where those working at construction sites are given opportunities for dialogues with others involved in the project. This is done to improve knowledge within the technology area and to gain an understanding of how the different technology areas affect each other and link together during renovation and new construction work and in a building's future energy efficiency life cycle.

- On-site instruction about certain special operations and new materials handling is also a highly prioritized wish. It is possible to detect a certain optimism among participants regarding reaching the 20-20 goal in Sweden, if they are helped to understand what is right, and how to do it. Easily accessible installation instructions for products with low impact products from materials suppliers – skills enhancement “just in time”.

6 General Strategy for achieving training requirement goals

Parallel to the other actions resulting from the European Parliament's and Council's directives on the promotion of the use of energy from renewable sources (RES, 2009/28/EG) and the directive on the energy performance of buildings (EPBD, 2010/31/EU), it is important that people working at construction sites have the skills required for achieving the sought-for characteristics. Construction workers, electricians, plumbing & HVAC installers and supervisors require sound, basic skills but need also to understand that energy-efficient buildings and installations place greater demands on accuracy and the interplay between different occupational groups.

6.1 Skills enhancement in energy-efficient construction today

There is already some local initiatives that includes courses and supplementary training in energy efficiency and renewable energy in buildings for skilled workers.

The Passive House Centre in Alingsås and the Technical Research Institute of Sweden (SP) have organized the course Passive Houses for construction workers. The course provides broad, basic general knowledge of passive house construction and energy-efficient buildings. In addition to energy efficiency, participants learn to regard a building as a system in which high durability and a good indoor environment are important characteristics.

The same operators – the Passive House Centre and SP – have begun a project with a programme named Lågan aimed at providing supplementary training for skilled workers in the construction industry. The project "Skills enhancement for skilled workers" will create a skills enhancement programme in energy-efficient buildings based on training the trainers. The dissemination of knowledge will thus largely take place as internal training in construction companies with the aid of the course material developed within the project. This procedure creates the means to quickly and cost effectively reach out with information to a large number of skilled workers in the construction sector.

Other operators have their own training courses. NCC has a 'Moisture and Energy Training' course lasting four hours for production personnel and covers: ongoing climate change, low-energy buildings and passive building design, airtight integrity, moisture control, structural details regarding moisture and integrity, cold bridges and penetrations.

Thus a lot of activity in the field is already taking place today, but there is no coordinated national grasp of skills enhancement for skilled workers and supervisors when it comes to energy efficiency improvement and nor is there any national register listing those who have undergone training. One difficulty in this context is the prevailing uncertainty regarding the level of political ambition when it comes to energy-efficient construction in Sweden. Some municipalities would like to see higher standards while others feel there should be coordinated standards for the country as a whole.

6.2 Skills enhancement in existing labour in roles close to production

The gap between the general skills level of construction workers and supervisors compared to what is necessary in connection with more energy-efficient construction was identified in the earlier subprojects. The completed survey and other studies show that skills enhancement activities are necessary at different levels from fundamental understanding to the more hands-on instruction.
It is in the interest of many construction companies to develop their personnel to meet the increasing demands that will occur in connection with low energy projects. But meeting the challenges presented by 2020 and the associated energy goals will require a skills boost in the great majority of construction projects.

The actions proposed in this roadmap are based on two basic conditions:

- Requirements – changed regulations or customer requirements
- The majority of people employed in the construction industry have the relevant vocational training.

In the case of the first condition a choice was made between proposing measure that require changes to national regulations and measures that can be linked to customer requirements. Measures linked to customer requirements at various levels were proposed for people already employed. The construction project client (purchaser) plays a key role in making demands for training activities and better communication between a construction project's operators. The proposal for basic supplementary training is not so extensive in time, it is probably a matter of one day's training and therefore no certification is proposed. Thus the requirement for training must be designed to be competitively neutral. A company that wins a tender must be able to ensure that the training requirement is met after the event. Purchasers of construction materials and ultimately skilled workers and supervisors may make demands for advanced information about installation and the correct performance of work.

The skills enhancement measures proposed below are not connected to the formal training system but are strictly non-formal and informal activities. Skills enhancement is often associated with 'courses' conducted in places reminiscent of school classrooms, but instruction at the workplace often takes place in informal contexts. Therefore the proposals are based on a combination of training in the form of a course, improved communication between all operators in the project from client and project planners to those employed on construction sites, and better conditions for performing the actual work through access to instructions.

The second condition is more complicated. Merely training individuals who lack basic professional skills in energy-efficient construction is hardly adequate. There is an unknown number of individuals currently in work who do not have basic vocational training and thus lack vocational certification or equivalent. These categories will therefore not be reached through changes to the educational system but must be reached via the skills enhancement activities proposed below. Skills enhancement alone linked to energy-efficient construction and the design of installations might however result in significant gaps in basic knowledge, therefore companies employing labour that lacks relevant vocational training bear a great responsibility. The client side must also agree that there are risks associated with using labour that lacks formal basic training in a project.

The following develops proposals that emerged from workshops and which can be summarized in three overall approaches:

- Foundational training that creates motivation.
- Skills enhancement through structured information in connection with construction start and during the construction phase itself.
- More easily accessible installation instructions from materials suppliers and manufacturers.

A fundamental condition is that funding can be ensured, e.g. through a new EU application in *Build Up Skills* Pillar II. Ongoing activities in the form of supplementary training, the introduction of briefings and further installation instructions from suppliers and manufacturers of construction and installation materials will entail more comprehensive finances than the initial investments described here. It is assumed that the platform used for monitoring ongoing operations will support this later phase.

6.2.1 Preparatory information to the client

The building project purchaser has a key role to play in energy efficiency improvement. Society's requirements for energy performance must be met and the client has everything to gain from achievement of the sought-for performance. Thus the client plays an important part in making the appropriate demands when purchasing a building project. For example, the client is able to make clearly defined demands. Even if all previous stages of a building project have fulfilled their respective obligations for achieving goals, work from previous BUSS sub-projects has shown that site personnel, skilled workers and management play an important part in ensuring that goals are met.

In addition to the various organizations for professional clients there are also private purchasers in the form of housing associations and house owners. These can be reached through their various organizations such as SBC, HSB, Riksbyggen and national and local house owners associations.

Proposal 1.10, 1.11: Information activity aimed at building project clients

- **1.10** Preparation of criteria for the purchase of building projects regarding supplementary training for people currently in work at construction sites and the introduction of briefings for all operators involved: clients, project planners, project managers, management and above all skilled workers. The intention is for these criteria to form the basis for the purchase of a building project with energy efficiency improvement elements. (Swedish Construction Clients Forum, Swedish Energy Agency, Swedish Environmental Management Council)

- **1.11** Information activity aimed at clients The purpose is to establish client requirements in connection with the purchase of building projects so that those employed at the construction sites undergo basic supplementary training in energy-efficient construction. The activity is also about the importance of calling construction project operators to briefings where skilled workers and supervisors are given the opportunity to meet clients and project planners for briefings and feedback while the project is in progress. (Swedish Energy Agency, National Board of Housing, Building and Planning, Swedish Environmental Management Council, the Association of Swedish Regional Energy Agencies, Passive House Centre)

6.2.2 Foundational training that creates motivation; supplementary training activity

Both the requirements analysis and the completed meetings with construction workers and supervisors have clearly shown the need for a basic training activity. This activity should provide the background to the importance of more energy-efficient construction, help create understanding, a shared view and respect among all involved in a construction project, and clarify the consequences of deficiencies in execution e.g. air leaks and faulty settings. Training should be demanded by the client in connection with the procurement of a building project. The occupational groups concerned will be those considered to have the greatest influence on a building's energy performance.

Costs must be kept at deliberately low levels and companies must in principle be able to train their own personnel with the assistance of trained instructors. Teaching media need to be prepared and made freely available to all trainers and participants.

Those who have already carried out this basic training activity should not have to repeat it. A number of companies have already carried out an equivalent training activity; they should be able to register that their employees have completed this.

Completed training should not, for reasons of competitive neutrality, be a pre-condition for tendering for a construction project. The requirement can instead be met within the project framework if there are skilled workers and supervisors who have not previously undergone training. This principle is already applied by the Swedish Transport Administration regarding safety training in connection with civil engineering projects.

Specific details of basic training will need to be developed at a later stage, but based on the requirements analysis we can draw attention to the following possible content:

- Why is it important to save energy? Climate change and the consumption of natural resources.
- The life-cycle perspective of a building.
- The interplay between installation systems, the building envelope and operations inside the building.
- Construction methods for low-energy buildings – increased performance demands increase the requirement for precision work.
- Logistical issues
- Energy efficiency improvements in the construction phase. Setting up temporary electricity and heating, etc.
- Collaboration and understanding between construction project operators.
- Documentation for correct work execution – drawings, descriptions, AMA (a Swedish standard for desciptions), installation instructions.
- Low energy products.
- Environment and quality requirements.
- Horror stories: "When things go really wrong"

Proposal: 1.20-1.24 Basic supplementary training

- **1.20** A *Basic supplementary training course on energy-efficient construction* should be designed in order to create a basic understanding of energy-efficient construction. Supplementary training should be possible to sub-order as required and be carried out in different ways by different operators. Instructors may thus be available in construction and installation companies and at training providers. Supplementary training must combine theoretical and practical information. Training material must be created and made freely available to all trainers. The stakeholder group should also be responsible for the administration and development of training. (Stakeholders: Construction material industries, EIO - The Association for Swedish Electrical Contractors, Swedish Energy Agency, Passive House Centre, SP, Swedish Construction Federation, Swedish Association of Plumbing and HVAC Contractors)

  1.21 *Material from The Swedish National Board of Housing, Building and Planning's"Build to Live dialogue", where a number of rights are held by IVL could be re-used.*

- **1.22** The establishment of an industry-wide register covering people who have undergone a *basic supplementary training course on energy-efficient construction* (Construction Skills Council (RBK) – Swedish Construction Federation, Swedish Organization for Managers, Swedish Construction Clients Forum)

- **1.23** Training of 500 teachers/instructors to perform the supplementary training activity. (Stakeholders: BFAB/STF - Education Provider for Engineers, EIO - The Association for Swedish Electrical Contractors, SP, Passive House Centre, Swedish Construction Federation, Swedish Association of Plumbing and HVAC Contractors).

- **1.24** Implementation of the *basic supplementary training course on energy-efficient construction*. (Construction companies and building industry organizations). **This part is not funded by the IEE programme Build Up Skills pillar II.**

6.2.3 Skills enhancement at the construction site

Skills enhancement is not just about courses. Requirements analyses and workshops also highlight the need to inform everyone involved including skilled workers in different trades at the start of a construction project. Follow-up meetings are also necessary while the project is in progress with opportunities for feedback of experiences. This in itself is nothing new and untried, but the client has a natural opportunity to place demands on this type of collaboration between advisers and performers. In projects with high energy efficiency demands there is an increased need for well-reasoned solutions that are actually carried out as intended.

In this context it is also important to study energy efficiency in the construction phase to minimize the use of energy for temporary heating and to solve the need for heating and lighting huts in an energy-efficient manner. For labour market reasons it is not possible to plan all construction for warmer seasons, but at the

early stages of a project, planners should strive to minimize the requirement for heating uncompleted sections of a building.

Proposal: 1.12, 1.13 Requirement for briefings and follow-up meetings and supplementary training

- **1.12** Promoting the introduction of requirements for briefings in connection with the start of a construction project and follow-up meetings while the project is in progress into tender documentation. All operators involved during the construction phase of a project such as clients, project planners and above all skilled workers and supervisors need to participate. (Swedish Construction Clients Forum, Swedish Environmental Management Council)

- **1.13** Promoting the introduction of requirements for a basic supplementary training course on energy-efficient construction for personnel employed at construction sites who can influence the energy performance of a building into tender documentation. (Swedish Construction Clients Forum, Swedish Environmental Management Council)

One of the other common threads in the results from requirements analyses and meetings with skilled workers and supervisors is the need for easily accessible information in connection with the execution of various work operations – skills enhancement/training/instruction in connection with execution. The requirements analysis also made clear that a significant cause of perceived stress is the lack of knowledge when performing work operations.

Suppliers of construction materials and installation products should be encouraged to make existing instructions easily accessible on the internet or create new ones. Instructional films that supplement more conventional text and image-based material would be an advantage.

Many manufacturers and suppliers of construction and installation material operate internationally and coordination with other countries regarding *Build Up Skills* activities should be looked in to.

A good example is the plumbing & HVAC industry's ”Säker vatten” (Safe Water) instructional films available on their website at www.sakervatten.se.

Because such instructions must be easy to find we therefore propose that existing organizations that work with industry information such as the Swedish Building Centre create portals for installation instructions.

6.2.3-1 Example of an instructional film

Proposal: 1.30-1.32 Product-specific training activities – materials suppliers

- **1.30** Suppliers and manufacturers of materials and equipment must develop installation instructions with text, images and possibly instructional films, all aimed at skilled workers. *The interface between different materials and products must be given special attention* as must the conditions for repairing damaged material. Construction and installation materials companies with multi-national markets should be especially able to create material within the *Build Up Skills* framework that contributes to the common European 20-20 and 50-50 goals.
  We propose that EU funds be sought for the introduction of ten different pilot projects representing different types of materials and suppliers. It would be an advantage if some of these projects were carried out transnationally.
  1.31 Based on experiences from the creation of installation instruction, framework descriptions will be created to facilitate continued development of the instructions..
  (Construction material industries, incl. Swedish Ventilation, plus electrical suppliers)

- **1.32** We also propose that a portal be opened to make installation instructions and films easily accessible for personnel at Swedish construction sites.
  (Swedish Building Centre)

6.3 Development of basic training in upper secondary and vocational training schools

6.3.1 Current training programmes in upper secondary schools

A review of the current status analysis of construction-oriented vocational training programmes in upper secondary schools showed that there are already formulations in policy documents referring to energy efficiency improvements. However, some of the formulations are so general that there is a risk that it will not be possible for vocational teachers to transform them into concrete training activities.

Comments below refer to how goals for the training programmes concerned are formulated. Text from the Swedish National Agency for Education is in italics. We have underlined text ourselves only to clarify which parts can be linked to energy-efficient construction. Additional goals will probably need to be realized to provide the necessary leadership for vocational teachers.

The upper secondary school policy document consists of programme goals, programmes structure and subject plans including syllabuses. The subject plan states the purpose of a subject and is the *core content* in the underlying syllabuses that clarifies what students are required to learn. The National Agency for Education also provides leadership in the form of *comments* to the various course contents.
The subject plans also form the basis for admission to vocational teaching courses. These courses do not contain any subject related sections per se, but new teachers must be assessed and qualified based on the subject plans. There is a risk that energy-related content has little weight in such assessments.

An extremely important factor in addition to the policy document is the qualification a vocational teacher should have when it comes to energy-efficient buildings and installations. Changed content in upper secondary schools will require skills enhancement activities in the existing teaching body. The approximate number of affected vocational teachers – 1500 – that emerged from the current status analysis has been allocated at programme level.

The distribution of teachers of different subjects in the 2011/2012 school year is according to the National Agency for Education.

Vocational teachers per subject group

Subjects	Total number of vocational teachers	Number affected*	Number to be trained
Cons/civil eng. technology (Cons & civil eng. programme)	978	80%	around 800
Electricity-/telecom technology (Electricity- and energy programme)	899	65%	around 600
Operations/ maintenance tech (plumbing & HVAC programme)	129	95%	around 120

** the proportion is based on an estimate derived from the number of students per subject in the table below.*

The table shows the number of construction-oriented vocational programmes in upper secondary schools in years 2 and 3 in the 2011/2012 school year. (The programme changed name for students beginning year 1 in 2011/2012).

Construction programme	students	proportion	**El. programme**	students	proportion	**Energy programme**	students	proportion
New name from autumn term 2011. Construction and civil engineering programme			*New name from autumn term 2011. Electrical and energy programme*			*New name from autumn term 2011. Plumbing & HVAC and building services programme*		
Installation	590	8%	automation	1178	16%	Ops/maint. technology	59	4%
House construction	5756	78%	computer technology	1142	16%	Marine technology		0%
Painting	677	9%	electronics	205	3%	plumbing & HVAC	1446	94%
Sheet metalwork	299	4%	el technology	4604	64%	Commercial	29	2%
Commercial	64	1%	commercial	55	1%			
total	7386		total	7184		Total	1534	

Thus around 80% of the Construction & Civil Engineering teachers can be considered to be candidates for skills enhancement activities concerning energy-efficient construction.. In the Electrical and energy programme around 65% of teachers train to meet construction industry needs in the electrical technology specialization, and in the plumbing, HVAC & building services programme it is fair to assume that 95% of vocational teachers are affected.

Construction and civil engineering programme

Extract from the overall programme goal:

"...Training must develop the student's knowledge of and skills in construction and civil engineering in e.g. new construction, conversions and renovations. Because construction and civil engineering work impacts society's infrastructure and the

environment in which people live, training must provide proficiency in rational, safe and environmentally sustainable construction. Training must also impart an understanding of the industry's different professions, work processes, entrepreneurship and enterprise, which will provide a firm basis for collaboration at the workplace and with customers..."

The underlined text is all that is said at this level to indicate that the goals in the training even include energy-related issues. In the more concrete subject and course plans we can see the formulations shown in the following extracts.

The course **Natural Science 1 a** includes the obligatory subject Natural Science (this course is included in all upper secondary school vocational programmes).

Extract from the course's core content:

"Instruction in the course must take up the following core content:

- *Issues regarding sustainable development: energy, climate and ecosystem impact. Ecosystem services, resource exploitation and ecosystem viability.*
- *Various aspects of sustainable development, such as consumption, resource allocation, human rights and equality..."*

Here at least is a basis for understanding the fundamental problems regarding why energy-efficient construction is important.

The following formulation can be read under 'Subject aims' in **Construction and Civil Engineering**:

"...Instruction must lead students to develop knowledge about legislation and other regulations in their vocational field and how to find information regarding the appropriate regulations. It must also lead students to develop an ability to work with due consideration for health and safety. The instruction must give students the opportunity to develop an understanding about the industry's responsibilities in sustainable development..."

The following comment provides further clarification:

"...Sustainable Development
Construction and civil engineering work affects the environment in several different ways. The industry transforms surroundings, creates infrastructure, uses resources and creates construction waste. Instruction in the subject Construction and Civil Engineering leads students to develop an understanding of sustainable development.
Sustainable development is a broad concept that includes economic and social aspects in addition to ecological. Social aspects may include e.g. equality and diversity at the workplace, which entails such things as a conscious effort to develop attitudes that combat abusive behaviour.

It also states that:
Instruction in the subject Construction and Civil Engineering must provide students with the conditions to develop the following: ...9.Knowledge of everyday vocations and work processes in construction and civil engineering and what sustainable development entails for the industry..."

There are two obligatory courses within the subject**; Construction and Civil Engineering 1** and **Construction and Civil Engineering 2**, with 200 points each. In very general terms, one point is equivalent to about 1 hour's instruction.

In the second course the formulations about sustainable development reappear:

"Instruction in the course must address the following core content:

- *Information searches for the assignment with the aid of the internet and other means.*
- *Practical assignments within civil engineering, house construction, painting and sheet metal work.*
- *Planning and calculations to solve assignments.*
- *Tools and equipment for various purposes. Handling and maintenance.*

- *Various types of materials and their characteristics.*
- *General knowledge on legislation, regulations and design requirements.*
- *Work Environment Authority and industry organization safety requirements and qualifications necessary for work within the industry.*
- *Basic instruction in fire hazards, fire prevention, flammable goods and electrical safety.*
- *Various types of risks associated with assignments; risk assessment methods.*
- *First aid and CPR.*
- *Health and ergonomics.*
- *Methods for documenting and evaluating own work.*
- *Various occupations within the construction and civil engineering industry and field trips to different workplaces.*
- *Construction project planning and collaboration between various occupational groups, the client and customer.*
- *The construction and civil engineering industry's role in society and as regards sustainable development.*
- *Resource use in connection with sustainable development and company profitability, e.g. materials handling, storage, minimizing spillage and the sorting of construction waste.*
- *Industry terminology.*

In this example core content is included in its entirety to show the context in which sustainable development formulations appear. The formulations are somewhat general and provide great scope for interpretation regarding these issues.

After choosing a course within the programme it is chiefly in *House Construction* where students prepare for *specific trades* (woodworker, bricklayer, concrete worker, etc.) that may be associated with assignments affecting a building's energy consumption, e.g. the insulation of the buildingenvelope.

From 'Subject aims' in the **House Construction**:

It must give students the opportunity to develop an understanding about the industry's responsibilities in sustainable development..."

Further:

Instruction in the subject house construction must provide students with the conditions to develop the following:
...8. Knowledge of what sustainable development entails in the construction and civil engineering industry..."

Courses in the subject

The house construction process, 200 points, which builds on the course construction and civil engineering 2.

..."• Natural disasters such as floods, landslides and avalanches; structural building requirements. How future climate change may affect requirements for building structures and safety in existing buildings.
...• The industry's role in sustainable development, e.g. materials handling, minimizing spillage and the sorting of construction waste. Economy and use of resources
• Various occupational roles and working conditions at the workplace. Professional identity and professional culture..."

House construction 1, 100 points, which builds on the course construction and civil engineering 2 or on the courses production equipment 1 and production knowledge 1.

..."• Energy-efficient building designs and construction methods....

• Sustainable construction. Materials handling e.g. storage, minimizing spillage and the sorting of construction waste and residual products. The use of resources connected to the assignment..."

House construction 2, 200 points, which builds on the course house construction 1.

• Sustainable construction. Materials handling e.g. storage, minimizing spillage and the sorting of construction waste and residual products. The use of resources connected to the assignment.

House construction 3 – conversion, 200 points, which builds on the course house construction 2.

Subject - Wood

"The subject takes up work involving various wooden constructions. It also deals with all kinds of board used in building structures. In addition the subject covers different types of external cladding used on buildings.

Subject aims
Instruction in the subject must seek to ensure students develop an ability to carry out construction using wood. It must provide students with the opportunity to develop knowledge of joists and beams, frames and wooden roof structures. Instruction must also lead students to develop knowledge of interior and exterior roof and wall cladding and interior floor coverings. The training must provide students with the opportunity to develop knowledge of installing material that insulates against heat and cold as well as moisture and air tightness. Students must also be given the opportunity to develop knowledge of window and door installations and of carpentry, furnishings and mouldings.
Instruction must lead students to develop knowledge about legislation and other regulations in their vocational field and how to find information regarding the appropriate regulations. Instruction must also lead students to develop an ability to work with due consideration for health and safety. It must also give students the opportunity to develop an understanding about the industry's responsibilities in sustainable development...
...Instruction in the subject 'wood' must provide students with the conditions to develop the following:
...9. Knowledge of what sustainable development entails in the construction and civil engineering industry.
10. The ability to collaborate and communicate with others and to use industry terminology..."

Wood 1 — frames, 100 points

Core content

"Instruction in the course must address the following core content:
• Information searches for the assignment with the aid of the internet and other means.
• Simple planning and calculations to solve assignments.
• Wooden frames, e.g. joists and beams, frames, roof structures and prefabricated wooden structures.
• Form construction
• Materials for insulating against sound, heat and cold.
• Wind barriers and diffusion.
• Protecting building structures from damage due to moisture.
• Wooden materials and different types of insulation material and their characteristics.
• Wooden materials finishing process.
• Tools and equipment for various purposes. Handling and maintenance.
• Legislation and other regulations concerning the work environment, health and safety. Ergonomic working methods
• Various types of risks associated with assignments; risk assessment methods.
• Simple problem solving in connection with assignments.
Methods for evaluating own work.
• Sustainable construction. Materials handling e.g. storage, minimizing spillage and the sorting of construction waste and residual products. The use of resources connected to the assignment.
• Field trips to and information about construction sites.
• Industry terminology in relation to the assignment.

Wood 3 — installation, 100 points

Core content

Instruction in the course must address the following core content:

• Information searches for the assignment with the aid of the internet and other means.
• Planning and calculations to solve assignments.
• Installation of windows and doors.
• Installation of woodwork such as cabinetry in kitchens and bathrooms.
• Solid wood, lamella and laminate floors.
• Mouldings such as door and window frames, interior door frames and window cases, cornices and skirting boards.
• Various material and their characteristics.
• Tools and equipment for various purposes. Handling and maintenance.
• Legislation and other regulations concerning the work environment, health and safety. Ergonomic working methods
• Various types of risks associated with assignments; risk assessment methods.
• Problem solving in connection with assignments.
Methods for evaluating own work.
• Sustainable construction. Materials handling e.g. storage, minimizing spillage and the sorting of construction waste and residual products. The use of resources connected to the assignment.
• Industry terminology in relation to the assignment.

To sum up we can see there is support for certain training elements connected to energy-efficient construction. However, there is a risk that the methods passed on are not sufficiently up-to-date to function in connection with the design of high-performance structural solutions required in today's and tomorrow's levels of energy efficiency.

The frequently recurring formulations regarding *sustainable construction* risk being marginalized in relation to more explicit knowledge objectives. Therefore, in our opinion, the policy documents need to be reviewed, corrected and also supplemented with exhaustive comments. In addition to these corrections and supplements, vocational teachers need a specially created refresher training programme in regard to sustainable construction, in which energy aspects are one of the major components.

Even recently produced teaching media for vocational training needs to be updated and supplemented with sections that support training elements associated with energy-efficient and sustainable construction.

Proposal: 2.10, 2.20, 2.21, 2.31, 2.51 Changes to the Construction and Civil Engineering programme in upper secondary schools

- **2.10** Identify the requirement for changed formulations in subject and course plans or supplementary comments together with concerned national programme councils. (National Agency for Education in collaboration with the national programme councils)

- **2.20, 2.21** Development of programs for training of vocational teachers in relevant occupations in collaboration with concerned organizations. (National Agency for Education, BYN; The Construction Industry Training Board and PVYN; The Training Board for Sheet Metal Workers and Ventilation Fitters in collaboration with EIO - The Association for Swedish Electrical Contractors and the Association of Plumbing and HVAC Contractors)

- **2.31** Implementation of skills development activities for vocational teachers (BYN and PVYN)

- **2.51** Supplementing existing teaching media (BYN, PVYN and Liber)

Photo: Jonas Gerdle for Swedish Construction Federation

Photo: EIO - The Association for Swedish Electrical Contractors

Electrical and energy programme

"Programme goals

The electrical and energy programme is a vocational programme. On completion of the programme exam students will have the necessary knowledge to work with automated production systems, systems for energy, the environment, water technology, or computer and communications systems, or to work as an electrician within electrical distribution or installation.

The training must develop student knowledge of supporting and assisting important basic social functions such as production, installation and distribution of electricity, energy and water systems. It must therefore provide knowledge of electrical and energy technology and automation and proficiency in completing assignments in these areas of work. Computer and communications technology and society's IT infrastructure must also play a central role in the training.

Safety issues are of the utmost importance for work in the various occupational fields. The training must therefore lead students to become well acquainted with national and international agreements regarding technology, information security, standards, work safety and the work environment.

The training must teach students how to make conscious choices such as the ability to select the appropriate material and tools and to plan and evaluate a work process. Furthermore, the training must lead students to understand the importance of being able to document problems and systematically solve them. All electrical, automation, and computer technology knowledge is based on scientific principles. Exercise of the profession is conditional upon the ability to perform correct calculations. The training must therefore develop the student's knowledge of mathematics.

The training must provide the student with knowledge of how to contribute to the development of the profession, the company and society both nationally and locally. The internationalization of the electrical, energy, automation and computer industries requires an ability to use language. The training must provide students with opportunities to broaden their knowledge of English.

In working life the student will meet different people and be responsible for ensuring that a professional job is done, often in collaboration with other occupational groups. The training must therefore develop the student's ability to collaborate with others, approach customers, provide service and perform work proficiently in companies and in people's homes. Within these industries major companies and sole proprietorships are both common. The training must therefore provide knowledge of the conditions and constraints of entrepreneurship, economy and direct and indirect environmental impact.

Workplace environment issues must take a central place in the training to prevent industrial injuries and to promote good health.

On-the-job training must form part of all vocational programmes. On-the-job training must contribute to the development of the student's professional knowledge, professional identity and understanding of the professional culture to become part of the professional community at the workplace. On-the-job training can also give insights into the conditions and constraints of entrepreneurship.

The overall programme goal applies to both in-school training and apprenticeships.

Thus the overall programme goal entirely lacks any connection to energy efficiency improvements and sustainable construction. However, as shown below, these issues are dealt with in the Energy Technology course which forms an obligatory part of the programme, in a way that includes all students.

The Natural History course is one of the obligatory courses even in the Electrical and energy programme (see Construction and Civil Engineering programme).

*"**Subject - Energy technology***

About the subject

The subject energy technology takes up energy technology objects and how systems work and are structured. The subject is based in part on scientific principles applied at energy technology installations. The environmental perspective is included since energy technology systems impact the environment greatly.

Subject aims

Instruction in the subject energy technology must ensure students develop knowledge in carrying out operations, maintenance and service of energy technology installations and the ability to solve practical problems in this area. It must also lead students to develop an understanding of basic physical quantities, the necessary mathematics and basic chemistry. Furthermore, students must be given the opportunity to develop knowledge of the treatment, sampling and analysis of various types of water used in the process industry and in energy, environmental and water technology. Moreover, instruction must lead students to develop a theoretical foundation in the field of energy.

Students must be given the opportunity during training to develop an understanding of efficient, sustainable energy consumption and eco-cycle thinking. Students must also be given the opportunity to develop knowledge of both conventional and alternative energy systems plus the opportunity to develop safety-mindedness, professional identity and a professional, ethical approach.

Students must be given the opportunity to develop an ability to solve problems concerning operations, maintenance and service of energy technology installations by means of experimentation, laboratory experiments and an investigative approach. Students must be given the opportunity to develop technical knowledge and maintain technical equipment by means of practical exercises.

Instruction in the subject energy technology must provide students with the conditions to develop the following:

1. Knowledge of various types of energy technology equipment.
2. Knowledge of the structure, function and principles of different energy technology system solutions.
3. Knowledge of various energy sources and fuels plus the characteristics of energy carriers.
4. The ability to perform assignments in various energy technology installations and work with due regard to safety, quality and the environment.
5. The ability to optimize and carry out control and operational procedures and energy-saving measures in different energy installations.
6. The ability to solve physical or water-related chemical problems with the aid or laboratory work.
7. The ability to handle materials and tools.
8. The ability to document and evaluate own work.
9. The ability to collaborate with others and to use industry terminology.
10. The ability to work in compliance with legislation and regulations.

The courses common to the programme, which all students in the Electrical and energy programme must take, include the **course Energy Technology 1**, 100 points

"The course energy technology 1 includes items 1–10 under the heading Subject aims

Core content

Instruction in the course must take up the following core content:

• A fundamental understanding of systems in applicable energy areas and efficient energy handling.
• The energy content of various fuels.
• Renewable energy sources: sun, wind, wave, heat pump, energy gases, biofuels and alternative vehicle fuels.
• Energy consumption within the EU.
• Process knowledge in respect of nuclear power, hydro-eclectic power, thermal power, district heating and district cooling.
• Process knowledge in respect of the purification of drinking water and polluted water plus environmental and eco-cycle thinking.
• Handling, installation, metering and simple maintenance of energy technology equipment.
• Safety regulations in the energy field.

• Metering systems for energy and output plus units and abbreviations for energy and output.
• The use and maintenance of equipment and tools.
• Safety-mindedness and professional ethics. Working environment and ergonomics.
• Legislation and other regulations."

Explicit formulations regarding energy efficiency are lacking in the other obligatory courses included in the Electrical technology programme in which prospective electricians are trained For this reason no examples of the syllabuses are provided.

While the course Energy Technology 1 common to the programme, which is reproduced above, includes formulations about energy efficiency there is reason to believe teacher qualifications necessary to meet course objectives are lacking.
Even the optional Building Automation course has content that is crucial for the prospective electricians ability to ensure correct function. Because many schools deselect this course it raises the question of whether or not the course should be made obligatory in the in the Electrical technology programme.

Proposal: 2.10, 2.20, 2.22, 2.32, 2.51 Changes to the Electrical technology programme in upper secondary schools

- **2.10** Identify the requirement for changed formulations in subject and course plans or supplementary comments together with concerned national programme councils. (National Agency for Education in collaboration with the national programme councils)

- **2.20, 2.22** Development of programs for training of vocational teachers in relevant occupations in collaboration with concerned organizations. (National Agency for Education, BYN; The Construction Industry Training Board and PVYN; The Training Board for Sheet Metal Workers and Ventilation Fitters in collaboration with EIO - The Association for Swedish Electrical Contractors and the Association of Plumbing and HVAC Contractors)

- **2.32** Implementation of skills enhancement activities for vocational teachers. (EIO - The Association for Swedish Electrical Contractors)

- **2.51** Supplementing existing teaching media. (Liber, EUU)

Photo: EIO - The Association for Swedish Electrical Contractors

Photo: Colourbox for the Association of Plumbing and HVAC Contractors

Plumbing, HVAC & building services programme

"Programme goals

The plumbing, HVAC & building services programme is a vocational programme. On completion of the programme exam students will have the necessary knowledge to work with in the building, cooling, heat pump, ventilation and ventilation and sanitation.

The training must develop the students' knowledge of installation, troubleshooting, repair, operation, maintenance and administration of buildings, technical installations and systems such as heating, ventilation and cooling systems. It must also provide students knowledge of control technology and energy optimization in installations and develop their systematic thinking ability. Planning, implementation and documentation of assignments, quality assurance and the evaluation of completed tasks must also be included in the training. Additionally, the training must provide the student with knowledge of workplace environment and safety regulations plus familiarity with national and international regulations that apply to the profession.

The training must raise the students' environmental awareness and develop their ability to put their knowledge of the environment, ecology and the use of resources into practice. Students must be given the opportunity to understand how efficient energy consumption leads to sustainable development. Knowledge of systems and products that are most energy efficient and how to work with the greatest consideration for the environment is necessary in new construction, conversion of the existing building stock, repairs, maintenance and installation.

Many assignments in the occupational area involves contact with contractors, clients and customers. This demands social skills and a feel for service. The training must therefore develop the student's ability to communicate and collaborate with other people and occupational groups. The training must also develop service mindedness, quality consciousness and creativity. The training may also prepare the student for entrepreneurship within the field.

The training must develop the student's ability to review and evaluate their own work critically in regard to quality and safety requirements. Professional proficiency must form a significant part of the training and must be carried out such that students learn to complete tasks alone and together with others. The training must also provide students with the opportunity of working with both new and proven materials and working methods.

On-the-job training must form part of all vocational programmes. On-the-job training must contribute to the development of the student's professional knowledge, professional identity and understanding of the professional culture to become part of the professional community at the workplace. On-the-job training can also give insights into the conditions and constraints of entrepreneurship.

The overall programme goal applies to both in-school training and apprenticeships.

The Natural History course is one of the obligatory courses even in the Plumbing, HVAC & building services programme (see Construction and Civil Engineering programme).

"Subject - Systems knowledge

The subject Systems knowledge covers the structure and function of heating, ventilation, cooling and heat pump systems. It also covers the significance of systems maintenance. The subject also takes up energy efficiency in buildings, the media used in systems, their physical characteristics and how the transformation of energy takes place.

Subject aims

Instruction in the subject Systems knowledge must ensure students develop knowledge of the structure and function of heating, ventilation, cooling and heat pump systems. Students must be given the opportunity to develop knowledge of individual systems per se and in conjunction. Instruction must also provide students with the opportunity to develop knowledge about building structures and an understanding of how its envelope and operations affect system dimensioning. The course must provide students with the opportunity to develop knowledge of working principles, environmental impact and production conditions.

Instruction must lead students to develop proficiencies in assessing and calculating output requirements in heating and cooling processes and knowledge of how energy consumption affects health and the environment and how this can take place in sustainable development. It must also lead the student to develop a sound, ergonomic and appropriate approach to the workplace environment. Furthermore, students must be given the opportunity to develop knowledge of terms and concepts used in the installation and building fields.

Instruction must be run such that students are given the opportunity to put theoretical solutions into practice.

Instruction in the subject Systems knowledge must provide students with the conditions to develop the following:

1. Knowledge of energy technology function, structure and the characteristics of energy carriers.
2. Knowledge of thermodynamics and proficiencies in performing calculations that apply to heating, sanitation, ventilation, cooling and heat pump systems.
3. Knowledge of efficient, eco-friendly energy consumption.
4. An understanding of drawings, driftkort, user manuals and instructions, plus drafting skills.
5. An ability to perform operational checks.
6. Knowledge of legislation, regulations and design requirements.
7. The ability to work safely and ergonomically.

Common course Systems structures, 100 points

"The systems structures course includes items 1 and 3–7 under the heading Subject aims, with special emphasis on items 1 and 4.

Core content

Instruction in the course must take up the following core content:

• A holistic view of the function and interplay between heating, sanitation, ventilation, cooling and heat pump systems in buildings, structures and installations.
• The structure and function of heating, sanitation, ventilation, cooling and heat pump systems and how they are installed and maintained.
• Flow directions, temperatures and pressures in various systems.
• How system appliances and components function individually and in conjunction.
• Simple system schematics, drawing symbols and designations plus how they are used to describe systems.
• Flow charts, driftkort and user manuals for performing operational checks or real and virtual systems.
• Installation regulations, construction legislation and workplace environment regulation for compliance with society requirements for energy conservation, health and safety.

Optional course specialization Configuration technology, 100 points

"The configuration technology course includes items 1–6 under the heading Subject aims

Core content

Instruction in the course must take up the following core content:

• Basic principles of pump technology, pump data and operating modes for circulation pumps, fans and valves.
• Terminology, concepts and function of control technology components.
• Units and quantities that occur in the installation and construction industries.
• Methods for measuring pressures, temperatures, flows and rates of low in water and air.
• Measuring instruments for the application.
• Function testing to ascertain system correctness and ensure functional requirements.
• Equipment for controlling temperatures and flows.
• Configuration and commissioning of control circuits.
• Installation regulations, construction legislation and workplace environment regulation for compliance with society requirements for energy conservation, health and safety.
• Combustion analysis methods in heating furnaces."

Common course in Thermodynamics, 100 points

"The thermodynamics course includes items 1 –7 under the heading Subject aims, with special emphasis on items 2 and 6.

Core content

Instruction in the course must take up the following core content:

• The connection between heat and other forms of energy. Thermodynamics concepts such as heat transfer, temperature, transformation of energy and pressure.
• Methods of applying energy and output calculations.
• The dimensioning of pipes and air duct systems, heating and cooling media system air coolers and their internal flows and pressure drops.
• Efficient energy consumption in buildings.
• Simple system schematics, drawing symbols and designations plus how they are used to describe systems.
• Product information, calculation handbooks, templates, crib sheets, computer programs, methods of calculation and how they are used to perform system calculations.
• Construction legislation for compliance with society requirements for energy conservation, health and safety.

Summary: The policy document for plumbing & HVAC and the building services programme includes explicit formulations regarding energy efficiency; we consider the document to be well-formulated and helpful in fulfilling the sought-for teaching of energy-efficient construction. Vocational teachers within the programme may however need updating as regards new installation technology solutions.

Proposal: 2.10, 2.23, 2.33, 2.32, 2.51 Changes to the Plumbing & HVAC and building services programme in upper secondary schools

- **2.10** Identify the requirement for changed formulations in subject and course plans or supplementary comments together with concerned national programme councils. (National Agency for Education in collaboration with the national programme councils)

- **2.20, 2.23** Development of programs for training of vocational teachers in relevant occupations in collaboration with concerned organizations. (National Agency for Education, BYN; The Construction Industry Training Board and PVYN; The Training Board for Sheet Metal Workers

and Ventilation Fitters in collaboration with EIO - The Association for Swedish Electrical Contractors and the Association of Plumbing and HVAC Contractors)

- **2.33** Implementation of skills enhancement activities for vocational teachers (Association of Plumbing and HVAC Contractors)

- **2.51** Supplementing existing teaching media (Liber, Association of Plumbing and VVS-YN)

6.3.2 Other training courses for skilled workers

In addition to training in upper secondary schools vocational training for adults takes place under the Yrkesvux employment training programme and under industry auspices as 'conventional apprentices' in companies. These training activities are either defined by upper secondary school courses or industry descriptions of objectives. It is therefore worthwhile to study the content in the training boards' objectives.

6.3.3 The Training Boards' descriptions of objectives

Three different training boards operate in the occupational areas of interest within the *Build up Skills* programme; The Swedish Construction Industry Training Board (BYN), the Central Committee of the Electrical Trade for Vocational Training (ECY) and the plumbing & HVAC industry's Training Board (VVS-YN). ECY has no proprietary descriptions of objectives, but uses the National Agency for Education objectives.
Set out below are descriptions of objectives for two typical occupations; woodworkers (BYN) and plumbing & HVAC installers (VVS-YN). Underlined text seeks to highlight training elements that are specifically linked to energy-efficient construction and the need to understand and respect other operators in the process.

Description of objectives **Woodworker**		
Main area	**Common basics, all**	
Area	Operation	Description
Construction documentation	Different types of construction documentation	Familiarity with the different statuses of construction documents, standard construction industry agreements, AMA, regulations, contracts and construction directions.
	Reading drawings, basics	Must understand: scale, views, different types of drawing, common symbols, principles of dimensioning, title blocks and revisions.
Construction equipment and tools	Equipment and tools	Familiarity with how to use and care for common hand tools and power tools.
Construction material and the outdoor environment	Construction material, basics	Familiarity with common construction material regarding; area of use, quality, characteristics, prices and health and safety aspects.
	Environmental considerations	Familiarity with environmental management systems and the principles of natural cycles and recycling. Ability to source-sort construction materials
The construction process	The workplace	Familiarity with: The labour market roles of parties. Agreements and legislation governing employment. Vocational training agreement Workplace insurance
	The construction process	Familiarity with: Big picture and integration in the construction process Construction process: phases,

		operators and types of contract
		Familiarity with the construction site's various occupational and roles, the basis for working in teams with different occupational groups.
		Familiarity with regulations and authority resolutions that govern construction, checks, quality requirements and inspections.
Construction technology and calculations	Building structures	Familiarity with common installation and building structures and their characteristics and modes of operation.
	Structural characteristics; requirements and solutions	Familiarity with the characteristics of common construction materials and areas of application in respect of heat, moisture, sound and fire.
	Construction technology	Familiarity with where to find information about the performance of common construction technology solutions such as the AMA system, materials instructions and authority requirements.
	Measurement technology, basics	Familiarity with the most usual methods of setting out used at the workplace.
	Occupational mathematics	Ability to perform simple production economy calculations such as materials usage.
		Familiarity with the interplay between production technology and economy.
Health and Safety	Working environment, basics	Familiarity with: Basis of the Swedish Work Environment Act and its purpose Swedish Work Environment Authority regulations (AFS).
		Familiarity with: Construction industry workplace environment agreements Workplace environment regulations for young people in working life. Human capabilities and limitations. Work environment organisation. Purpose of the work environment plan
	Lifting and carrying	Knowledge of various forms of material handling; manual and with the aid of equipment and various working methods for lifting and carrying correctly.
		Knowledge of areas of application of cranes and lifting devices present. Signals and hand signals Lifting and lashing technology.
	Practical preventive workplace environment activities	Familiarity with the more common risks prevailing at construction sites and how to prevent them.
		Knowledge of: First aid, Fire prevention, electrical safety and the use of personal protective equipment. Work environment, health and safety activities at the workplace
		Familiarity with the function of ergonomic aids.
		Ability to apply Work Environment Authority regulations for protective devices and aids, steps, trestles, trestle scaffolds, access and transport routes, safety rails, protective roofs and scaffolding.
Main area	**Common basics, buildings**	
Area	Operation	Description
Reinforcement	Reinforcement	Familiarity with the function of reinforcement in concrete structures.
Construction documentation	Reading drawings, building construction	Ability to interpret and decipher drawings
	Reading drawings, building construction	Familiarity with various drawings for used in the construction of buildings, common symbols and principles of dimensioning.
Construction material and the outdoor environment	Material and transport technology	Knowledge of volumes and an ability to calculate weights of construction elements for safe lifting.
		Ability to carry out secure attachments in various construction elements or materials.
		Ability to apply suitable lifting techniques for safe lifting in connection with the shipping of construction components.
		Ability to apply transport methods for common

		construction materials.
		Ability to apply special instructions and regulations unique to the occupation in connection with material and transport technology with due consideration for climate and risks.
The construction process	Architecture	Familiarity with: The architect's profession and the impact of architecture through the ages. Common architectural terms. Form and function.
Construction technology and calculations	Occupational mathematics	Ability to apply and understand the mathematics used in the performance of their occupation at the workplace.
Health and Safety	Hot works	Familiarity with heat emissions in connection with various production methods.
		Practical exercise with extinguishing media and equipment.
		Ability to take fire precautions and carry out fire extinguishing.
		Familiarity with legislation, regulations and instructions, insurance terms, fire risks and safety regulations.
	Equipment and tools	Ability to use ergonomic aids.
	Erecting scaffolds.	Ability to install steel/metal scaffold systems up to 9 metres high in accordance with AFS general training.
Insulation work	Insulation	Knowledge of the theoretical connections regarding heat, moisture, sound and fire.
Main area	**Field of knowledge, wood**	
Field	Operation	Description
Construction technology and calculations	Measurement technology	Ability to erect forms for setting out foundations
Façades	Wall cladding	Ability to install exterior cladding with common materials; wooden board, plaster and fibre cement, standing and horizontal wooden panels, corrugated sheet metal.
Interior fittings	Carpentry and interior fittings	Practical exercise: Installation of windows, doors and interior fittings. Fitting and installation of edging, architraves, skirting, cornices and panels. Installation of fittings and other equipment.
Interior surfaces	Installation	Ability to install interior wooden panels.
	Carpentry	Ability to: Install cabinetry. Fit cornices, skirting, architraves, frames and panels Install fittings.
	Floor coverings	Ability to lay solid wood floors and laminate floors.
Insulation work	Insulation	Ability to carry out insulation work with in respect of heat, moisture, sound and fire.
Additional framing	Installation	Ability to install non-load-bearing interior walls with wooden or metal frames and plaster, wood, or fibre cement cladding.
		Ability to install ceiling panels
		Ability to install windows and doors.
	Sub floor	Ability to lay sub floor of wood and wood-based board.
	Wall cladding	Ability to install interior cladding with common materials; wooden board, plaster and fibre cement, standing and horizontal wooden panels.
Frame	Joists and beams	Ability to carry out load-spreading measures in joists and beams such as cross bridging and screw gluing, etc.
	Form construction	Familiarity with form pressure in concrete forms and the stresses connected with casting and vibration of concrete.
		Ability to set forms using both prefabricated and site-built forms for walls, pillars, beams, footing forms and straight stairs and the ability to erect forms for setting out foundations.
	Prefab	Ability to complete site-built element structures.
		Ability to carry out installation of elements such as walls, joists and beams and roof trusses.
	Wooden frame structures	Ability to carry out construction of wooden frames such as exterior walls, joists, beams, roofs, lintels and other reinforcements.

		Ability to fasten attachments, ties and joints.
	Frame stabilization	Ability to carry out temporary and permanent frame stabilization.
Roof	Installation	Ability to: Installation of roof with tongue-and-groove boards, boards and foil. Laying underlayment felt.
	Safety measures	Ability to carry out safety measures on roofs such as hand rails, access routes, covers, etc.
	Roofing	Ability to install a load-bearing underlayment for a layer of tiles, sheet or other common waterproofing.
Main area	**Field of knowledge, concrete**	
Field	Operation	Description
Reinforcement	Reinforcement	Ability to perform simple reinforcement of concrete structures
Concrete casting	Concrete casting	Familiarity with the qualities of various grades of concrete when casting and curing.
Frame	Footing form	Familiarity with form pressure
		Practical exercise: Reading drawings, setting out measurements, making forms from loose timber, simple reinforcement.

Proposal: 2.41 Changes to descriptions of objectives within the Construction Industry Training Board

- **2.41** The training board's descriptions of objectives needs to be reviewed to introduce more explicit formulations on objectives related to skills to clarify why energy-efficient construction and the correct completion of energy-efficient building structures from various materials are important. (BYN)

Photo: The Swedish Construction Federation

Plumbing & HVAC Training Board

Description of objectives for P&HVAC installers

P&HVAC theory and P&HVAC materials

Familiarity with:
- system structure in P&HVAC installations in different types of installation.

Ability to:
- use protective equipment, follow safety instructions and work ergonomically.
- take measurements, make and install piping and components in various types of installations.
- to look for necessary parts and components with the aid of the manufacturer's instructions and other catalogues.
- select the material required for the installation
- carry out leak tests and put installations into operation.
- carry out simple fault finding, perform service in the installation and take care of customer contacts
- carry out work on the basis of current safety regulations with due consideration for their own health and environment and that of others.
- read and understand installation documents and be able to create sketches and simple drawings as an aid to installation work.
- carry out maintenance of tools and other personal equipment.

P&HVAC welding technology

Familiarity with:
- the characteristics and use of non-alloy and alloy steel and other metals, and the determination of suitable welding and soldering methods
- the function of electric welders and their area of application
- skills requirements and test methods according to current standards for welded and soldered joints, and for pipe and structural welding using electric welders.
- environmental and health risks when welding and soldering

Ability to:
- use protective equipment, follow safety instructions and work ergonomically.

Ability, when gas welding and soldering, to
- prepare joints and pretreat materials, select fillers, flux and the size and type of welding nozzle with the aid of tables and manuals
- join copper pipes by soldering or brazing in all positions and carry out leak tests
- weld steel tubing using the backward and forward methods in all positions
- ability to use flame-cutting equipment

Ability, when using an electric welder, to:
- prepare joints and select welding rods with the aid of catalogues and manuals
- perform fillet welds on structural steel using arc welding equipment in all welding positions

Work environment and safety
Familiarity with:
- how social contacts, cooperation, influence and personal development affect an individual's health and capacity for work
- the significance of the physical and psychological work environment and organization for the individual, the company and society
- the fundamentals of fire and fire prevention

Ability to:
- use protective equipment, follow safety instructions and work ergonomically.
- apply legislation and regulations regarding the work environment and safety.
- assess whether asbestos is present in existing insulation and take the appropriate action

- take action in the event of accidents; assess risks and prevent accidents.

Implements and tools
Familiarity with:
- the necessary handling, maintenance and safety instructions

Ability to:
- use protective equipment, follow safety instructions and work ergonomically.
- select the appropriate size equipment and aids based on the work operation concerned

Coolers, operations and maintenance

Familiarity with:
- the cooling process and the function of common components
- indirect systems in cooling and heat pump installations and a technical understanding of process relationships
- the environmental impact of refrigerants and the regulations that govern refrigerant handling

Ability to:
- use protective equipment, follow safety instructions and work ergonomically.
- carry out operational and maintenance checks on cooling and heat pump systems.
- select personal safety equipment to avoid exposure to refrigerants and oils

Electrical science
Familiarity with:
- current legislation

Ability to:
- use protective equipment, follow safety instructions and work ergonomically.
- take action in the case of electrical accidents
- carry out simple electrical tasks and be able to work with due regard to electrical safety in the chosen field of operation.
- understand the consequences incorrect actions in electrical work can lead to
- the types of work which may not be carried out without electrical qualifications
- the types of work which may be carried out with the necessary knowledge
- why an earth fault breaker must be used

Energy

Familiarity with:
- simple installation, operation, maintenance and service of energy technology equipment in the P&HVAC or energy areas
- performing calculations and describing energy technology installations using mechanics and thermodynamics

Ability to:
- use protective equipment, follow safety instructions and work ergonomically.
- the structure, principles and function of various system solutions in the P&HVAC or energy areas
- common types of conventional and alternative energy systems, their working principles, environmental impact and production conditions.

Documents and drawings
Ability to:
- remain well oriented at the workplace with the aid of drawings
- understand symbols and designations
- understand the relationship between elevations and plan views in drawings
- carry out P&HVAC work independently from drawings and descriptions
- gather information from manuals, regulations and catalogues
- correctly record and describe own work
- carry out quality assurance and self monitoring according to the company's established check lists.

Legislation, agreements and regulations
Familiarity with:

- current legislation, agreements and regulations common in the P&HVAC industry.
- various quality and environmental management systems
- basic economic concepts, expenses/revenues, prices/calculations, production costs, etc.

Ability to:

- perform hot works (requires certification)
- gather information necessary for completion of the work from e.g. VVS-AMA, BBR and regulations in Säker Vatten

Proposal: 2.42 Changes to descriptions of objectives within the Plumbing & HVAC Training Board

- **2.42** The training board's descriptions of objectives needs to be reviewed to introduce more explicit formulations on objectives related to skills to clarify why energy-efficient construction and the correct completion of energy-efficient installations are important. (VVS YN)

6.3.4 Current training programmes at vocational training schools

There are a large number of programmes educating technicians for the building trade that fall within the vocational training school remit. A significant proportion of these programmes have management as one of the prospective areas of operation for students. They bear titles such as Construction Engineer – Production; Construction Manager – Production or Installation Engineer. Other programmes are aimed more toward the project planning role with designations such as Construction Engineer – Sustainable Construction; HVAC Engineer or Ventilation Engineer and so forth. There are also several programmes focused directly on energy such as Energy Analyst or Energy and Environment Coordinator. But because these programmes are intended for roles other than construction supervision they fall outside the scope of this roadmap. While an energy coordinator may have a supporting role to play in the management of a construction project, additional requirements regarding energy-related content in an energy coordinator training programme are hardly to be expected.

There are currently no definitive requirements regarding what a programme aimed at construction or installation management should include. Every training coordinator consults with local representatives from working life and also gains inspiration from other programmes on offer. Programmes aimed at installation technology naturally include a larger proportion of training items linked to energy efficiency. Social trends have a certain influence on the content and areas such as sustainable construction occur in some of the programmes.

The National Agency for Higher Vocational Education has carried out surveys to define the basic requirements for training within entirely different occupational areas One example is in the train driver area where there are now a number of fundamental criteria from a decision taken by the agency. The decision is based in part on an EU directive on qualifying tests for train drivers.
Energy-related elements of programmes aimed at supervisory roles could also be linked to political decisions in the same way.

Extract from: Ordinance (2009:130) on higher vocational education

8 §/Comes into force: 15/12/2012/ Where training has aims requiring nationwide equivalent content the National Agency for Higher Vocational Education will prescribe the subjects, skills and qualifications that all students must achieve by completion of training. It must be a matter of training where
1. certain requirements are made in enactments or ordinances,
2. which leads to an occupation or function for which certain requirements are made in order for a licence for the occupation or function to be issued or where other requirements are placed on the training for qualification, approval or certification for the occupation or function,
3. and which also leads to an occupation that has an important social function or
4. which must have nationwide equivalent content for safety reasons.

The agency will also prescribe regulations regarding training programmes whose aims require nationwide equivalent content other than those mentioned in the first paragraph.

The agency must consult with representatives for the authorities and organizations concerned before it prescribes regulations. Ordinance (2012:643).

Proposal: 2.60 Minimum requirements for qualifications from higher vocational education

- **2.60** We suggest that the Swedish Construction Federation consider the possibility to define the minimum common content in terms of qualifications including energy-efficient building practices in the construction and installation technically oriented training for construction managers and to discuss the possibility of prescribing the content related to the design of new courses in higher vocational education. (Swedish Construction Federation)

Technology programme and a new fourth year

A pilot scheme with a new fourth year following the upper secondary Technology programme has been under way since 2011. This programme also has supervisory roles in construction and installation companies as its main focus after the Community builder profile. The content of the fourth year is preliminary and may change.
In the underlying instruction, the three regular years of the technology programme include basic courses in *Environmental and energy knowledge* and *Sustainable community development*.

6.4 Follow-up and development of the roadmap

Because the European energy and climate goals run up until the year 2020 there is a need to follow-up roadmap proposals. Sweden's long-term goal of halving energy consumption by 2050 also provides an opportunity to develop the roadmap over the long term.

6.4.1 Creating a platform for implementing and following up the roadmap

We propose that a national platform be created to ensure that the proposed activities are realized and the continued operation takes place. Applications prior to Build Up Skills phase 2 should also be coordinated vis the platform. The platform should consist of important stakeholders with associations to energy-efficient construction and must also be able to act as a forum for any changes in direction that the roadmap indicates.

Proposal: 3.20 Platform - operators

- **3.20** We propose that the Swedish Energy Agency be responsible for the creation of the BUSS platform in collaboration with the following stakeholders: Bebo, Belok, National Board of Housing, Building and Planning, Swedish Construction Clients Forum, Construction material industries, EIO – The Association for Swedish Electrical Contractors, Swedish Energy Agency, Association of Swedish Regional Energy Agencies, Glass Industry Association, KARF, SABO, Construction Federation, Byggnads (trade union for construction workers) and Association of Plumbing and HVAC Contractors.

6.4.2 Coordinating authority

The overarching energy goals for 2020 were decided at the political level. Certain departments and associated authorities are already working to achieve these goals. Roadmap activities require the participation and coordination of relevant national authorities. New initiatives to improve energy-efficient construction skills are also being planned and implemented in the construction industry, such as the certification of installers of certain heating systems powered by renewable energy and skills enhancement initiatives in near-net-zero construction The measures proposed in the roadmap should be coordinated with these initiatives by the relevant authorities.

7 Roadmap for implementation

Follow-up and quality assurance of the proposed activities will be necessary, as will coordination of the responsibilities and actions of stakeholders and national authorities. As mentioned previously, the majority of the proposed activities are contingent upon external funding. Implementation of the roadmap is predicated upon a guarantee of funding. Here is a summary of the various proposals that emerged from the project.

The activity number refers to the proposals in main section 6: General Strategy for achieving training requirement goals. Refer to the list of contents.

7.1 Roadmap summary

Sub-projects normally involve several operators

Act No.	*Sub-project*	*Proposed operators*	*Undertaking*	*Start date*	*End date*
1.10	**Creation of criteria for skills enhancement in construction projects**	Swedish Energy Agency	Work for the creation of skills enhancement criteria for construction site personnel in respect of energy-efficient construction in connection with the purchase of building projects.	Sep 13	Dec 13
		Swedish Environmental Management Council	Creation of skills enhancement criteria in respect of energy-efficient construction in connection with the purchase of building projects.		
		Swedish Construction Clients Forum			
1.11	**Information to building project clients**	Swedish Energy Agency	Assume responsibility for coordination and implementation of information activities aimed at clients regarding the need for improved project communication and client requirements for basic supplementary training in energy-efficient construction.	Jan 14	Dec 14
		National Board of Housing, Building and Planning	Implement information activities aimed at clients regarding the need for improved project communication and client requirements for basic supplementary training in energy-efficient construction.		
		Swedish Environmental Management Council			
		Association of Swedish Regional Energy Agencies			
		Passive House Centre			
1.12	**Introduction of requirement for briefings and follow-up meetings with all involved.**	Swedish Construction Clients Forum	Work to introduce requirement for briefings and follow-up meetings with all involved.	Aug 14	Dec 19
		Swedish Environmental Management Council			

Act No.	*Sub-project*	*Proposed operators*	*Undertaking*	*Start date*	*End date*
1.13	**Introduction of requirement for basic supplementary training**	Swedish Construction Clients Forum	Work to introduce requirement for basic supplementary training in connection with the procurement of construction projects with elements of energy efficiency improvement.	Aug 14	Jul 17
		Swedish Environmental Management Council	Introduce requirement for basic supplementary training in connection with the procurement of construction projects with elements of energy efficiency improvement e.g. using Environmental Management Council check lists.		
1.20	**Basic supplementary training in energy-efficient construction – creation of course**	Passive House Centre	Assume responsibility for, and coordinate, the creation of basic s+ and training material. The material must be freely available for copying and printing or as online documents.	Jan 14	Jul 14
		Construction material industries	Assist with the creation of basic supplementary training and training materials.		
		EIO - The Association for Swedish Electrical Contractors			
		SP			
		Swedish Construction Federation			
		Association of Plumbing and HVAC Contractors			
		National Board of Housing, Building and Planning			
		Swedish Energy Agency	Work to ensure that the training material created using EU funds is made available at cost to the training providers who wish to use it.		
1.21	**Rights to Bygga Bo dialogue material**	National Board of Housing, Building and Planning	Assist as necessary to ensure that Bygga Bo dialogue material may be reused in the training material created for the basic supplementary training.	Nov 13	Dec 13
1.22	**Register completed supplementary training**	Swedish Construction Federation	Assume responsibility for the creation of an industry-wide register of supplementary training students through RBK	Mar 14	Jul 14
		Swedish Construction Clients Forum	Work for the creation of an industry-wide register of supplementary training students through RBK		
		Swedish Organization for Managers			
1.23	**Basic supplementary training in energy-efficient construction – training trainers**	EIO - The Association for Swedish Electrical Contractors	Carry out training of teachers/instructors for the basic supplementary training initiative.	Aug 14	Mar 15
		Passive House Centre			

Act No.	*Sub-project*	*Proposed operators*	*Undertaking*	*Start date*	*End date*
		SP			
		Swedish Construction Federation			
		Association of Plumbing and HVAC Contractors			
		BFAB/STF Post-graduate engineering			
1.24	**Basic supplementary training implementation**	Many stakeholders (industry associations, training providers, companies)	Implement basic supplementary training for relevant occupational groups at construction sites as per client requirement.	Oct 14	May 18
1.30	**Installation instructions - creation.**	Construction material industries	Develop installation instructions for target groups construction workers, plumbers & HVAC installers; to be made available on internet. The instructions must be linked to actions that have an effect on a building's energy performance and be pedagogically set up with a combination of text, images and video. It would be ideal if these activities were aimed at a broad European market. Seven pilot projects in construction, plumbing & HVAC	Aug 13	Dec 13
		Swedish Ventilation			
1.30	**Installation instructions - creation.**	Electrical materials suppliers	Develop installation instructions for target groups electricians and supervisor installers; to be made available on internet. The instructions must be linked to actions that have an effect on a building's energy performance and be pedagogically set up with a combination of text, images and video. It would be ideal if these activities were aimed at a broad European market. Three pilot projects in the electrical field	Aug 13	Dec 13
1.31	**Framework descriptions, installation instructions - creation.**	Construction material industries	Creation of framework descriptions of installation instructions, based on pilot project experience, to clarify the design and content of instructions.	Jan 14	Mar 14
		Electrical materials suppliers			
1.32	**Portal, installation instructions - creation.**	Swedish Building Centre	Creation and administration of a national portal for installation instructions aimed at construction site employees and with special focus on energy efficient building structures and installations.	Oct 13	Dec 13

Act No.	*Sub-project*	*Proposed operators*	*Undertaking*	*Start date*	*End date*
2.10	**Review of policy document, upper secondary schools**	National Agency for Education	Identify requirements for changed or supplemented policy documents in consultation with the national programme councils for Construction and civil engineering, Electricity & energy, and Plumbing & HVAC and building services programmes.	Aug 13	Jun 13
2.20	**Supplementary training programme, vocational teachers, Construction and civil engineering programme – creation**	National Agency for Education	Development of programs for skills development for vocational teachers in relevant occupations in collaboration with concerned organizations.	Jan 14	May 14
2.21	**Supplementary training programme, vocational teachers, BA programme – creation**	BYN PVYN	Creation of a programme for supplementary training of vocational teachers in sustainable construction and energy efficiency in collaboration with relevant organizations and the National Agency for Education. Includes relevant vocational teachers from the Construction and civil engineering, Electricity & energy, and Plumbing & HVAC and building services programmes	Jan 14	May 14
2.22	**Supplementary training programme, vocational teachers, Electricity & energy programme – creation**	EIO - The Association for Swedish Electrical Contractors	Creation of a programme for supplementary training of vocational teachers in sustainable construction and energy efficiency in collaboration with relevant organizations and the National Agency for Education. Includes relevant vocational teachers from the Construction and civil engineering, Electricity & energy, and Plumbing & HVAC and building services programmes	Jan 14	May 14
2.23	**Supplementary training programme, vocational teachers, Plumbing & HVAC and building services programmes – creation**	Association of Plumbing and HVAC Contractors	Creation of a programme for supplementary training of vocational teachers in sustainable construction and energy efficiency in collaboration with relevant organizations and the National Agency for Education. Includes relevant vocational teachers from the Construction and civil engineering, Electricity & energy, and Plumbing & HVAC and building services programmes	Jan 14	May 14

Act No.	*Sub-project*	*Proposed operators*	*Undertaking*	*Start date*	*End date*
2.31	**Supplementary training of vocational teachers, Construction and civil engineering programme**	BYN	Implementation of supplementary training of vocational teachers on sustainable construction and energy efficiency.	Aug 14	Dec 15
2.32	**Supplementary training of vocational teachers, Electricity & energy programme**	EIO - The Association for Swedish Electrical Contractors	Implementation of supplementary training of vocational teachers on sustainable construction and energy efficiency.	Aug 14	Dec 15
2.33	**Supplementary training of vocational teachers, Plumbing & HVAC and building services programmes**	Association of Plumbing and HVAC Contractors	Implementation of supplementary training of vocational teachers on sustainable construction and energy efficiency.	Aug 14	Dec 15
2.41	**Review, descriptions of objectives, BYN**	BYN	Update training board descriptions of objectives so that they more clearly express training objectives related to energy-efficient construction for the relevant occupational groups.	Aug 13	Dec 13
2.42	**Review, descriptions of objectives, VVS YN**	Plumbing & HVAC Training Board	Update training board descriptions of objectives so that they more clearly express training objectives related to energy-efficient construction for plumbing and HVAC installers.	Aug 13	Dec 13
2.51	**Review/supplementary teaching media for the Construction and civil engineering, Electricity & energy, Plumbing & HVAC and building services programmes**	Liber	Supplement existing teaching media to include energy-efficient construction/ energy efficient installations.	*Jan 14*	*Dec 14*
	Review/supplementary teaching media for the Construction and civil engineering programme in collaboration with Liber	BYN	Supplement existing teaching media to include energy-efficient construction.		
	Review/supplementary teaching media for the Construction and civil engineering programme in collaboration with Liber	PVYN	Supplement existing teaching media to include energy-efficient installations.		
	Review/supplementary teaching media for the Electricity & energy programme in collaboration with Liber	EUU	Supplement existing teaching media to include energy-efficient installations.		
	Review/supplementary teaching media for the Plumbing & HVAC and building services programme in collaboration with Liber	Plumbing & HVAC Training Board	Supplement existing teaching media to include energy-efficient installations.		

Act No.	*Sub-project*	*Proposed operators*	*Undertaking*	*Start date*	*End date*
2.60	**Qualification requirements, vocational training**	Swedish Construction Federation	Consideration of the possibility to define the minimum common content in terms of qualifications including energy-efficient building practices in the construction and installation technically oriented training for construction managers and to discuss the possibility of prescribing the content related to the design of new courses in higher vocational education.	May 13	Nov 13
3.20	**Platform - setting up**	Swedish Energy Agency	Assume for the creation of a BUSS platform in collaboration with stakeholders and coordinate the quality assurance of the proposed measures.	Apr 13	Dec 19
		Association of Swedish Regional Energy Agencies	Assist with the BUSS platform to ensure the quality of the proposed measures. Coordinate applications to IEE in regard to BUSS, phase II		
		Bebo	Assist with the BUSS platform to ensure the quality of the proposed measures.		
		Belok			
		National Board of Housing, Building and Planning			
		Glass Industry Association			
		KARF			
		Swedish Construction Federation			
		Association of Plumbing and HVAC Contractors			
		EIO - The Association for Swedish Electrical Contractors			
		Swedish Construction Clients Forum			
		Byggnads			
		SABO			
		Construction material industries			

7.2 Roadmap summary per operator

Proposed operators	*Act No.*	*Sub-project*	*Undertaking*
Bebo	**3.20**	Platform - setting up	Assist with the BUSS platform to ensure the quality of the proposed measures.
Belok	**3.20**	Platform - setting up	Assist with the BUSS platform to ensure the quality of the proposed measures.
BFAB/STF Post-graduate engineering	**1.23**	Basic supplementary training in energy-efficient construction – training trainers	Carry out training of teachers/instructors for the basic supplementary training initiative.
National Board of Housing, Building and Planning	**1.11**	Information to building project clients	Implement information activities aimed at clients regarding the need for improved project communication and client requirements for basic supplementary training in energy-efficient construction.
	1.20	Basic supplementary training in energy-efficient construction – creation of course	Assist with the creation of basic supplementary training and training materials.
	1.21	Rights to Bygga Bo dialogue material	Assist as necessary to ensure that Bygga Bo dialogue material may be reused in the training material created for the basic supplementary training.
	3.20	Platform - setting up	Assist with the BUSS platform to ensure the quality of the proposed measures.
Swedish Construction Clients Forum	**1.10**	Creation of criteria for skills enhancement in construction projects	Creation of skills enhancement criteria in respect of energy-efficient construction in connection with the purchase of building projects.
	1.12	Introduction of requirement for briefings and follow-up meetings with all involved.	Work to introduce requirement for briefings and follow-up meetings with all involved.
	1.13	Introduction of requirement for basic supplementary training	Work to introduce requirement for basic supplementary training in connection with the procurement of construction projects with elements of energy efficiency improvement.
	1.22	Register completed supplementary training	Work for the creation of an industry-wide register of supplementary training students through RBK
	3.20	Platform - setting up	Assist with the BUSS platform to ensure the quality of the proposed measures.
Construction material industries	**1.20**	Basic supplementary training in energy-efficient construction – creation of course	Assist with the creation of basic supplementary training and training materials.

Proposed operators	*Act No.*	*Sub-project*	*Undertaking*
	1.30	Installation instructions - creation.	Develop installation instructions for target groups construction workers, plumbers & HVAC installers; to be made available on internet. The instructions must be linked to actions that have an effect on a building's energy performance and be pedagogically set up with a combination of text, images and video. It would be ideal if these activities were aimed at a broad European market. Seven pilot projects in construction, plumbing & HVAC
	1.31	Framework descriptions, installation instructions - creation.	Creation of framework descriptions of installation instructions, based on pilot project experience, to clarify the design and content of instructions.
	3.20	Platform - setting up	Assist with the BUSS platform to ensure the quality of the proposed measures.
Byggnads	**3.20**	Platform - setting up	Assist with the BUSS platform to ensure the quality of the proposed measures.
BYN	**2.21**	Supplementary training programme, vocational teachers, BA programme – creation	Creation of a programme for supplementary training of vocational teachers in sustainable construction and energy efficiency in collaboration with relevant organizations and the National Agency for Education. Includes relevant vocational teachers from the Construction and civil engineering, Electricity & energy, and Plumbing & HVAC and building services programmes
	2.31	Supplementary training of vocational teachers, Construction and civil engineering programme	Implementation of supplementary training of vocational teachers on sustainable construction and energy efficiency.
	2.41	Review, descriptions of objectives, BYN	Update training board descriptions of objectives so that they more clearly express training objectives related to energy-efficient construction for the relevant occupational groups.
	2.51	Review/supplementary teaching media for the Construction and civil engineering programme in collaboration with Liber	Supplement existing teaching media to include energy-efficient installations.
EIO - The Association for Swedish Electrical Contractors	**1.20**	Basic supplementary training in energy-efficient construction – creation of course	Assist with the creation of basic supplementary training and training materials.
	1.23	Basic supplementary training in energy-efficient construction – training trainers	Carry out training of teachers/instructors for the basic supplementary training initiative.

Proposed operators	*Act No.*	*Sub-project*	*Undertaking*
	2.22	Supplementary training programme, vocational teachers, Electricity & energy programme – creation	Creation of a programme for supplementary training of vocational teachers in sustainable construction and energy efficiency in collaboration with relevant organizations and the National Agency for Education. Includes relevant vocational teachers from the Construction and civil engineering, Electricity & energy, and Plumbing & HVAC and building services programmes
	2.32	Supplementary training of vocational teachers, Electricity & energy programme	Implementation of supplementary training of vocational teachers on sustainable construction and energy efficiency.
	3.20	Platform - setting up	Assist with the BUSS platform to ensure the quality of the proposed measures.
Electrical materials suppliers	**1.30**	Installation instructions - creation.	Develop installation instructions for target groups electricians and supervisor installers; to be made available on internet. The instructions must be linked to actions that have an effect on a building's energy performance and be pedagogically set up with a combination of text, images and video. It would be ideal if these activities were aimed at a broad European market. Three pilot projects in the electrical field
	1.31	Framework descriptions, installation instructions - creation.	Creation of framework descriptions of installation instructions, based on pilot project experience, to clarify the design and content of instructions.
Swedish Energy Agency	**1.10**	Creation of criteria for skills enhancement in construction projects	Work for the creation of skills enhancement criteria for construction site personnel in respect of energy-efficient construction in connection with the purchase of building projects.
	1.11	Information to building project clients	Assume responsibility for coordination and implementation of information activities aimed at clients regarding the need for improved project communication and client requirements for basic supplementary training in energy-efficient construction.
	1.20	Basic supplementary training in energy-efficient construction – creation of course	Work to ensure that the training material created using EU funds is made available at cost to the training providers who wish to use it.
	3.20	Platform - setting up	Assume for the creation of a BUSS platform in collaboration with stakeholders and coordinate the quality assurance of the proposed measures.

Proposed operators	*Act No.*	*Sub-project*	*Undertaking*
EUU	**2.51**	Review/supplementary teaching media for the Electricity & energy programme in collaboration with Liber	Supplement existing teaching media to include energy-efficient installations.
Association of Swedish Regional Energy Agencies	**1.11**	Information to building project clients	Implement information activities aimed at clients regarding the need for improved project communication and client requirements for basic supplementary training in energy-efficient construction.
	3.20	Platform - setting up	Assist with the BUSS platform to ensure the quality of the proposed measures. Coordinate applications to IEE in regard to BUSS, phase II
Glass Industry Association	**3.20**	Platform - setting up	Assist with the BUSS platform to ensure the quality of the proposed measures.
KARF	**3.20**	Platform - setting up	Assist with the BUSS platform to ensure the quality of the proposed measures.
Swedish Organization for Managers	**1.22**	Register completed supplementary training	Work for the creation of an industry-wide register of supplementary training students through RBK
Liber	**2.51**	Review/supplementary teaching media for the Construction and civil engineering, Electricity & energy, Plumbing & HVAC and building services programmes	Supplement existing teaching media to include energy-efficient construction.
Swedish Environmental Management Council	**1.10**	Creation of criteria for skills enhancement in construction projects	Creation of skills enhancement criteria in respect of energy-efficient construction in connection with the purchase of building projects.
	1.11	Information to building project clients	Implement information activities aimed at clients regarding the need for improved project communication and client requirements for basic supplementary training in energy-efficient construction.
	1.12	Introduction of requirement for briefings and follow-up meetings with all involved.	Introduce requirement for briefings and follow-up meetings with all involved.
	1.13	Introduction of requirement for basic supplementary training	Introduce requirement for basic supplementary training in connection with the procurement of construction projects with elements of energy efficiency improvement e.g. using Environmental Management Council check lists.
Many interested parties (industry ass., training providers, companies)	**1.24**	Basic supplementary training implementation	Implement basic supplementary training for relevant occupational groups at construction sites as per client requirement.
Passive House Centre	**1.11**	Information to building project clients	Implement information activities aimed at clients regarding the need for improved project communication and client requirements for basic supplementary training in energy-efficient construction.

Proposed operators	*Act No.*	*Sub-project*	*Undertaking*
	1.20	Basic supplementary training in energy-efficient construction – creation of course	Assume responsibility for, and coordinate, the creation of basic supplementary training and training material. The material must be freely available for copying and printing or as online documents.
	1.23	Basic supplementary training in energy-efficient construction – training trainers	Carry out training of teachers/instructors for the basic supplementary training initiative.
PVYN	**2.21**	Supplementary training programme, vocational teachers, BA programme – creation	Creation of a programme for supplementary training of vocational teachers in sustainable construction and energy efficiency in collaboration with relevant organizations and the National Agency for Education. Includes relevant vocational teachers from the Construction and civil engineering, Electricity & energy, and Plumbing & HVAC and building services programmes
	2.51	Review/supplementary teaching media for the Construction and civil engineering programme in collaboration with Liber	Supplement existing teaching media to include energy-efficient installations.
SABO	**3.20**	Platform - setting up	Assist with the BUSS platform to ensure the quality of the proposed measures.
National Agency for Education	**2.10**	Review of policy document, upper secondary schools	Identify requirements for changed or supplemented policy documents in consultation with the national programme councils for Construction and civil engineering, Electricity & energy, and Plumbing & HVAC and building services programmes.
	2.20	Supplementary training programme, vocational teachers, Construction and civil engineering programme – creation	Development of programs for skills development for vocational teachers in relevant occupations in collaboration with concerned organizations.
SP	**1.20**	Basic supplementary training in energy-efficient construction – creation of course	Assist with the creation of basic supplementary training and training materials.
	1.23	Basic supplementary training in energy-efficient construction – training trainers	Carry out training of teachers/instructors for the basic supplementary training initiative.
Swedish Building Centre	**1.32**	Portal, installation instructions - creation.	Creation and administration of a national portal for installation instructions aimed at construction site employees and with special focus on energy efficient building structures and installations.

Proposed operators	*Act No.*	*Sub-project*	*Undertaking*
Swedish Ventilation	**1.30**	Installation instructions - creation.	Development of installation instructions for target group ventilation technicians; to be made available on internet. The instructions must be linked to actions that have an effect on a building's energy performance and be pedagogically set up with a combination of text, images and video. It would be ideal if these activities were aimed at a broad European market. Seven pilot projects in construction, plumbing & HVAC
Swedish Construction Federation	**1.20**	Basic supplementary training in energy-efficient construction – creation of course	Assist with the creation of basic supplementary training and training materials.
	1.22	Register completed supplementary training	Assume responsibility for the creation of an industry-wide register of supplementary training students through RBK
	1.23	Basic supplementary training in energy-efficient construction – training trainers	Carry out training of teachers/instructors for the basic supplementary training initiative.
	2.60	Qualification requirements, vocational training	Consideration of the possibility to define the minimum common content in terms of qualifications including energy-efficient building practices in the construction and installation technically oriented training for construction managers and to discuss the possibility of prescribing the content related to the design of new courses in higher vocational education.
	3.20	Platform - setting up	Assist with the BUSS platform to ensure the quality of the proposed measures.
Association of Plumbing and HVAC Contractors	**1.20**	Basic supplementary training in energy-efficient construction – creation of course	Assist with the creation of basic supplementary training and training materials.
	1.23	Basic supplementary training in energy-efficient construction – training trainers	Carry out training of teachers/instructors for the basic supplementary training initiative.
	2.23	Supplementary training programme, vocational teachers, Plumbing & HVAC and building services programmes – creation	Creation of a programme for supplementary training of vocational teachers in sustainable construction and energy efficiency in collaboration with relevant organizations and the National Agency for Education. Includes relevant vocational teachers from the Construction and civil engineering, Electricity & energy, and Plumbing & HVAC and building services programmes
	2.33	Supplementary training of vocational teachers, Plumbing & HVAC and building services programmes	Implementation of supplementary training of vocational teachers on sustainable construction and energy efficiency.

Proposed operators	*Act No.*	*Sub-project*	*Undertaking*
	3.20	Platform - setting up	Assist with the BUSS platform to ensure the quality of the proposed measures.
Plumbing & HVAC Training Board	**2.42**	Review, descriptions of objectives, VVS YN	Update training board descriptions of objectives so that they more clearly express training objectives related to energy-efficient construction for plumbing and HVAC installers.
	2.51	Review/supplementary teaching media for the Plumbing & HVAC and building services programme in collaboration with Liber	Supplement existing teaching media to include energy-efficient installations.

7.3 Estimated budget

The budget is a very rough estimate to be considered as an indication only. Some remarks made in connection with the referral process indicate that the budget is too conservative in certain parts. Furthermore, the budget only refers to the costs that should be funded under Pillar II of *Build Up Skills*. More accurate budgets must naturally be prepared for the various sub-projects in collaboration with the relevant parties.

Act No.	*Sub-project*	*Proposed operators*	*Budget remark*	*Own commitment*	*Total cost, Pillar II [SEK]*
1.10	**Creation of criteria for skills enhancement in construction projects**	Swedish Energy Agency Swedish Environmental Management Council Swedish Construction Clients Forum	Costs for development of criteria as per Environmental Management Council experience		200,000
1.11	**Information to building project clients**	Swedish Energy Agency National Board of Housing, House and Planning Swedish Environmental Management Council Association of Swedish Regional Energy Agencies Passive House Centre	Meeting costs in connection with implementation of information activities	Participants own work time and travel	600,000
1.12	**Introduction of requirement for briefings and follow-up meetings with all involved.**	Swedish Construction Clients Forum Swedish Environmental Management Council			
1.13	**Introduction of requirement for basic supplementary training**	Swedish Construction Clients Forum Swedish Environmental Management Council			
1.20	**Basic supplementary training in energy-efficient construction – creation of course**	Passive House Centre Construction material industries EIO - The Association for Swedish Electrical Contractors SP Swedish Construction Federation Association of Plumbing and HVAC Contractors National Board of Housing, Building and Planning Swedish Energy Agency	Costs for meetings and project management in connection with preparation of training plan. Costs for creation of teaching media	Work time and travel costs in connection with project meetings	1,000,000
1.21	**Rights to Bygga Bo dialogue material**	National Board of Housing, Building and Planning	Rights to parts of Bygga-Bo dialogue material		100,000
1.22	**Register completed supplementary training**	Swedish Construction Federation Swedish Construction Clients Forum	Costs for creation of registers	Work time for participating stakeholders Costs for	200,000

Act No.	*Sub-project*	*Proposed operators*	*Budget remark*	*Own commitment*	*Total cost, Pillar II [SEK]*
		Swedish Organization for Managers		ongoing registration of course participants recovered from training provider	
1.23	**Basic supplementary training in energy-efficient construction – training trainers**	EIO - The Association for Swedish Electrical Contractors	Costs in respect of premises, teaching media, teachers	Participants own work time and travel	5,000,000
		Passive House Centre			
		SP			
		Swedish Construction Federation			
		Association of Plumbing and HVAC Contractors			
		BFAB/STF Post-graduate engineering			
1.24	**Basic supplementary training implementation**	Many interested parties (industry ass., training providers, companies)		Implementation of courses incl. teacher courses Participants own work time and travel	Not funded by BUSS Pillar II
1.30	**Installation instructions - creation.**	Construction material industries	The amount refers to preparation of installation instructions (text, images and video) for seven pilot projects Coordinated with Swedish Ventilation and electrical suppliers.	Continued activities with creation of instructions The cost should be included within companies' normal information activities.	1,400,000
		Swedish Ventilation			
		Electrical materials suppliers	The amount refers to preparation of installation instructions (text, images and video) for three electrical technology pilot projects Coordinated with Construction material industries and Swedish Ventilation.		600,000
1.31	**Framework descriptions, installation instructions - creation.**	Construction material industries		A description should be created clarifying what an installation instruction should include based on experiences from the pilot projects.	
		Electrical materials suppliers			

Act No.	*Sub-project*	*Proposed operators*	*Budget remark*	*Own commitment*	*Total cost, Pillar II [SEK]*
1.32	**Portal, installation instructions - creation.**	Swedish House Centre	The amount refers to consultant services in respect of the creation of a portal linked to existing information on the Swedish Building Centre website.	Running costs could be covered by the Swedish Building Centre's regular activities with materials information.	200,000
2.10	**Review of policy document, upper secondary schools**	National Agency for Education		Policy document reviews are performed in collaboration with the industry in connection with regular programme activities.	
2.20	**Supplementary training programme, vocational teachers, Construction and civil engineering programme – creation**	National Agency for Education	The amount refers to the National Agency for Education's participation in the creation of training for vocational teachers in the three construction-related vocational programmes.		200,000
2.21	**Supplementary training programme, vocational teachers, BA programme – creation**	BYN PVYN	The amount refers to training boards' participation in the creation of training for vocational teachers specifically for the BA programme.		500,000
2.22	**Supplementary training programme, vocational teachers, Electricity & energy programme – creation**	EIO - The Association for Swedish Electrical Contractors	The amount refers to the organization's participation in the creation of training for vocational teachers specifically for the Electricity & energy programme.		500,000
2.23	**Supplementary training programme, vocational teachers, Plumbing & HVAC and building services programmes – creation**	Association of Plumbing and HVAC Contractors	The amount refers to the organization's participation in the creation of training for vocational teachers specifically for the Plumbing & HVAC and building services programme.	0	500,000

Act No.	*Sub-project*	*Proposed operators*	*Budget remark*	*Own commitment*	*Total cost, Pillar II [SEK]*
2.31	**Supplementary training of vocational teachers, Construction and civil engineering programme**	BYN	The amount is intended to cover course costs for around two days' classroom training. Premises, teacher, board and lodge.	Teachers' pay, travel and possible costs for substitutes.	6,400,000
2.32	**Supplementary training of vocational teachers, Electricity & energy programme**	EIO - The Association for Swedish Electrical Contractors	The amount is intended to cover course costs for around two days' classroom training. Premises, teacher, board and lodge.	Teachers' pay, travel and possible costs for substitutes.	4,800,000
2.33	**Supplementary training of vocational teachers, Plumbing & HVAC and building services programmes**	Association of Plumbing and HVAC Contractors	The amount is intended to cover course costs for around two days' classroom training. Premises, teacher, board and lodge.	Teachers' pay, travel and possible costs for substitutes.	960,000
2.41	**Review, descriptions of objectives, BYN**	BYN		The cost could be covered by normal work on the review of the industry's descriptions of objectives for the relevant occupations.	
2.42	**Review, descriptions of objectives, VVS YN**	Plumbing & HVAC Training Board		The cost could be covered by normal work on the review of the industry's descriptions of objectives for the relevant occupations.	
2.51	**Review/supplementary teaching media for the Construction and civil engineering, Electricity & energy, Plumbing & HVAC and building services programmes**	Liber	The amount is intended to cover additional costs for revision of existing teaching media so that the content also describes aspects of energy efficiency.		300,000
	Review/supplementary teaching media for the Construction and civil engineering programme in collaboration with Liber	BYN			
	Review/supplementary teaching media for the Construction and civil engineering programme in collaboration with Liber	PVYN			
	Review/supplementary teaching media for the Electricity & energy programme in collaboration with Liber	EUU			

Act No.	*Sub-project*	*Proposed operators*	*Budget remark*	*Own commitment*	*Total cost, Pillar II [SEK]*
	Review/supplementary teaching media for the Plumbing & HVAC and building services programme in collaboration with Liber	Plumbing & HVAC Training Board			
2.60	**Qualification requirements, vocational training**	Swedish Construction Federation			
3.20	**Platform - setting up**	Swedish Energy Agency	The amount is intended to cover additional costs for conferences and meetings in the period up to 2020.		500,000
		Association of Swedish Regional Energy Agencies	The amount is intended to cover additional costs for work with the coordination of project applications.		500,000
		Bebo		Participants own work time and travel	
		Belok			
		National Board of Housing, Building and Planning			
		Glass Industry Association			
		KARF			
		Swedish Construction Federation			
		Association of Plumbing and HVAC Contractors			
		EIO - The Association for Swedish Electrical Contractors			
		Swedish Construction Clients Forum			
		Byggnads			
		SABO			
		Construction material industries			

Total **SEK 24,460,000**

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Appendix 1 Participating BUSS project stakeholders

Steering committee

Swedish Construction Clients Forum	Mats Björs
Construction material industries, BMI	Monica Björk
Centerpartiet	Leif Walterum
EIO - The Association for Swedish Electrical Contractors	Jan Siezing
NCC	Johan Gillberg
Ministry of Enterprise, Energy and Communications	Fredrik von Malmborg
Passive House Centre	Carlos Andersson
Ministry of Education	Fritjof Karlsson
Association of Plumbing and HVAC Contractors	Roine Kristianson

Project group – consortium

Swedish Energy Agency	Roger Eriksson
NCC	Stefan Dehlin
SP Technical Research Institute of Sweden	Anna-Lena Lane
Swedish construction workers union, Byggnads	Rolf Levin
Swedish Construction Federation	Lars Tullstedt, Åsa Douhan
WSP	Åke Blomsterberg, Robert af Wetterstedt
Association of Plumbing and HVAC Contractors	Magnus Everitt

Reference group

Bebo (WSP)	Göran Werner
BELOK (CIT Energy management)	Per-Erik Nilsson
BFAB	Anna Granholm Thorén
BFAB	Johan Onno
National Board of Housing	Hans-Olof Karlsson-Hjorth
National Board of Housing	Anders Sjelvgren
Swedish Construction Clients Forum	Per Lilliehorn
Construction Industry Training Board, BYN	Nils-Gunnar Bergander
EIO - The Association for Swedish Electrical Contractors	Ulf Pettersson
Swedish Property Federation	Yogesh Kumar
Swedish Centre for Innovation and Quality in the Built Environment	Anna Sander
Jobblotsen Sverige AB	Wadih Elachkar
Swedish Municipal Workers' Union	Jonny Jakobsson
KYH	Elisabeth Emdin
KYH	Sanna Könönen-Wahlstedt
Kyl- och värmepumpföretagen	Henrik Brengesjö
Swedish Organization for Managers	Per Hedelin
Ministry of Enterprise, Energy and Communications	Per Högström
Passive House Centre	Carlos Andersson
Passive House Centre	Hans Eek
SABO	Therese Rydstedt
SBUF	Ruben Aronsson
SEK, Swedish El. Standards	Thomas Korssell

National Agency for Education	Lotta Naglitsch
National Agency for Education	Paula Starbäck
SP Technical Research Institute of Sweden	Carl-Magnus Capener
Svenska Teknik&Designföretagen	Lena Wästfelt
Sweden Green Building Council	Bengt Wånggren
Swedisol	Conny Pettersson
Swedisol / Paroc	Anders Olsson
Swedish Ventilation	Britta Permats
Swedish construction workers union, Byggnads	Christer Carlsson
Swedish Association of Local Authorities and Regions	Jonas Hagetoft
Trä och möbelföretagen, TMF	Anders Rosenkilde
Swedish White-Collar Workers' Union	Krister Strålberg
Plumbing & HVAC Training Board	Nils Otterstål

Appendix 2 Workshops, skilled workers and supervisors

WORKSHOPS held in the BUSS project regarding future energy-efficient construction.

Location: Näringslivets Hus/Sveriges Byggindustrier, Stockholm and Sveriges Byggindustriers Hus in Gothenburg.
Date: September 18, 19 and 20, 2012
Participants: in total 28.
Counties represented: Stockholm, Uppsala, Örebro, Dalarna and Västra Götaland.
Skilled workers from construction, plumbing & HVAC, and electrical plus supervisors/project managers from construction, plumbing & HVAC, and electrical.

September 18 + 20: workshop in Stockholm and Gotheburg with people with experience of near-net-zero-energy and/or low-energy building philosophy.
September 19: A workshop in Stockholm with people with no experience of energy-efficient construction acting as the control group.
Applications were received via a link to the form in the invitation, via mail and by telephone.

Extract from the invitations to September 18 and 20:
We are looking for people like you who want to share their opinions on tomorrows construction and renovation using near-net-zero-energy or low-energy building philosophy. If you have participated in such a project we would be happy if you could come and tell us about your experiences, good or bad. This is your chance to influence planning for tomorrow's energy-saving construction training. What new knowledge will we need? What is important to understand?
Confirmation was emailed to applicants around 10 days prior to the day of the workshop.

Workshop leaders: Åsa Douhan, Swedish Construction Federation.
A short presentation of the BUSS project by Lars Tullstedt, Swedish Construction Federation.

Methodology:
Innotiimi OPERA is a method which

- is a systematic meeting and process tool.
- creates participation, clear objectives and robust commitment in a rapid, creative process.
- especially effective for rallying individuals around an important issue.
- gets everyone to contribute to the whole while also drawing out a group's collective standpoint on an issue.
- combines creativity with structure, and participation with recognized principles for activity-based training.
- is a very democratic process in which everyone has one vote, regardless of position or title.

Participants weighted the responses that emerged from the exercises. Headings were then jointly established. The figures in brackets indicate the strength of a priority measured by the number of selected alternatives/crosses. Even alternatives that were not prioritized are shown under the table, as are those which are similar to other answers.
Outcomes below are reported per question – not per location – followed by a summary and a conclusion.

Opera process questions:

1. **HOW can we best carry out skills enhancement in low-energy construction?**
2. **HOW can we motivate skilled workers/supervisors to enhance their low-energy construction skills?**

WORKSHOP QUESTION 1 HOW can we best carry out skills enhancement in low-energy construction?

Information/documentation in execution/production (13)	**Training (10)**	**Commitment/ motivation (5)**	**18/09/12 Sthlm Experienced**
Work preparation + Follow-up (4)	Training at every level in the industry (2)	Awareness from information awakens interest. (1)	
Simple, standardized installation instructions (3)	Experience feedback (2)	Describe better type LCC, 20-20, 50-50 (1)	LCC = life cycle cost
Execution/installation instructions Must be easily accessible at the workplace. (3)	Theory & practical training for all, even sub contractors (2)	Project briefing for all (1)	
More clear, straightforward information at sites. (2)	Experience feedback (no re-inventing the wheel) (1)	Common (joint) project name (1)	
Include solutions in drawing (details) (1)	Certification leads to better quality (1)	Work preparation incl BAS-P (1)	BAS-P=site environment coordinator – planning
	Some form of course that leads to certification (1)		
	Train all occupational groups individually (1)		

Unprioritized suggestions: Work preparation at start of installation of construction elements and components. “Why plastic foil”. Choice of right tool and set-ups. Training in taping and installing plastic foil. Emphasize importance of correct execution. Good work supervision; competitions, schooling. Make use of good examples. Lectures from specialists. Do it right from the start. Understanding.

Experience feedback (6)	**Training (4)**	**Information (4)**	**20/09/12 Gothenburg Experienced**
More contact between designer, installers and fitters (3)	Practical/theory (2)	Internet (website) (3)	
Experience feedback - Execution - Climate - Energy consumption - Function All involved give commitment, involvement (2)	Training in importance of installing as per instructions (1)	Check for different solutions (1)	
Arrange meetings with different project teams to swap good, bad experiences (1)	Practical exercise (1)		

Unprioritized suggestions: Training! (poss. several stages); full training for all occupational categories in all areas, theoretical. Complete training, all categ. in all areas. Practical training in reading drawings and instructions; training in what is good internal inspection and how it is done. Knowledge from around the world.

WORKSHOP QUESTION 1, cont. HOW can we best carry out skills enhancement in low-energy construction?

Skills enhancement (5)	**Planning before (3)**	**Planning during (3)**	**Planning after (3)**	**19/09/12 Sthlm Non-experienced control group**
Why low-energy (What is improved) (2)	Client wants must be right, otherwise cannot work (1)	Better cooperation between occupational groups (2)	Project follow-up	
Work on "comprehension of the individual employee (1)	Short film, general (1)	Better collaboration & understanding between different occupational groups (1)	Feedback for consultants and designers (1)	
Training in material handling (client responsibility) and execution (1)	Main skills must be available at planning stage (1)			

Unprioritized suggestions: Feedback on work completed, together. Get rid of: We've always done it this way.

WORKSHOP QUESTION 2 HOW can we motivate skilled workers/supervisors to enhance their low-energy construction skills?

Commitment **(11)**	**Requirement** **(9)**	**Development** **(7)**	**Compensation/ reward** **(3)**	**18/09/12 Sthlm Experienced**
Create understanding Why (4)	Right conditions in project (4)	Same training for all (3)	Bonuses/premiums (2)	
Show results Performance (3)	Time (2)	Link in development (1)	Competition "Energy follow-up" (1)	
Explain why (1)	Authority requirements (2)	Follow-up (1)		
Fun courses & kick-off (1)	Pay – time for extra work (1)	industry standard course certificate; see Hot Works, GVK etc. (1)		
Specialization in certain areas = jobs (1)		Maintain professional pride through enhancement		
Future requirements				

Unprioritized suggestions: Internal trng. Grants. Campaigns & opinion. Certification requirement "several levels". Internal inspections. Bonus pay. Course lottery. Bonus/carrot. Skills enhancement = commitment. Performance-related bonus. Ongoing, topical information.

Training **(6)**	**Information** **(4)**	**Development materiology** **(2)**		**20/09/12 Gothenburg Experienced**
Training and information increases understanding and interest (2)	Environmental benefits (3)	New technology is developmental (new construction methods) (2)		
Qualification: Certificate mean higher pay (1).	Feedback. Individuals sign off their work (who has done what in a construction job).			
Certification (1)				
Paid training (1)				
Certification for passive building (e.g. HVAC, el, wood etc.). (1)				

Unprioritized suggestions: Pay/profit share. Better knowledge gives better quality. Personal gain (low energy) private. Information about actual savings/reduced environmental impact.

WORKSHOP QUESTION 2, cont. HOW can we motivate skilled workers/supervisors to enhance their low-energy construction skills?

	Community level (8)	**Employer level (4)**	**Individual level (2)**	**19/09/12 Sthlm Non-experienced control group**
OPINION FORMING	Arouse enthusiasm via media (3)	Environment, world (1)	Understanding (1)	
MOTIVE	Raises status, trendy	Opportunities - Earn money - Change the world - Advance career (2)	Carrots - Assignments - Pay - Responsibility - Position (1)	
TRAINING	Alternative training methods (2)	There is a skills requirement (knowhow demand) (1)		
REQUIREMENT	Requirement, certification Lowest level (1)			

Unprioritized suggestions: Need – why must we do this? Challenge = be better than others – sell more – cutting edge skills. Opportunity for supplementary training for interested people. Pays to live in house that uses less energy

Appendix 3, Workshop stakeholders

28/08/12 WORKSHOP held in the BUSS project regarding future energy-efficient construction.

Location: WSP Globen.
Date: August 28, 2012 in connection with a 2-day project meeting arranged by the Swedish Energy Agency.
Participants: Twelve participants from the BUSS reference group and invited guests from the construction industry.

Workshop leaders: Åsa Douhan, Swedish Construction Federation.
A short presentation of the BUSS project by Lars Tullstedt, Swedish Construction Federation.

Opera process questions:

3. **HOW can we motivate companies to invest in skills enhancement in low-energy construction?**
4. **HOW can we motivate skilled workers to enhance their low-energy construction skills?**

Methodology:
Innotiimi OPERA is a method which

- is a systematic meeting and process tool.
- creates participation, clear objectives and robust commitment in a rapid, creative process.
- especially effective for rallying individuals around an important issue.
- gets everyone to contribute to the whole while also drawing out a group's collective standpoint on an issue.
- combines creativity with structure, and participation with recognized principles for activity-based training.
- is a very democratic process in which everyone has one vote, regardless of position or title.

Participants weighted the responses that emerged from the exercises. Headings were then jointly established. The figures in brackets indicate the strength of a priority measured by the number of selected alternatives/crosses. Even alternatives that were not prioritized are shown under the table, as are those which are similar to other answers.

28/08/12 WORKSHOP QUESTION 1

HOW can we motivate <u>companies</u> to invest in skills enhancement in low-energy construction?

BUSINESS STRATEGY (9)	**CLIENT REQUIREMENTS (7)**	**STANDARD INDUSTRY SYSTEM (2)**		
Green image for company (2)	Introduce client requirement (3)	Training ladder with steps in each industry/occupation (1)		
Participation in development (2)	Increased client requirements - energy declaration - consumption levels - render savings visible - airtight integrity tests (2)	Trained personnel advantage in marketing (certification) (1)		
Business opportunities (2)	Demand for low-energy buildings (it exists) (1)			
Attract new employees (2)	Customer advantages – end result and reduced environmental impact (1)			
Profitable in long term (2)				

Unprioritized suggestions: Obligatory inclusion in basic training at early stage (Maths, Phys. Chem.). Consider business aspect of skills enhancement. Increased demand for low-energy buildings will require workers with more skills. Increase energy requirements when procuring buildings. Work on quality, new technology and green commitment gives virtuous circle for companies and employees. Requirement for certification with skills requirement. Savings opportunities (reduced spillage, time, repeat work). Blaze trail for future construction and new requirements; involve employees(e.g. increased pay for reduced spillage). Train company executives. Introduce qualification requirements in tenders. The technology is mature; place demands.

28/08/12 WORKSHOP QUESTION 2

HOW can we motivate <u>skilled workers</u> to back skills enhancement in low-energy construction?

PERSONAL DEVELOPMENT (7)	**PAY STRUCTURE (5)**	**EXTERNAL REQUIREMENTS (3)**	**COMMUNITY COMMITMENT (2)**	**BETTER WORK ENVIRONMENT (1)**
Personal development means more interesting assignments (3)	Affects pay (3)	External requirements, law, etc. (2)	Commitment to community; building for tomorrow (1)	low-energy construction means order and tidiness at work (1)
Personal development, career (1)	Affect on pay (1)	Requirement for skills (1)	making a difference for the future; children and grandchildren. Green thinking! (1)	
Motivation, personal development (1)	Pay structure based on skills (1)			
Status; attractive on lab. mart (1)				

Unprioritized suggestions: Expectations in company for employee skills enhancement. Industry certification at personal level. Opportunity for pay improvement. More secure employment – knowledge, self-confidence, higher status/position, commitment. More interesting jobs and assignments; more attractive on labour market (pay). Participation in green construction. Better at job.

Appendix 4 Letter of Commitment

Specimen: We reserve the right to make changes.

Letter of Commitment

BUILD UP SKILLS SWEDEN (BUSS)

Background

Build Up Skills is part of Intelligent Energy Europe (IEE) – an EU programme that supports energy efficiency and renewable energy.

Build Up Skills is a direct result of the EU's energy and climate objective of a 20 per cent energy efficiency improvement in buildings by 2020, to be introduced in all 27 EU countries plus Norway, Switzerland and Macedonia. Therefore the need for training and supplementary training for the whole of the construction industry is great throughout Europe where the construction industry needs to shift towards more energy-efficient construction. The transition is needed to meet the EU's energy and climate goals. The principal target groups are skilled workers and installers at construction sites.

Build Up Skills is divided into two parts:

- **Pillar 1** Consists of a national survey and preparation of an roadmap.
- **Pillar 2** Consists of the development of new or existing courses and training programmes. The basis will be the Swedish roadmap prepared in Pillar 1.

Pillar I began in November 2011 and will continue until April, 2013. Pillar 2 will be announced in the beginning of 2013 and the last day for applications will be April 30, 2013. There will be a second announcement in the autumn of 2013.

Build Up Skills Sweden (BUSS) is the Swedish part of the project; refer to www.buildupskills.se.

Purpose

Build Up Skills Sweden (BUSS) seeks to create an roadmap and platform for supplementary training and enhancement of the skills of people who work at construction sites.

Assuring applications

The Swedish Energy Agency is offering financial support for the creation of a common EU application for Pillar 2 in the autumn of 2013 in accordance with the established Roadmap. Coordination of work groups and coordinators for the EU application is taking place in collaboration with the project group, Build Up Skills Sweden (BUSS).

Letter of Commitment

By signing this Letter of Commitment the undersigned declares **acceptance of the appended** *Roadmap: Building skills for energy-efficient building dated* 11/02/2013 on the condition that the submitted EU application for Pillar 2, autumn 2013, is accepted.

Place, date

Signature

Name in block capitals:

Organization/Company