



**BUILD UP
SKILLS**

ENERGY TRAINING
FOR BUILDERS



Summary

Build Up is intended to raise the competence of tradesmen in improving energy efficiency

Build Up Skills Norway is the national follow-up of the Intelligent Energy Europe project Build Up Skills. The purpose of the project is to identify measures that will raise the level of competence in the area of energy among tradesmen in the building industry. Relevant vocational groups have been chosen because they are key to success in improving energy efficiency and the use of renewable energy in buildings.

Why are tradesmen key to reducing the use of energy in buildings?

Energy-efficient buildings require suitable technical execution in order to achieve high-quality buildings with low energy needs. Particular attention must be paid to air leakage, insulation and damp prevention. This supposes a high level of expertise among tradesmen, for which reason specific competence targets for different trades have been identified as part of the Build Up Skills project. The targets have been set for those who will erect new buildings at a passive building/ near-zero energy level, renovate existing buildings to very high energy standards or install heating and ventilation systems in new and existing buildings.

Is there a need to raise the competence of tradesmen in order to build passive buildings?

The Norwegian Low Energy Program carried out a survey among electricians, plumbers, ventilation installers, carpenters and others to review the present level of competence. The survey indicates variable, and to some extent, lacking competence in the areas that will be needed to build quality and energy-efficient buildings. The survey also showed that three out of ten tradesmen thought that a lack of time made it difficult to participate in organised training. Cost was also mentioned as an obstacle to training, while three out of ten tradesmen answered that they do attend courses.

What measures will be prioritised in order to raise competence in energy efficiency among tradesmen?

There are at present around 100.000 tradesmen in Norway connected with the building and construction industry. It would be difficult to raise the competence of all of these within a reasonable time without putting specific measures into action. The Build Up Skills roadmap proposes a number of measures that should therefore be taken. Since the amount of work involved is extensive, the

report proposes three areas to be prioritised until 2015.

Development of material and teaching aids: There is a need to develop and update guidance materials, building details on the passive building level, both for new buildings and for energy-efficient renovations. Existing course material should be further developed so as to give detailed knowledge for each vocational group, necessary to facilitate the practical use of this knowledge on construction sites. It is appropriate to start the development of material for those vocational groups that have the greatest significance for the energy efficiency of buildings, such as carpenters, electricians, plumbers and ventilation installers.

Increase participation on courses by tradesmen in the building industry: One of the goals is to get more tradesmen to attend courses in order to increase their knowledge about energy-efficient buildings. To increase course participation there will be focus on organising instructors' courses, so as to increase their capacity and at the same time ensure that knowledge is spread across the country. This will make it easier to attend local courses and could therefore neutralise one of the main obstacle to taking part in courses. The main target group for course participation will be foremen and site managers, because these are considered to have positions that make them especially suited to following up the work on the building site. To begin with, courses should be aimed at the vocational groups that have the greatest influence on the energy efficiency of buildings.

Increase participation in further and post-qualifying education in the area of energy by teachers of vocational subjects: It is important to get knowledge of passive building included in what is actually being taught, both in vocational training and in formal further education. The level of knowledge among teachers is vital in that perspective. Practical on-site training for teachers and increased support for post-qualifying education for teachers could be important instruments for increasing the education in energy efficiency of teachers of vocational subjects.

What instruments could help to increase the competence in energy efficiency among tradesmen?

There are a number of regulatory, economic and informative instruments that can be used in order to implement the priority measures for raising competence. This report gives a review of today's instruments that can help to increase the energy efficiency competence of builders and also gives a description of possibilities for changing existing instruments and creating new ones. The report does not look at instruments that are intended to increase demand for passive buildings, since this falls outside the scope of the Build Up Skills project. Neither are any recommendations given as to which instruments are to be preferred, only a qualitative description of the most relevant instruments so as to show possibilities that exist. A discussion on prioritising the different instruments will naturally be included in third part of Build Up Skills.

Relevant instruments that can be reinforced or brought into use and that will directly or indirectly

help to achieve the priority measures are:

- ☒ qualification requirements for tradesmen through the Building Permit Regulations (byggesaksforskriften)
- ☒ specification of the different competence targets in curricula for building trades subjects so as to provide learning goals in energy efficiency in buildings
- ☒ Qualifications requirement beyond the regulatory requirements for those who perform construction work supported by Enova or the Norwegian State Housing Bank
- ☒ increased financial support for those who implement projects using competent tradesmen, such as increased rates per m² or one-off support for such projects
- ☒ requirements for publishing results in connection with the award of research funding
- ☒ increased support for post-qualifying education of teachers in the areas of energy efficiency and energy conversion
- ☒ new organisation of the funding of post-qualifying education of teachers, to ensure that the financing is used for post-qualifying education and that key areas such as energy efficiency and energy conversion are prioritised by teachers in construction trades
- ☒ establishing a national system for further education in subjects so that further development (to a certain extent) in a subject can have a national exam that can be added to the certificate of apprenticeship as a specialisation
- ☒ seven pilot projects spread across Norway in which passive buildings or passive building modules are built by schools
- ☒ extension of Directorate for Education and Training's subsidies for teaching aids, so that these can be updated in line with today's and tomorrow's energy solutions
- ☒ government funding to Bygg21, which covers the costs of developing instructions, guidelines and course material
- ☒ increased government funding to the Low Energy Program, to ensure that priority measures are implemented
- ☒ financing measures through Enova's energy fund
- ☒ certification/competence norms to increase the market advantage for those who focus on competence
- ☒ Better insurance terms for tradesmen who meet competence targets, or for house owners who use tradesmen who meet a competence target

Will the society benefit from focusing on raising the competence of tradesmen?

The analysts Analyse& Strategi have investigated the socio-economic benefits from raising competence in the building industry in the following areas:

☐

☐ implementing energy efficiency measures in existing buildings to regulatory level

☐ installation of renewable heating systems

The report demonstrates how increased competence can contribute to socio-economic benefits over a 14-year period as a result of increased energy saving, reduction in building damage and increasing the number of years tradesmen remain at work. The report looks at three different packages of measures, depending on the ambition level that forms the basis for competence enhancement. Allowing for a great deal of uncertainty in the estimates, the analysis indicates socio-economic benefits between NOK 379 million and NOK 980 million for the period 2012-2026.

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1. 2020 goals in Norway

The EU's climate and energy goals involve a 20% reduction in primary energy use, a 20% increase in the production of renewable energy and a 20% reduction in greenhouse gas emissions by 2020 [1]. The Norwegian government has adopted an objective of a 30 TWh increase in renewable energy production and energy efficiency measures between 2001 and 2016[2]. It has also been decided that Norway shall overfulfill the Kyoto obligations by 10% in the first commitment period of the Kyoto Protocol, that Norway shall commit itself to cutting global greenhouse gas emissions by 2010 by an amount corresponding to 30% of Norway's emissions in 1990 and that Norway shall be carbon neutral by 2050 [3].

The energy objectives have not been specifically divided across different sectors and there are no official objectives for energy efficiency or the use of renewable energy in buildings. In connection with an all-party agreement on climate measures (klimaforliket), the Norwegian parliament (Storting) asked the government to set a separate target for energy efficiency. It is projected as possible to halve energy consumption in buildings by 2040, which means a reduction in energy consumption from about 80 TWh a year to 40 TWh a year. It has also been considered realistic to reduce energy use in buildings by 10 TWh a year by 2020. Most of this saving would have to derive from renovating existing buildings to make them more energy efficient. As we approach 2040, the effect of better energy standards in new buildings will be increasingly felt [4, 5].

The Energy Performance of Buildings Directive 2010/91/EC (recast) sets requirements for Member States for the introduction of near zero energy buildings as the regulatory level by 2020 [6]. The government's white papers 21 (2011-2012) and 28 (2011-2012) addressed to the Norwegian Parliament (Storting) state that the government will tighten energy requirements in building regulations to the passive building level in 2015 and a near zero energy level as the building standard in 2020 [3, 7]. The government will set rules on how to define the passive building and near zero energy levels later. However Norwegian standards for low-energy and passive building levels for residential and non-residential buildings exist already [8, 9]. But the decision on regulatory levels will be made on the basis of socio-economic analysis. The government will also introduce component requirements for existing buildings and clarify what building work and components these requirements will apply to, including on the basis of an assessment of energy effects and costs [3, 7].

The purpose of the Renewable Energy Directive (2009/28/EC) is to increase the proportion of renewable energy in the EU, from 8.5% in 2005 to 20% by 2020 [10]. Norway has accepted a goal of 67.5% renewable energy by 2020. This corresponds to an increase of 9.5 % compared with the proportion of renewable energy in 2005. A key element in following the Renewable Energy Directive in Norway is the establishment of a joint Norwegian-Swedish electrical certification market. In total the new certification system will contribute to 26.4 TWh renewable energy production in Norway

and Sweden combined between 2012 and 2020 [11]. Other instruments that could contribute to the fulfilment of obligations under the Renewable Energy Directive could for example include support for energy efficiency measures and renewable heating from the state-owned enterprise Enova, tightening energy requirements in building regulations, energy labelling of buildings, transport policy, tax policy etc. [12].

2. The need for competence enhancement among tradesmen

2.1 Competence goals

Compared with usual energy standards, high energy-efficient buildings require particular attention to indoor climate and damp prevention. Among others, it is important to reduce the risk of high temperatures, ensure that no damp enters the structures, limit air leakage and avoid thermal bridges. As part of Build Up Skills in Norway, competence goals have been defined for the energy field for what the various executing professions need to know in order to:

- erect new buildings to passive/near-zero energy levels,
- renovate existing buildings to a very high energy standard,
- install renewable heating and cooling systems in both new and existing buildings.

The competence goals are based on the criteria for passive buildings [8, 9] and regulatory requirements aimed at facilitating energy supplies other than direct-effect electricity and fossil fuels [13]. The competence goals are found in a report from Rambøll AS that was commissioned by the Low Energy Program and in the status quo analysis carried out in the framework of the Build Up Skills project [14, 15]. The most important competence goals are connected to the following working operations:

- Planning risk-reducing measures to avoid buildings defects resulting related to damp.
- Tasks intended to achieve low leakage figures.
- Tasks connected with insulation and avoiding thermal bridges.
- Insulating heat generating pipes and components so as not to give off excessive heat.
- Adjustment of air volumes in ventilation systems and executing duct systems so as to achieve the lowest possible Specific Fan Power (SFP) factor.
- Design, execution and adjustment of heating systems.
- Extending and post-insulating existing structures.

Generally speaking, work in existing buildings will be more demanding in execution than new building to passive/near-zero energy levels. In addition, the work of preparing instructions and standard solutions for energy measures in existing buildings is not that developed so far..

Even though Build Up Skills is limited to on-site workers, the competence goals cover the knowledge necessary to make simple assessments of technical building solutions. This because manual worker companies, especially outside the cities, may be asked for suggestions for technical building measures and solutions, due to lack of instructions for example, or because instructions are difficult to put into practice [15]. This may be particularly relevant in respect of renovating homes, where it is

usually the tradesmen and skilled workers who are in contact with the households. The greater part of Norway's building stock is owned by private individuals. About half of the country's built area is totally owned by private individuals (detached and terraced houses) [4], and 75% of all Norwegian households own their own homes [16]. Therefore to achieve energy savings in existing buildings,, tradesmen performing construction works should have a theoretical knowledge to enable them to assess technical building solutions, without this meaning that they have to take on project planning responsibilities.

The competence goals for building pupils in upper secondary education are far more general than the identified competence goals for building passive buildings, perform ambitious energy measures in existing buildings and install renewable heating solutions. Since few of teachers seem to spend time in further education and training in the building industry, a right measure could be to ensure that the persons responsible for education and training are given suitable knowledge about passive building and energy-efficient building solutions.

2.2 The need for competence enhancement

A survey carried out by Respons Analyse AS and commissioned by the Low Energy Program shows that today the energy competence level among tradesmen and skilled workers is variable and in some cases lacking altogether [17], assessed against the competence required to do the job. Figure 2-1 shows answers from various vocational groups to statements (true or false) about passive buildings. The figure only shows the proportion that gave the correct answer for each statement. This does not necessarily mean that the rest of them gave wrong answers since respondents had the option of saying they were not sure.

Statements on passive buildings - the proportion giving the correct answer to each statement

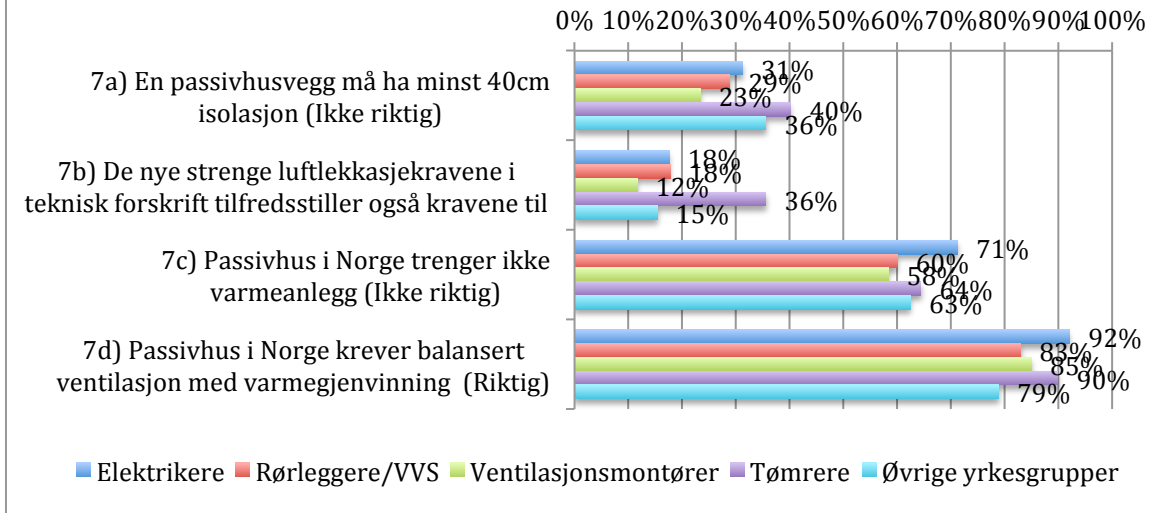


Figure 2-1: Results of the survey: Statements about passive buildings. Source: [17]

Another topic in the survey was to test knowledge about avoiding damp in structures. There has been concern about the increased risk of mould and damp in highly-insulated building structures, because the humidity level can increase when the outside part of the structure becomes colder, as well as a the time deemed necessary for building damp and accidental leakages to dry out with significant insulation thickness. In most cases these effects can easily be countered with a right choice of materials and structures and the correct execution [18]. However a relatively high proportion of tradesmen did not give the right answer regarding statements about damp prevention in structures (Figure 2-2). The results clearly indicate that knowledge about damp prevention should be a priority in courses about passive building and renovations with ambitious energy saving goals.

Statements on avoiding damp is constructions - the proportion giving the correct answer to each statement

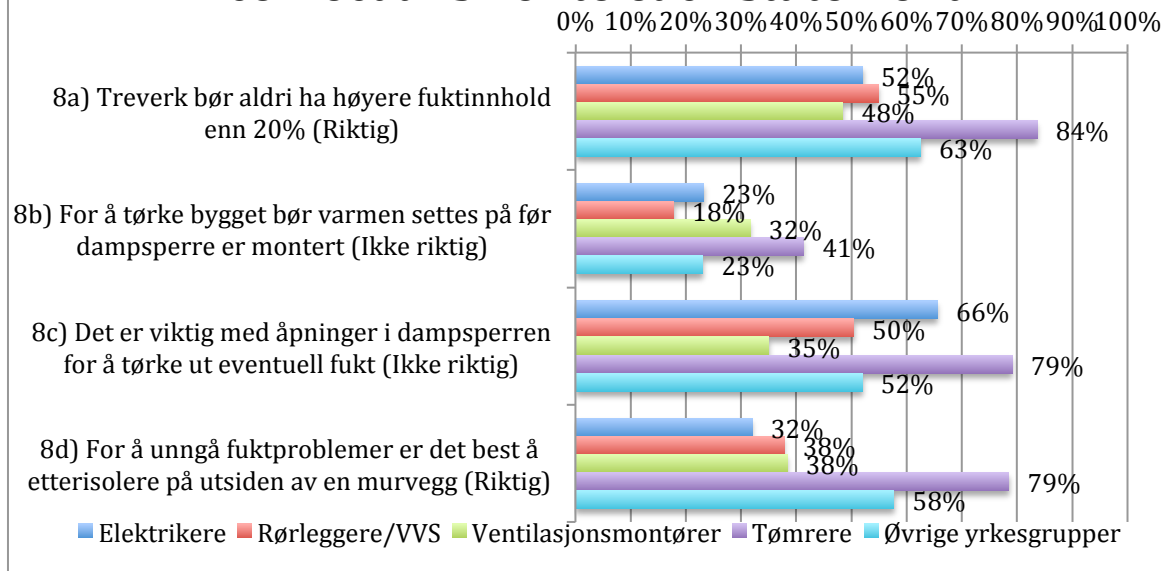


Figure 2-2: Results of the survey: Statements about damp prevention. Source: [17]

The survey also covered knowledge among tradesmen by inserting statements related to energy efficiency and renovation. For three of the statements, a majority (albeit a varying one) among all the target groups gave the right answer. However, only a few gave the right answer to the statement that natural gas could be a renewable alternative when replacing oil-fired boilers. This statement is of course incorrect, but only 20 to 27 per cent in the different target groups knew (figure 2-3). The results show that it is not only important to raise competence in respect of energy-efficient building and renovation, but also in respect of achieving energy conversion to increase the use of renewables..

Statements on energy efficiency and renovation - the proportion giving the correct answer to each statement

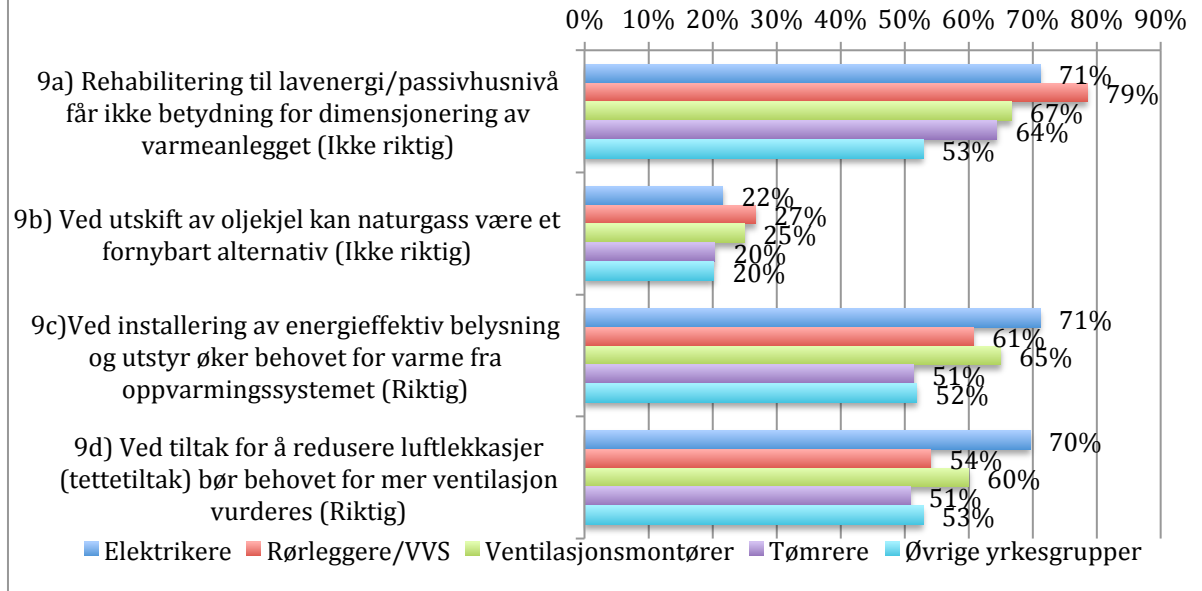


Figure 2-3: Results of the survey: Statements about renovation. Source: [17]

The different professions were also asked to assess their own energy competence in six areas that were specific to their vocational group. On a scale of 1 to 10, most placed themselves just above the middle (about 6) in most of the areas. The tradesmen working in ventilation were the ones who gave themselves the highest score for their own competence. In spite of the fact that the survey shows that knowledge among tradesmen is variable and lacking for many energy topics, it is positive that the majority of respondents said that they wanted to gain more competence in this area. Of course the desire of so many for more competence also indicates that today's competence of many tradesmen is just not good enough. But it also indicates a widespread willingness to acquire more energy competence. It is therefore important to facilitate this so that different vocational groups in the building industry can obtain such competence [17].

2.3 Obstacles to competence enhancement

In the survey carried out by Respons Analyse AS for the Low Energy Program in 2012, about 30% of respondents, who were foremen/site managers in construction companies, believed that lack of time

was an obstacle to participation to organised training. 13% thought that the cost of taking courses was an issue. This may refer to course fees, travel and accommodation or lost income. 32% of the respondents said that there were no problem issues and that they took part in the courses they needed [17]. In a corresponding survey carried out by Respons Analyse AS for the Low Energy Programme in 2010, the target group was company managers in the building industry. Here, respondents also thought that the major issues preventing competence enhancement (by attending adequate course) were lack of time (61%) and lack of money (39%). 14% thought that lack of motivation was a major barrier to implementing competence enhancement in the field of energy. This was a large proportion compared with companies in the project phase (architects and consultant engineers), where only 5% of companies stated lack of motivation as a barrier to raise competence. Only 14% answered that it was quite difficult or very difficult to perform competence enhancement and updating with regard to the newly introduced changes to the building regulations at that time [19]. Experience from industry organisations may indicate that training activities in the context of new regulatory requirements are normally given a high priority, since this is a condition for being able to carry out building in accordance with new regulations.

Hva er de største utfordringene i din virksomhet for å få gjennomført organisert læring i praksis? - Samlet for alle grupper (n=601)

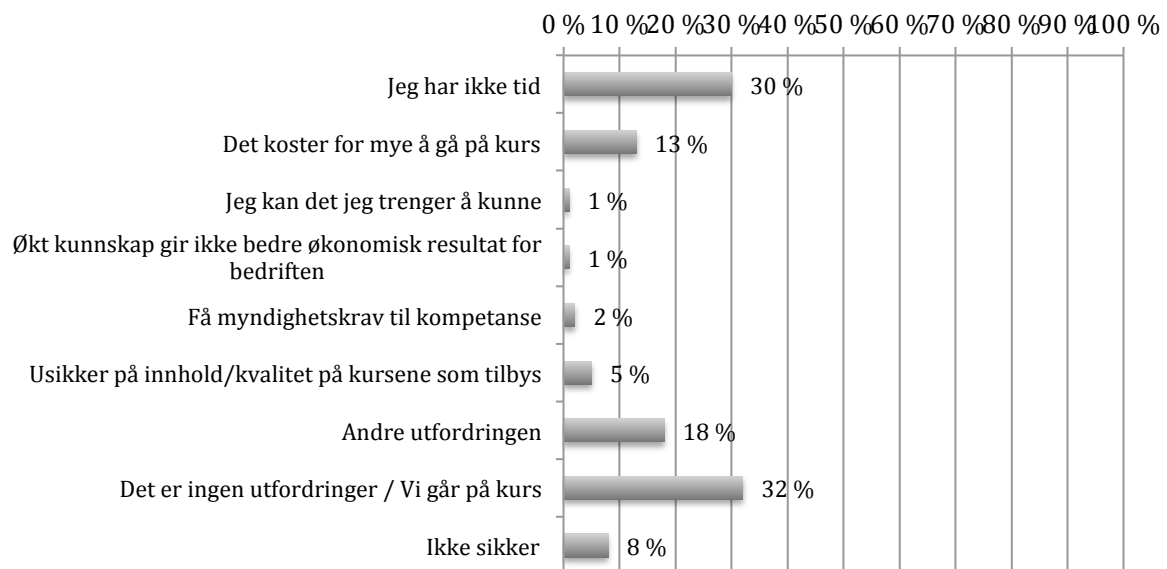


Figure 2-4: Results of the survey: Obstacles to course participation. Source: [17]

That a lack of time and money is a significant barrier to competence enhancing is also supported by the findings of an evaluation by the educational wing of the Norwegian Association of Building Contractors. Course fees, subsistence, accommodation and lost earnings are all real expenses for companies taking part in courses. Feedback from building companies showed that more than 60% of respondents wanted more local and regional courses. There was a desire for better coordination of courses across regions, making it possible to travel to a neighbouring region for a course instead of having to travel to the capital Oslo for courses that did not have enough participants in a particular region. Almost none of the respondents outside the area of the capital thought that more of the courses should be held in Oslo. Almost 30% wanted more internal company courses to be offered. Over 60% also wanted more courses to be available on the web, avoiding travel costs and time barrier as these courses could be followed in parallel with ordinary activities. Another interesting finding was that almost 60% had the impression that there would be better motivation to participate in courses ("yes" and "to a certain extent") if the courses qualified for study points [20]. This might indicate that barriers connected with a lack of motivation can be countered by giving participants more visible and documentary evidence of the effect of course participation.

Enova's barriers study (2012) showed that the most important barrier to energy efficiency in homes, from society's point of view, is the generally low and sometimes null attention given to energy use and energy related measures for private owners [21]. This may partly be explained by the fact that household energy expenses only represent about 4-5% of the annual expenditure on consumables. Profitability for major energy renovation measures is generally low, but somewhat better if they are included as part of planned maintenance and renovation. The lack of profitability is the biggest obstacle to more renovations of private dwellings to a high energy standard.

The second largest barrier is the lack of public recommendations and support. The so-called "fuss and bother", such as gathering information, organisation, discomfort and disturbance to everyday life, is the third most important barrier. In many cases the barriers are the same as those applying to energy efficiency in non-residential buildings. For non-residential buildings, the economic barriers stood out as important and major obstacles, especially in the early stages, when an investment decision has to be made. Here it is the financial barriers that dominate. In the project planning phase, the technical barriers are the most important, while in the implementation phase it appears that the lack of knowledge and sufficient competence are the biggest barriers [21].

When it comes to increased use of local, renewable heat in buildings, the lack of a proper market, lack of infrastructure and low profitability are clearly the biggest barriers [22]. It is important to avoid unnecessarily expensive heating systems, since the motivation behind the choice of a particular

heating system is often financial [23]. Heating systems designed for room heating needs at today's regulatory level would be overdimensioned for passive buildings [24]. It is important to bear in mind that simplified heating systems can lead to financial savings.

3. Measures for competence enhancement

A measure is defined as the physical action that leads in the direction of a given goal (in this case competence enhancement among those employed in the building industry). Instruments are the legal, economic or informative means that can be used to implement the measure. In other words, instruments can be looked upon as catalysts that trigger the measure that in turn helps to achieve the desired goal. Instruments can be either public or private.

This report proposes measures for raising competence in the field of energy. Section 4 of the report gives a summary of possible instruments that can be used. The costs and consequences of the measures may vary with the choice of instruments, so section 5 gives a short description of possible instruments without making recommendations. Emphasis has been placed on ensuring that it is possible to implement the measures proposed in practice and that there should be a wide consensus of agreement on them among partners to the Build Up Skills project.

The last part of Build Up Skills will seek to come to agreement on how the proposed measures can be implemented. A specific report will be prepared describing the implementation of the measures. In this phase it will be natural to return to a more comprehensive discussion of the use of instruments. It is intended that an implementation report for the measures proposed in Build Up Skills project will be available May 2013.

3.1 Education and training

Proposals for competence enhancement in the area of energy in the education system:

- Establish several pilot projects in which upper secondary schools, vocational schools, universities and university colleges, local authorities, local building and construction companies etc. collaborate to get knowledge about passive building into education and training for building and electrical trades.
- Increase the recruitment of pupils with craft or journeyman's certificates from the school system into the building and construction industry.
- Establish more schemes in which vocational teachers can spend time in companies that have ambitious building projects in the area of energy, where they can get up-to-date information about new building techniques, new materials, new regulations etc.
- Increase participation in further and post-qualifying education in the area of energy by teachers of vocational subjects.
- Establish collaboration between the building industry and the county councils to develop special teaching modules for instructors (in companies that take apprentices) on building at passive building level, renovation with ambitious energy goals and the use of renewable energy.
- Include renewed updated knowledge about passive building, energy-efficient renovation and the use of renewable energy for heating and ventilation in the next revision of teaching aids and materials for the vocational subjects involved in building and construction.

3.1.1 Passive building knowledge in education and training

Traditionally, only a small proportion of tradesmen in the building industry allocate enough time to participate in lifelong learning activities [26]. It is therefore important to target those in the education and training systems with information about energy efficient building solutions.

Experience shows that teachers of building trades in educational institutions also have a great need for competence enhancement in energy and construction solutions, in which a great deal has happened in recent years. It is therefore important to develop nationwide education and training schemes for the building and electrical trades in which pupils, students and teachers can acquire practical knowledge of passive building, renovation with ambitious energy goals and the use of renewable energy in buildings.

Research projects with ambitious energy goals for upper secondary teaching have been started up in five places in Norway: Froland, Sogndal, Mandal, Stavanger and Oslo. In Froland, pupils at Blakstad Upper Secondary School are building four residential care homes to passive building standard. The school has had good experience in terms of actual learning outcome, reducing the number of pupils dropping out from upper secondary education and in collaboration with local business and the local authorities. The school has also seen an increase in the number of applicants with building and construction as their first choice since the project started. The Blakstad model must be taken up by other vocational colleges, including sør-Trøndelag (Åfjord, Malvik and Røros) and Nord-Trøndelag (Vikna, Steinkjer and Stjørdal). In Oslo, the Low Energy Program has started a similar interdisciplinary project between the Oslo School of Architecture and Design, Oslo and Akershus University College of Applied Sciences, Oslo Vocational College, Sogn Upper Secondary School, SINTEF and several industrial partners involved in building and renting modules – with competence in passive building as the goal.

Based on experience from the research projects, several initiatives have been taken to spread this kind of project further so that pupils and students throughout the country can obtain practical and relevant experience of passive building. The aim is to get competence in passive building and renewable energy into all the teaching of building trades - from planning to building - throughout the country. One initiative that has been put forward is to create seven school hubs geographical spread across the country. The activities will form the basis for developing tuition of building and construction in upper secondary schools. Preparations are being made for upper secondary schools, vocational schools, universities and university colleges, local authorities, local building and construction companies etc. to cooperate closely in the framework of education and training projects. Finally, results, experience gained, teaching materials etc. will be collected and disseminated to other schools, to make it easier for them to establish corresponding projects.

All the education projects must develop a teaching plan for planning and building passive buildings, energy-efficient renovation and/or the use of renewable energy. But different models may be envisaged for implementing the education projects. Such projects may for instance be based on building projects for traditional new buildings for private customers, health and social care housing in collaboration with the Norwegian State Housing Bank and local authorities, modules, renovation, the use of new technology for renewable energy or company-controlled projects in which training is included as part of the project. In every education project, the parties involved must agree on a distribution of responsibilities between various education and training environments, local business and any other participants in the project.

The cost of realising seven hub projects for education in passive building is roughly estimated at about NOK 6.000.000 over two years. It is estimated that each project would receive a subsidy of up to NOK 700,000 to cover costs related to project management, staff, teaching aids, study trips, competence enhancement measures for teachers etc. It is therefore assumed that projects achieve a collaboration with local business to cover material costs and access to technical competence. Other but smaller budget items would include central project management, communication, preparation of information material and organising technical seminars for teaching staff. In addition, considerable commitment would be expected from upper secondary schools, universities, university colleges and local and regional building industries in the education projects that receive support.

It is difficult to quantify the beneficial effect for society of establishing education projects getting knowledge of passive building into teaching. The qualitative effect would be to ensure a high level of competence in the area of energy among vocational pupils and building students entering working life. This would help to ensure that national goals for energy efficiency in buildings could be achieved without severe risk of buildings defects. The projects could also help new establish useful and long lasting relationships between educational and training institutions for the building trades and local industry. Local businesses could be an important source of competence in the building trades for the schools and colleges, while at the same time this type of collaboration could help local builders to improve their technical knowledge. Finally, establishing education projects focusing on passive building could help stimulate motivated pupils, lead to more applicants and a lower dropout rate from upper secondary education in the building trades.

Box 3-1: Kuben Yrkesarena. Source [28].

Kuben Yrkesarena is a new competence centre for vocational subjects, located in Oslo. The building is designed to take about 1,800 pupils and students and will be ready for its first intake in autumn 2013. Kuben comprises an upper secondary school, an apprentice centre for the building trades and Oslo Vocational College (*Fagskolen i Oslo*). Kuben Upper Secondary School will offer courses in building and construction techniques (150 pupils) and electrics (180 pupils). One of the purposes of colocation is to offer complete and flexible teaching from upper secondary to vocational college, as well as courses of various lengths for those already employed. The aim is to create a dedicated meeting place in which schools and businesses can collaborate in developing the subjects and the content of the education and training being offered. Kuben could therefore be an excellent place for collaboration between the building industry, city authority, upper secondary school, vocational college and other institutions to get knowledge about passive building, energy-efficient renovation and the use of renewable energy into education and training.

3.1.2 Good recruitment

Projections from FAFO, (Norwegian Institute for Labour and Social Research) and Statistics Norway indicate an increasing need for tradesmen in building and construction. Given a stable level of activity, FAFO believes that employment in building and construction will increase on average by about 4,000 persons a year up to 2020. If the level of activity increases, the workforce needs will approach 9,000 new jobs a year. Correction has been made here for natural wastage of 3,000 persons aged over 62 per year [29]. Statistics Norway's forecasts show that the need for labour with vocational subjects in building and construction will increase steadily from about 100,000 persons employed in 2010 to about 125,000 in 2030 [30].

The EU energy efficiency directive is also expected to lead to an increased demand for workforce in building up until 2020. The European Commission has estimated that the directive could mean up to 400,000 new workplaces in the EEA area, a large proportion of which would be expected to be in building and construction [31]. Among others the directive indicates that 3% of government buildings over 500 m² (250 m² from July 2015) a year must be renovated to regulation level or better up to 2020 [32].

One important strategy for meeting the workforce need in building and construction is naturally to work on recruitment from the school system. This involves both getting more students to choose building and electrics for study and reducing the dropout rate of vocational training. A good level of recruitment from the school system would not in itself raise the energy competence of tradesmen. This measure is however important to ensure that there is enough qualified workforce in the building

and construction industry to enable the implementation of new building and renovation so that energy savings goals can be achieved to a sufficient extent. The involved parties in business and the education authorities are constantly collaborating to ensure a high enough number of applicants for the vocational subjects in building and electrics at upper secondary level, as well as a low dropout rate.

The number of applicants for vocational training in building and construction techniques has been relatively stable over the last four years, at just over 4,000 a year. In 2012 there were about 600 fewer applicants than there were places available in building and construction techniques. For electricians, the number of applicants for the first year of vocational education (VG1) increased from about 5,500 in 2009 to over 6,000 in 2012 [33]. It must be mentioned here that the upper secondary subject "*elektrofag*" covers a number of trades and professions using electrics and electronics, while only electricians are directly relevant for the building industry. If all pupils completed the course and gained their craft or journeyman's certificates, the need for workforce of the building and construction industry could largely be covered by recruitment from the school system. However, the dropout rate among pupils in vocational subjects is high. For example, fewer than 70% of pupils starting VG1 in building and construction take apprenticeships with companies [33]. For electricians, the percentage is a little higher (see table 3-1). Dropout in the final two years of apprenticeship in companies is also a reality, in addition to a proportion of pupils not attaining the journeyman's certificate (8-9% according to the Directorate for Education and Training) [34].

The Federation of Norwegian Construction Industries estimates that only about 50% of those who start VG1 in building and construction passed their craft or journeyman's certificates within five years [35]. There will also be apprentices who do not wish to get a job in their trade after their apprenticeship or who will leave the building and construction industry at an early stage. However, most apprentices (all vocational subjects, not just building trades) want to get a job in their trade after their apprenticeship [36].

Table 3-1: Number of applicants for upper secondary education in 2012 by chosen educational programme. Source: [33]

Educational programme	VG1	VG2	VG3 (Applicants for apprenticeships)
Building and construction techniques	4,223	4,024	2,849
Electrician	6,081	4,428	3,995
Design / craft	2,596	2,128	1,081

Study specialisation	28,382	24,780	23,256
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There is a broad agreement that it is important to reduce the dropout rate in upper secondary schools. An official Norwegian report NOU 2008:18 stated that the dropout rate from secondary schools, especially in the vocational subjects, must be reduced [37]. The government has announced that it intends to present a white paper during spring 2013, with a full review of the Knowledge Promotion Reform (*Kunnskapsløftet*) introduced in 2006. Reinforcing the vocational subjects will be a key element of the new white paper [38]. Organisation within the building industry have already set up working groups so that they can provide input to the Ministry of Education and Research with regard to the new white paper. It would therefore not be sensible to present a detailed discussion of the use of instruments here. It may however be briefly stated that the Federation of Norwegian Construction Industries has suggested for example that the educational programme for building and construction techniques (VG1) should be split into two - one for construction and one for building - and that arrangements should be made to allow a greater part of the upper secondary training in subjects and theory to be done in the teaching companies [35, 39]. At the same time, vocational training should focus more on an interdisciplinary approach for teaching across several subjects, which will become even more crucial for energy-efficient buildings.

Finally, a good programme of further education and vocational training after craft or journeyman's certificate could help to increase recruitment to the building and electrical trades at upper secondary level. According to the Federation of Norwegian Construction Industries, tradesmen and skilled workers are the group of employees in the building industry who currently have the poorest opportunities for further education or vocational training. This could affect the attractiveness of a vocational training in building trades [40]. Measures regarding formal further education and further education are described in sections 3.2 and 3.3.

3.1.3 Increased competence in the area of energy among teachers and instructors in building trades

An important characteristic of the Norwegian vocational training model is that it is carried out partly in school and partly in one or several teaching companies. The usual model is two years school followed by two years apprenticeship in a company. The quality of this model depends on the competence of both teachers (in school) and instructors (in companies). The formal competence requirements for the two arenas are different, but in practice both teachers and instructors must have suitable technical and teaching competence in order to teach well [41].

The OECD has carried out a review of Norwegian vocational training. In the report "Learning for Jobs", the three-way collaboration at national, regional and industry levels, was put forward as one of the strengths of the Norwegian model. Among the challenges involved, the report pointed out the need to look more closely at the recruitment of vocational teachers and the competence of

instructors [42].

The Karlsen Committee report NOU 2008:18 on vocational training for the future says that vocational teachers have a great need for updating in line with technical changes in working life. The committee believed that, to a greater extent, instructors in teaching companies would need competence enhancement in many of the same areas as the teachers. The partnership between schools and professional environments was put forward as an important focus area in the task of raising the quality of vocational training [37].

Teacher training for the vocational subjects differs from other training in that all students will have completed vocational training and had at least two-years' relevant work practice before starting teacher training. Traditionally, most of those who are recruited as vocational teachers in upper secondary schools are experienced tradesmen from industry. A survey carried out by NIFU STEP in 2007 showed that a solid majority of vocational teachers in building, construction and electrical subjects have craft certificates and several years of work experience. Many also have additional qualifications (master's certificate, technical college, university college etc.), which can provide an interesting combination of practical and theoretical competence. Where people are recruited from the industry, they must undergo teacher training to be formally qualified as vocational teachers. According to NIFU STEP's 2007 survey, one out of five vocational teachers in building and construction and one out of ten vocational teachers generally do not have formal teacher training [43].

The education sector is one of the working sectors with the highest participation in formal further education [26, 44]. A survey carried out for FAFO in 2003 showed that 17% of teachers in upper secondary schools had participated in formal further education in the past year. The proportion was higher among vocational teachers than humanities teachers. About one vocational teacher out of four had taken part in further education. A probable explanation may be that many vocational teachers did not have teacher training or theoretical education when they were appointed. A great deal of the further education includes subjects such as education, practical teacher training, vocational guidance and vocational teaching. The same survey showed that three out of four teachers at upper secondary schools had taken part in further education measures such as courses and seminars in the previous year. This proportion was equally high among vocational and humanities teachers. However, the proportion receiving an update in their own subject area was higher among humanities teachers than vocational teachers. Vocational teachers more frequently stated that they had received updates or development outside their own subject area than did humanities teachers [45].

Vocational teachers also face particular challenges when it comes to covering their competence needs. General competence development schemes will not adequately cover the need for technical development and updates in all areas. The internal professional environment in vocational colleges could be limited. Technological and other changes in the performance of the work may therefore require a technical update that is difficult to obtain outside the workplace. Structural changes in

schools also mean that teachers also have an increasing need for more competence in other subject areas [41, 44]. Energy consumption in buildings is a good example of an area in which things are moving quickly, with new building products, technology, requirement levels and focus areas for practical building and renovation.

Surveys in teaching companies indicate that the self-perceived need for competence among instructors is more limited than in upper secondary schools. It is a common assumption in most measures providing skills for instructors in the performance of the work that these will also help them to become more skilled instructors of apprentices. But, as in the workplace generally, lack of time is an important obstacle to taking part in competence development [41]. Even so, it is interesting that the interest in formal competence development measures of instructors is limited. In the Knowledge Promotion Reform evaluation (box3-2), only 7% of instructors stated they had taken part in such training. On the other hand, as many as 61% had participated in courses, seminars or other training, which was intended to provide training to vocational instructors but did not give formal study points or credits. All in all, the instructors spent 27 hours on courses, seminars or other training that provided no formal competence but was relevant for their role as instructor. One instructor out of three thought they needed more training related to their instructor role. In other words, the self-perceived need for training in the teaching companies was at the same level as before the Knowledge Promotion Reform. The training needs were partly related to technical updates and partly to motivating and guiding apprentices. Some also mentioned a need for more knowledge of the new curricula [44].

The Knowledge Promotion Reform was introduced from the 2006-2007 school year. Report to the Norwegian parliament (Storting) nr. 30 (2003–2004) *Culture for learning* signalled that it would be necessary for a period to allocate government funding to competence development in order to achieve the changes the reform presupposes. A considerable focus on competence development was therefore announced, with priority for measures directly related to the reform. According to the plan, the "Competence for Development" initiative was to give school owners the necessary basis for covering the need for competence development in connection with the introduction of the reform. The national strategy document for this initiative was signed by the Ministry of Education and Research, the Norwegian Association of Local and Regional Authorities, the Union of Education Norway, the Norwegian Association of Graduate Teachers,, the Norwegian Union of School Employees and the Association of School Leaders. The most important target groups for the initiative were heads of schools and teachers and instructors and supervisors in the teaching companies. It was also stressed that the structural and content changes in upper secondary education would to a great extent set competence requirements that would be the same for instructors and teachers. Stress was placed on the significance of creating common meeting places for teachers and instructors through the development of new competency enhancement measures. "Competence for Development" was implemented during the period 2005-2008. In its white paper to the Norwegian parliament (Storting) Nr. 31 (2007–2008) *Quality in School*, the Ministry of Education and Research signalled its intention to further develop their collaboration with the Norwegian Association of Local and Regional Authorities and other organisations to renew the focus on competence development. The strategy document "Competence for Quality" was presented in autumn 2008. The document emphasises the need for reinforcing teachers' formal competence. On this basis, the new strategy created a framework for a lasting system for further education for teachers, with the government covering cost of study places. While "Competence for Development" gave funding to school owners, government funding in "Competence for Quality" went to universities and university colleges, so that these would be able to offer free study places to teachers.

Box 3-2: The Knowledge Promotion Reform. Source: [41]

Practical on-site training for teachers in companies is not widespread in the building and construction sector. In a 2010 survey, only 14% of vocational teachers stated that they had spent time in a company in the past five years [41]. One of the concrete proposals of the report NOU 2008:18 on vocational training for the future was to develop systems for in-company training and the exchange of staff between school and working environments [37]. This proposal was followed up in the white paper nr. 44 (2008–2009) in which the government indicated that it would consider opportunities for in-company training and the exchange of staff between school and working environment [46]. Experience has shown that those who have taken part in such schemes believe it has had a positive effect on their teaching, that there is a positive attitude to in-company training as part of a more permanent formal further education and further education program and that companies are positive about giving teachers a technical update. There appears to be less of an expressed need for instructors to spend time in schools. There are several reasons why in-company training for teachers

appears to be more relevant than the other way round. It is in the companies that technical development occurs, where new building techniques and materials are used and where new regulations are implemented [41].

The Directorate for Education and Training has initiated a national research project on in-company training for vocational teachers. The research project is being implemented in cooperation with the Federation of Norwegian Construction Industries, the Enterprise Federation of Norway, the Norwegian Confederation of Trade Unions, the Union of Education Norway and some municipalities . It should be an objective that the national research project provides vocational teachers with greater knowledge in the field of energy. To achieve this, it is important for in-company training to be included in projects that involve passive building, renovation with ambitious energy goals and the use of renewable energy for heating and ventilation.

Relevant measures for increasing the energy competence of instructors will largely be the same as for building employees generally. But it might be especially relevant for instructors for local municipalities to establish training programmes for technical managers, instructors and examination board members. These programmes could include modules on passive building, renovation with ambitious energy goals and the use of renewable energy, as well as covering basic features of upper secondary training, content of regulations and curricula, updates with the introduction of reforms etc. Many different bodies could be involved in arranging such training, including the teaching companies themselves, education offices, industry associations and vocational training offices in local municipalities. It is important for these to collaborate so as to create a specific strategy for how increased knowledge of energy use in buildings can be included in training for instructors in teaching companies.

Local municipalities and vocational training boards bear an important responsibility for stimulating and facilitating collaboration between school and working environment. The Karlsen Committee (NOU 2008:18) proposed clarifying the county authorities' responsibility for providing competence development for vocational teachers and instructors. The committee also proposed that the county authorities and vocational training boards should establish binding local meeting arenas between schools and companies [37]. Projects for getting knowledge of passive building into education could be an example of a joint competence development measure for schools and teaching companies that could also facilitate further cooperation between schools and working environment. In many municipalities, involvement of business in training happens through education offices and vocational training boards providing input to the county authority. Three out of four instructors work in teaching companies that are members of education offices [44]. Cooperating with education offices in identifying competence needs and the development and implementation of competence measures can therefore be a good strategy. The challenge is to reach teaching companies that are not members of an education office.

Increasing the competence of teachers and instructors in energy issues will suppose that many of these must increase their knowledge through some form of lifelong learning. Regardless of the instruments used, this will mean less time for other working tasks, which will lead to costs for employers and for society in general. For example, teachers who participate in further education through the "Competence for Quality" initiative must be exempted from part of their normal duties. It is assumed that substitute teachers will be in place for teachers taking further education. The national education authorities give subsidies up to 50% of the substitute teacher costs to school owners who have been allocated study places. The school owner covers 25% of the substitute teacher costs and costs of travel, accommodation, teaching aids and other study items. The remaining 25% is the teacher's own contribution in the form of use of own time [47]. If several vocational teachers in building trades are to participate in further education in the area of energy, the cost for the government and for school owners will increase. If the government is also to cover part of the cost of substitute teachers when vocational teachers participate in courses outside the formal further education system, the costs will increase even more. If the government is to take on such costs, it may be right to look at opportunities for course participation giving study points in the education system and becoming part of vocational teachers' formal education. Similarly, a functioning in-company training scheme will depend on a financial support scheme that makes it possible to put qualified substitute teachers in place during the training period. Where several vocational teachers take part in such schemes the costs for school owners will increase. Nowadays whether there is a financing scheme for in-company training or not varies between municipalities. The amount of compensation also varies [41].

Instructors and technical managers are not covered by "Competence for Quality". However the strategy document indicates that the government will strengthen competence development for this target group by means of other measures. Increased course participation, formal further education etc. for instructors would involve costs for the company where the instructor is employed. There would also be less time for performing normal working tasks. However the cost of keeping up to date in energy issues cannot be ascribed to this measure, since employees of building and construction companies must in any case stay up to date in order to perform their jobs satisfactorily.

3.1.4 Updated teaching aids and materials

Teaching aids and materials must be updated in line with the development of requirement levels, building practice and practice in the building industry. In Norway, Gyldendal Forlag and Byggenæringens Forlag are the publishers of tekstbooks for most subjects related to building and construction. Elforlaget is the electrical industry's own publisher and part of the secretariat of NELFO (the electrical and IT companies' association). It publishes technical works and textbooks for the electrical industry that cover upper secondary education for electricians and electrical fitters, among others. The Norwegian Association of Plumbing, Heating and Ventilating Contractors has also published a number of textbooks for plumbing, but the association does not have its own publishing

house. Finally, there is e-learning material that can be used in vocational training available on various websites, such as www.murfag.no (bricklayers) and www.ifag.no (plumbers).

The Ministry of Education and Research is currently preparing a new white paper to the Norwegian parliament (Storting) with an evaluation of the Knowledge Promotion Reform. Changes in vocational teacher training will play an important part of this, which will involve a need to change curricula and therefore also teaching aids and materials. It is vital that the coming revision of teaching aids and materials for the building and construction trades includes knowledge of passive building, energy-efficient renovation and the use of renewable energy in heating and ventilation. This could be based on the competence goals for the various trades that have been developed in Build Up Skills project [14, 15]. In addition, it is necessary that apprentices know the theoretical background behind the energy goals as well as what the consequences of error might be. With higher ambitions for energy in building projects it will also be vital to be conscious of interfaces with other trades and to understand the significance of one's own and other trades for the end result.

3.2 Formal further education

Proposals for enhancing competence in the area of energy in formal further education:

- Vocational college: Review the curricula for building and climate, energy and the environment to include competence goals for energy and the environment, where these do not currently exist.
- Master's certificate: The master's certificate board have decided that training in the building trades shall be extended with a teaching module. At the present time no decision has been made on what technical goals will be included. It would be natural for climate and energy to be included when the content is developed.
- Establishing a qualification/ certification scheme for installers of heating systems based on renewable energy. Implementation should be followed up with information about the scheme.
- Consider establishing other qualification/certification schemes for tradesmen with regard to passive building or renovation with ambitious energy goals.
- Establishing a pilot project on energy to define specific formal training for tradesmen who wish to continue in their own vocational subject.
- Establishing a pilot project on energy to see how implementing courses with documented real expertise for tradesmen could be specifically related to curricula, subject and study plans in the formal education system (for example bachelor degree in university college, climate, energy and environmental studies in vocational college etc.).

3.2.1 Updating curricula for vocational college/master's certificate

Vocational colleges have several courses relating to building construction. These are:

- Building
- Construction
- Climate, energy and the environment
- Wood techniques

The national plan for the two first educational units (the first year) is common to all subjects with the exception of climate, energy and the environment. Building and wood techniques also follow a common plan for the third and fourth educational units. In the fourth unit, wood techniques will offer detailed coverage and a main project for specialisation aimed at wood-based building products and the use of wood in building and urban renewal.

Construction and climate, energy and the environment have their own plans for the third and fourth study units.

The curricula are devised in collaboration with the national committee for technical vocational college education. For energy efficiency and energy conversion, it will be relevant to look for correlations between buildings and climate, energy and the environment subjects.

Master's training is currently a mercantile further education based on craft or journeyman's certificate. It includes marketing, company set-up and management, economics and calculation, plus a project.

3.2.2 Certification for tradesmen – the Renewables Directive

According to the Renewables Directive (2009/28/EC) article 14 (3), EEA countries shall introduce a certification or qualification scheme for installers of technical systems based on renewable energy with effect from 2012. Technical systems covered by the scheme include thermal solar heating, heat pumps, biosystems and solar cells [10]. The Renewables Directive could therefore be implemented through the establishment of voluntary qualification/certification schemes, in addition to the development of a new regulation including requirement specifications for installer of renewable heating systems and requirements for accreditation of a certifying body [48]. These possibilities correspond to what has been proposed by Energimyndigheten, Boverket and Swedac in Sweden [49]. Certification could be handled by Det Norske Veritas, Nemko, the Technological Institute or other accredited certification bodies. These organisations already offer various services for certifying personnel [50, 51, 52].

The vocational colleges shall give vocational training that is based on upper secondary training or corresponding real expertise. This vocational training should provide expertise that can immediately be used in working life. Vocational college training in climate, energy and the environment has been

established at six technical colleges in Norway. The study module is for two years and has been developed for tradesmen who wish to have formal further education in climate technology for building and construction. The course content in climate, energy and the environment at the vocational colleges could form the basis for specifying the necessary knowledge before certification, possibly together with minimum requirements for work experience. The advantage of using the course content at vocational colleges is that this builds further on existing educational structures. The recruitment of installers is also ensured to a certain extent, because those who complete the climate, energy and the environment training at vocational college could easily be certified later.

In Norway it would be natural to focus on certification or qualification schemes for installers of water-borne heating systems, as well as solar cells. Heating systems based on point heating, such as biopellet stoves, wood-burning stoves and air-to-air heat pumps could fall outside the certification or qualification scheme because such systems are easy to install and the use of certified fitters would not give much added benefit. For installers of solar panels, it is recommended that an investigation be made of whether the register of electrical companies, which is held by the Directorate for Civil Protection and Emergency Planning, could meet the requirements of the directive [48].

Voluntary qualification/certification schemes could be of limited benefit in increasing the expertise of tradesmen. Surveys that have been performed indicate that the greatest obstacles to participation in lifelong learning are lack of time and the cost of participation, as well as too centralised courses [14]. There is a risk of low participation to voluntary qualification/certification schemes for tradesmen in the building industry since setting such schemes up do not in itself address these obstacles. But a voluntary scheme combined with a large-scale information campaign in order to create a market demand (i.e. both commercial building owners and households) for qualified tradesmen, such as heating installers, schemes could have a greater effect. Also the Swedish evaluations of implementation of article 14 (3) of the Renewables Directive conclude that good information will probably be vital if plumbing and HVAC companies are to consider it worthwhile to spend time and money on certification schemes for their installers. If new voluntary certification/qualification schemes are to have a sufficient impact on the market and give a knowledge lift, it is vital that they are accompanied by funding information and marketing of a regulation covering requirements for certification [48, 49].

A more comprehensive solution for implementing article 14 (3) of the Renewables Directive would be to introduce mandatory certification schemes. If requirements are to be established for mandatory certification of installers of renewable heating systems, a central register of personnel or companies that perform work on heating systems must be established. The need for information and marketing of the scheme will be less if certification is mandatory. This is however not recommended in Norway, Sweden or Denmark [48, 49, 53]. This is partly because it would be a demanding task to build up nationwide certification schemes with the capacity to handle the volume of tradesmen to be

certified. Also, mandatory certification could be expensive for companies in the building industry.

From the perspective of the building industry, there is a desire to link qualification/certification schemes with formal requirements, for example with the Building Permit Regulations. One solution could be to require certification for execution of the most complicated building measures in class 3 under the Building Permit Regulations [54]. It may be relevant for the Norwegian State Housing Bank and Enova to set formal requirements for expertise for subsidies for building projects with ambitious energy goals. For example, certification schemes could be a tool to enable Enova and the Norwegian State Housing Bank to finance large quantities of applications for subsidy for energy efficiency in the private house market, while at the same time ensuring quality of execution.

Establishing national qualification/certification schemes for installers of heating systems based on renewable energy is a requirement that follows from article 14 (3) of the Renewables Directive. The directive has been included in the EEA agreement and shall be implemented in Norway. The costs of implementing qualification/certification schemes for heating installers are uncertain, but if the schemes are voluntary, the costs for the building industry will probably be small. The beneficial effects of such voluntary qualification/certification schemes are also uncertain. Given good information about the schemes, setting them up could help to raise the level of knowledge among the trade groups affected, thereby increasing the quality of the work performed. However this depends on a market demand of qualified/certified heating installers.

After considering the experience of qualification/certification schemes for heating installers, the need for and benefits of similar schemes for other groups of tradesmen in building and construction could be evaluated. If such schemes are to be introduced, groups of tradesmen with the greatest significance for the energy efficiency of buildings should be prioritised, such as carpenters, electricians and ventilation installers.

3.2.3 Further education in energy for tradesmen

A lack of development opportunities has been put forward as one reason why it can be difficult to keep skilled tradesmen in the building and construction industry [40]. According to FAFO, one key success to meeting the workforce needs of the future will be to keep the experienced workforce in the working life [29]. Participating in lifelong learning measures could help to ensure that more tradesmen wish to remain longer in their jobs. For those who wish to remain in their trades, there is currently no national system or offer of systematic education or craft or journeyman's certificates.

The Federation of Norwegian Construction Industries has stated that a national framework should be established for systematic, documentable education for tradesmen and skilled workers, so that individuals can receive the necessary professional update to enable them to continue in their trades. The aim is to create a specific course of training for tradesmen who wish to get further education in their own trades, while they continue to perform them. In the energy field, it is proposed to establish

a pilot project in collaboration with Enova and the Low Energy Program [40]. The new technical knowledge acquired must be expertise that would not necessarily be obtained during the course of the daily work on the building site. It can be based on established competence goals for the various trades and existing courses on passive building, renovation with ambitious energy goals and the use of renewable heat. Training should also be supplemented with, for example, knowledge of mathematics, building construction, technical theory and practice from building projects with high-energy ambitions. Consideration should be given to linking such further education with any qualification/certification schemes for tradesmen (see section 3.2.2).

The European Qualifications Framework for Lifetime Learning (EQF) is implemented in Norway via the establishment of a national qualifications framework. The national framework covers qualifications in the formal education system and is not sufficiently detailed to be able to relate competence gained at work or in the voluntary sector directly to the framework. Real competence must be assessed and related to curricula, subject and study plans for the individual educational courses. One of the aims of introducing the qualification framework is to strengthen opportunities for lifetime learning and help in establishing schemes for testing, documentation and recognition of qualifications achieved outside the formal education system. Producing better tools for describing and assessing learning outcome in this way will therefore be essential, so as to be able to assess whether real competence is equivalent to learning outcome in the formal educational system, which is described in curricula, study plans etc. [55]. With regard to energy use in buildings, a pilot project could be established to define how implementation of quality-assured courses and documented real expertise could be specifically related to curricula and subject and study plans for various educational lines (such as bachelor degree in university college, climate, energy and environmental studies in vocational college etc.). The aim of the project is to help to define what criteria should form the basis so that documented learning through courses and daily work on the building site could give study points within the formal education system. If there is interest in taking a pilot project further, a project description should be prepared and an assessment made of project costs, financing possibilities, partners and governance. Relevant partners might include the Low Energy Program, industry organisations, unions, educational institutions, education authorities etc.

3.3 Formal further education

Proposals for enhancing competence in the area of energy in formal further education:

- Force the development and updating of building details, guidance material etc. at passive building level, for both new building and existing buildings.
- Further develop existing course material to give specific detailed knowledge for every single trade and to cover practical use of the knowledge on the building site.
- Organise courses for instructors so as to ensure the capacity of qualified course holders and to give a geographical spread of course holders, making it easier to take courses locally.
- Increase course participation among tradesmen in building and construction. Relevant instruments could be competence requirements for performing building work, competence requirements for receiving subsidies for building projects with ambitious energy goals, establishing qualification/certification schemes for various professions and trades or establishing a training fund.
- Integrating courses on energy efficiency in buildings, use of renewable energy and energy-efficient building products into the building goods chains' internal training.

3.3.1 Forced preparation of building details and guidance material

The building industry uses building details and guidance material partly to ensure that the building solutions they are choosing are good and reliable. Instructions, tools, preparation of standards, research and other development of knowledge and documentation must be developed at the same time as requirements for buildings are sharpened up. If passive building is to be the standard for new buildings and if renovation is to occur with high-energy ambitions, documented building solutions and building details at passive building level, as well as guidance material, must be developed, updated and adapted to new ambitions, Norwegian conditions and Norwegian building traditions. As per today we lack solid standard solutions and other tools for planning and building passive buildings and renovating to a high energy standard [56].

The Low Energy Program, the Norwegian State Housing Bank, the Norwegian Building Authority and Enova have commissioned a report that describes which instructions, tools or publications on solid standard solutions the building industry needs for passive building. The report also states what evaluation projects are necessary for pilot projects in order to ensure reliable and solid solutions and what R&D projects and topics are needed to obtain updated knowledge. It is estimated that the development of this instrument will cost about NOK 45 million a year, or about NOK 315 million over a seven-year period. In order to carry out this project, there will be a need for about 30 full-time people over the same period [56]. This shows the challenges in terms of both financing and competence, due to the lack of people who could perform the work.

The Building and Infrastructure series "*building industry quality norms*" has been developed by SINTEF Building and Infrastructure (Byggforsk) and gives documented building solutions that can be used to satisfy the requirements of the building regulations. The Building and Infrastructure series is one of several possible ways of spreading knowledge about passive building solutions. In a survey carried out for the Low Energy Program, 50% of the 400 tradesmen companies responded that the Building and Infrastructure series was a good way of raising competence and updating changes to regulations [19]. According to SINTEF Building and Infrastructure, more than 7,000 companies and tradesmen in the building industry use the series as part of their quality and competence development system [57]. This has therefore been taken as a basis for describing the extent of passive building solutions that must be developed and described in building details and guidance material. Industry instruments, consultants, the authorities, the Low Energy Program etc. will also naturally develop guidance material, recommended building solutions etc.

Based on the SINTEF Building and Infrastructure series, it is estimated that there will be a need for 200 building detail sheets on passive building over a seven-year period. This covers both new details and the revision of existing ones. The need for instructions can be linked to topics such as planning, documentation, building process, building shells (climate screening), installations, energy supply and

internal environment. This estimate includes new building and renovation of residential and non-residential buildings of all sizes. The report also assesses which topics for instructions it would be most natural to start with and that should come into place within the first or two 2 years. This start-up group includes about 15 instructions, about 10 of them existing instructions that must be upgraded and the rest new ones that must be prepared. The priority topics in the start-up group are:

- General principles for passive building
- Documentation relating to NS 3700 and NS 3701 - Criteria for passive building and low-energy building
- Floor solutions
- Outer wall solutions
- Roofing solutions
- Solutions for window installation
- Sealing - general principles and solutions
- Thermal bridge atlas
- Demand control and ventilation
- Simplified water-borne heating

The greatest potential for energy efficiency lies in existing buildings [21]. This indicates that instructions for step-by-step renovation to regulation level should also be a priority. In Denmark, a manual for building renovation has been devised that includes examples of building solutions, estimates of energy savings and cost estimates [58, 59]. A corresponding Norwegian manual could for example be devised based on course material about the renovation of common wooden and brick constructions that has been prepared by the Low Energy Programme, the Norwegian Association of Building Constructors and the Norwegian Association of Masons and Bricklayers [14].

3.3.2 Ensuring the quality of courses about energy in buildings

There are a certain number of organised courses for tradesmen in building and construction. In addition to the industry organisations, there are a number of privately organised courses. When introducing new regulations (public subsidy schemes etc.), it has also been a tradition for the authorities to organise so-called guide courses. Building product suppliers also hold courses with themed seminars, breakfast meetings etc. aimed at the professional market, including local tradesmen. These courses can be anything from pure product presentations for marketing purposes to a focus on regulations or building solutions. There is currently no system for ensuring the quality of the courses offered or method for assessing their quality [14].

No studies have been made that give an overview of courses currently offered in the field of energy that are aimed at tradesmen in the building industry, or an assessment of the courses themselves. One strategy that is used to ensure course quality is to develop quality-assured training material

centrally. The material can be used by organisations, course providers and others for training aimed at tradesmen. For example, SINTEF Building and Infrastructure and Rambøll have developed a passive building course aimed at various groups in the building industry, such as project owners, planners, active tradesmen and property managers. The price of developing the training material was estimated at NOK 1 million. Similarly, Multiconsult has developed a course compendium for carpenters and bricklayers for renovating buildings to energy standards corresponding to the current regulatory level. The costs of this compendium were about NOK 350,000. Seven industry associations have also developed a course compendium on water-borne heating and the use of renewable energy, such as solar energy, bioenergy, heat pumps and district heating. The overall financial framework for this project was about NOK 1.5 million.

The courses that have been developed all give relevant knowledge for tradesmen who wish to learn more about passive building, energy-efficient renovation and the use of renewable energy. But the courses do not really give detailed information that could be specific to each trade and do not involve practical use of the knowledge on the building site. The national status quo analysis carried out under the Build Up Skills project describes detailed competence goals, which tradesmen in the building industry must know in order to [14, 15]:

- erect new buildings to passive/near-zero energy levels,
- renovate existing buildings to a very high energy standard,
- install renewable heating and cooling systems in both new and existing buildings.

Consideration could be given to developing central course material that goes even more into detail about what the various tradesmen in building and construction must know regarding energy use in buildings and that also covers practical use of the knowledge on the building site. This could be based on course material that has already been developed, so as to limit costs. But it is worth noting that the public sector has had to finance a large part of the project costs in all three projects mentioned above, while the industry has had to make a corresponding contribution. Passive building level is indicated for new buildings with effect from 2015 [7]. One goal could be to ensure that specific and quality-assured course material on energy in buildings for all the relevant trades exists before new regulations come into force, so that they can be used by course organisers in the building industry.

Regardless of the quality of course and teaching material, it would be difficult to be able to guarantee the quality of training without knowing anything about the quality of the course holders. This may be resolved by arranging training of course holders for resource persons in the building and construction industry. Such training would also involve a cost. When developing passive building courses (new building), the Low Energy Program estimated that it would cost just under NOK 450,000 to organise a five-day training program for 60 participants. Travel and accommodation costs would be financed by the participants but the tuition itself would be free. Organising such courses could

ensure the capacity of qualified course holders and hopefully give a geographical spread of course holders, making it easier to take courses locally. The courses could include, for example, a technical part, instruction in presentation techniques as well as an examination. It is difficult to estimate how many course holders would be necessary. This must be assessed in each case based on the target group and customer base in each region for the courses to be developed.

Finally, the need for accreditation or certification of course holders or courses, has been considered. One advantage of accreditation or certification is the guarantee of the quality of courses being implemented. A disadvantage is that this would increase the cost of participation in training, which could give lower participation. In rural areas with fewer tradesmen to form a customer base for courses, there may be a risk that the expenses of accreditation or certification will be too high to make it interesting for private course organisers to initiate training measures. It was decided not to go further with accreditation or certification of instructors or courses, since the potential benefit was not considered to be high enough in relation to the costs involved.

Box 3-3: House and Health. Source [60].

House and Health was first developed in 1993 as a training programme on topics relating to indoor climate, building design, damp, ventilation, building processes etc. At that time, almost 35,000 people involved in building and operating buildings took part in organised training on how to achieve and maintain a healthy interior climate in buildings. The guideline was updated and reworked in 2009, based on new information from research and practice. House and Health is a good example of how major commitment and resources for practical training can help to achieve lifelong learning in the building industry. House and Health was the result of collaboration between the Norwegian Building Authority, the Norwegian State Housing Bank and SINTEF Building and Infrastructure.

3.3.3 Increased course participation among tradesmen

Surveys carried out for the Low Energy Program show that today's competence level in the field of energy among tradesmen and skilled workers is variable and in some cases lacking altogether [14, 17, 19]. The results of the learning conditions monitor also show that the building and construction industry is less involved in formal further education, further education and learning-intensive work than many other industries. The percentage of tradesmen taking part in lifetime learning has been greatly reduced in the last three years [26]. It is still positive however that there is a widespread willingness among tradesmen in the building and construction industry to acquire more competence in the energy field. This means it will be important to facilitate actual competence enhancement among tradesmen in practice [17].

Previous surveys indicate that preferred ways of raising competence among tradesmen have been external courses outside the companies, use of Building and Infrastructures series and learning from colleagues at the workplace [17, 19]. Most contractors also have specific internal training schemes [20]. Most of the possible external courses are through building goods suppliers and the industry associations. The proportion of companies making use of course offers from industry organisations, trade unions and the authorities increases noticeably with company size [17]. As mentioned in section 3, surveys carried out by VOX show that a relatively large proportion of companies in building and construction could be willing to finance training of their employees in full (38%) or make a partial contribution (32%) [27].

The largest group of tradesmen in building and construction in Norway are carpenters, followed by electricians and plumbers. If we resonate on the basis that there are about 50,000 carpenters who shall have knowledge about passive building and energy-efficient renovation over the next eight years, this means that an average of 6,000 to 7,000 carpenters a year must take part in training measures in the energy field. After carpenters, it is electricians (about 30,000) and plumbers (about 16,500) that are the biggest groups of tradesmen in the building and construction industry [61]. The task of ensuring training becomes less extensive for vocational groups with fewer people employed. At the same time, there will probably be a smaller market for courses for these professions.

It is advised that the most important thing is to reach the groups of tradesmen who have the greatest influence on energy results in a building. This would apply especially to carpenters, plumbers, electricians and ventilation fitters. Among these groups, the most important is to reach site managers and foremen, whose role on the building site has a great influence on the execution of a project.

It will be necessary to widen the scope of courses on energy use in buildings being offered by building goods suppliers, industry organisations, unions, the authorities and others. But it would hardly be realistic to expect that all tradesmen in building and construction could complete an external course on energy by 2015, or 2020 for that matter. Competence enhancement using building details from SINTEF Building and Infrastructure, learning from daily work on the building site and company courses will therefore be necessary. It is therefore imperative that key persons in relevant companies are offered courses and training and that these take responsibility for spreading the information to colleagues through internal company courses and more informal learning at the level of workplace.

From the results of other national status quo analyses in the framework of the Build Up Skills project,

it became apparent that many EEA countries have a scheme in which companies of a certain size pay a certain percentage of their turnover into a public training fund. The fund is used to organise free or heavily subsidised courses for tradesmen who work in the companies covered by the scheme. Such a scheme could make it attractive for companies to send their employees on courses, because the course fees have already been paid into the public training fund. The disadvantage of such a scheme is that it would probably be demanding to establish, as it would increase costs for companies. Most countries that have such schemes, such as the United Kingdom, Belgium, the Netherlands, France and Spain, established them a long time ago. One possibility however would be to look at further development or expansion of the Confederation of Norwegian Enterprise's information and development initiative (see box 3-4).

Surveys indicate that lack of time, money and local courses are the main obstacles to course participation among tradesmen in the building industry [17, 19, 20]. Private course organisers are dependent on their courses making a profit to make them worthwhile. In order to ensure sufficient, widespread quality-assured courses for tradesmen in rural areas where the customer base is limited, government subsidies may therefore be necessary. Criteria can be set for government subsidies for courses, such as for quality, scope and links to local business.

Box 3-4: Information and development fund. Source: [62]

The Confederation of Norwegian Enterprise (NHO) and the Norwegian Confederation of Trade Unions (LO) have established an information and development fund. The fund is endorsed by the primary agreement between these organisations and is financed by employers paying a fixed amount for each employee covered by tariff agreements. Apart from minor administration costs, the fund is divided equally between the organisations. The funds are to be used for training and competence measures that benefit companies and employees. There has also been a proposal that employees should have the right to devote ten per cent of their working hours to further formal and/or vocational education and training. The scheme would be financed by employers, employees and the government, contributing to a fund in order to cover wages and other costs for those following further formal education or further education and training. The proposal was however not adopted and such an education and training fund was never established.

3.3.4 Better product knowledge

The choice of building products is central for the quality of building. The scale of building faults and defects in Norway is extensive. Estimates vary greatly (between NOK 4 and 12 billion a year) and it is estimated that about 10% of defects can be directly ascribed to poor quality building products or faults in building products. In addition to this come faults where the building products are good

enough but have been used incorrectly due to the user's lack of expertise [7]. The choice of building products is also significant for a building's energy efficiency and the possibility of using renewable energy for heating and ventilation.

The choice of building products is made by the responsible builders or contractors. Normally it will be those who actually undertake the construction work, but planners can also specify the choice of products in some cases. It is important that companies that choose building products for projects with ambitious energy goals are competent in terms of product properties, suitability for purpose and regulations requirements regarding product documentation. The employees of building product suppliers should also have similar knowledge, since these can have an advisory function when tradesmen and normal consumers buy building products.

The term "chain school" is often used to describe internal training in the larger building construction products chains in Norway. A chain school is a way of organising systematic training in companies with many units of the same type that either have the same owner or are in some other way closely connected. An important point about the chain schools is that the individual company has the authority to decide what will be taught and how instruction will be given. Besides training for beginners, training of salespeople is the most widespread training in stores. According to FAFO, most of the trading companies have a fixed training programme that is held one or several times a year [63]. Integrating knowledge of energy efficiency and the use of renewable energy in the chains' internal training could help increase knowledge about and the use of energy-efficient products.

Internal training among the building goods suppliers could provide expertise that is also transferable to other companies outside trade. According to FAFO, internal training could also play a greater role in educational policy in that internal training could contribute to formal competence at upper secondary level. This could be done by connecting internal trading in the supply chains more closely with vocational training, for example by taking in more apprentices. This could help employees to get the opportunity to take craft certificates through practice candidate scheme, or by allowing those who lack a couple of subjects to take exams in these and thereby achieve formal competence at upper secondary level [63].

4. Priority measures and target groups for competence enhancement towards 2020

There are about 100,000 tradesmen in Norway in the building and construction industry [14, 25]. It would be a major challenge to give all of them expertise in passive building, energy efficiency in existing buildings and installing renewable heat by 2015, especially given the current low participation in lifelong learning opportunities [26]. It is also important to ensure that pupils leaving upper secondary school and vocational college have the necessary knowledge. In order to succeed the competence of teachers will be vital. The following principles have therefore been used in choosing target groups for effective competence enhancement in energy among tradesmen and teachers in the coming years:

- The main target group for course participation is foremen and site managers and supervisors, in this case meaning a person who has a central role in the individual trade on the building site. It is felt that these will be best equipped to act as resource persons in day-to-day work on the building sites.
- It is important to get knowledge of passive building into training. Key points will therefore be to prioritise post-qualifying education of vocational teachers and to develop new teaching aids that cover energy-efficient building and renovation. One instrument for increasing the competence of vocational teachers in energy efficiency is to further develop the present schemes for in-company training of vocational teachers.
- The trades with the greatest significance for buildings' energy efficiency and energy supply will be prioritised in the development of course material. This would typically apply to carpenters, plumbers, electricians and ventilation fitters.
- Resources are assigned for the central development and quality-assurance of teaching material on passive building, energy measures in existing buildings and the use of renewable heat. Instructor courses are being initiated to ensure good quality in the training of tradesmen. Course and instructor materials can freely be used by various other interested parties..
- Measures are being initiated to ensure that tradesmen with documented expertise in energy respond to a demand from the market. This can be done with the aid of various instruments, such as (voluntary) qualification/certification schemes combined with information, competence requirements for the execution of projects that receive public subsidies, requirements for documentation of competence in order to take on building commissions etc.
- The preparation of instructions connected with energy, such as the Building and infrastructures series from SINTEF Building and Infrastructure, could be speeded up.

As a result of this, and to ensure quality and results, Build Up Skills Norway therefore proposes that the following three areas are prioritised: development of materials and teaching aids, increased course participation by tradesmen in the building industry and increased participation in post-qualifying and further education on energy by vocational teachers. Within each of these priority

areas, there are several measures that are relevant for success. The most important measures within each area are listed in table 4-1.

Priority areas	Relevant measures
Development of material and teaching aids	<ul style="list-style-type: none"> ☑ Force the development and update of building details, guidance material etc. at passive building level, for both new building and existing buildings. ☑ Further develop existing course material to give specific detailed knowledge for every single trade and to facilitate practical use of the knowledge on the building site.
Increase participation on courses by tradesmen in the building industry	<ul style="list-style-type: none"> ☑ Organise courses for instructors so as to ensure the capacity of qualified course holders and to give a geographical spread of course holders, making it easier to take courses locally. ☑ Establish a pilot project on energy to define specific formal training for tradesmen who wish to continue in their own vocational subject. This must be considered in connection with any need for establishing a specific qualification/certification system for tradesmen. ☑ Integrate courses on energy efficiency in buildings, use of renewable energy and energy-efficient building products into the building goods chains' internal training.
Increase participation in further and post-qualifying education in the area of energy by teachers of vocational subjects.	<ul style="list-style-type: none"> ☑ Establish several pilot projects in which upper secondary schools, vocational schools, universities and university colleges, local authorities, local building and construction companies etc. work together to get knowledge about passive building into education and training for the building and electrical trades. ☑ Increase participation in further and post-qualifying education in the area of energy by teachers of vocational

	<p>subjects.</p> <ul style="list-style-type: none"> ☒ Establish more schemes in which vocational teachers can spend time in companies that have ambitious building projects in the area of energy. ☒ Increase participation in further and continuing education in the area of energy by teachers of vocational subjects.
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All these measures would represent a stepping up of the present efforts in these areas. For a better overview of the costs, extent and benefits of these measures please refer to section 7, which describes the financial consequences of the measures. It defines three different packages of measures based on the description in section 3 and gives an account of the socio-economic consequences of implementing the packages with given assumptions.

The biggest obstacles to tradesmen's participation in courses are the lack of time and money [17, 19]. Centralised courses may explain the low participation from rural areas. It is important that the measures taken address these obstacles, so that both companies and the employees themselves see the benefit, in both the short and long term, of using time and money to raise energy expertise. The benefits of increased participation in lifelong learning by this working group for the society will be better quality of the built environment, lower energy costs and experienced tradesmen staying longer in activity. Practical knowledge of passive building in the tuition of vocational subjects could also help increase recruitment into the building trades from the school system.

Experience from building and construction industry organisations may indicate that training activities in new regulatory requirements are normally given a high priority, since this is a condition for being able to erect building in accordance with legislation and regulations. New building regulations, with a requirement for passive building as standard, are expected from 2015 [7]. This means that the next couple of years could be well suited to implementing training measures related to energy, because it will be important to acquire such knowledge before the new regulations come into force. Closer collaboration between the authorities and the building industry should be possible, in order to obtain the necessary competence enhancement, for example via the Low Energy Program. It may be sensible to coordinate training in new buildings, renovation and the use of renewable energy, so that helpful information on several energy topics can reach tradesmen. A survey carried out by VOX showed that 38% of building and construction companies polled were willing to fully finance training measures for their employees, while a further 32% were willing to part-finance such training [27].

The action plan can be updated and specified in the final part of the Build Up Skills project, where agreement will be sought between various parties with regard to instruments for implementing the

measures in practice.

5. Possible instruments for increasing energy efficiency competence among tradesmen

Here we briefly describe some central instruments for increasing competence in energy efficiency in the building industry. This does not include instruments whose purpose is to increase demand for energy efficiency, since the mandate of the Build Up Skills project is to contribute to competence enhancement. Instruments that set stricter requirements through legislation or regulations will thus not be discussed. Having said this, it must also be pointed out that there is a close connection between instruments that increase demand for energy-efficient buildings and instruments that increase the competence in energy efficiency among builders. Increased demand for energy-efficient buildings could be an important incentive for the building industry to carry out general competence enhancement in this area and therefore have a reinforcing effect on the achievement of goals. It is therefore important to be clear about this connection, even though only the most important competence-raising instruments will be discussed here.

No recommendations will be given as to which instruments are to be preferred, just a qualitative description of the most relevant instruments so as to demonstrate the possibilities that exist. It would be natural for a discussion on prioritising the different instruments to be included in part 3 of the Build Up Skills project.

The report "Socio-economic effects of competence measures for tradesmen" prepared by Analyse & Strategi for the Low Energy Program, describes costs and socio-economic benefits of various packages of measures for raising competence [64].

5.1. Regulatory instruments

Regulatory instruments are primarily laws and regulations. Regulatory instruments are largely used where it is desirable to set specific requirements, orders, or to prevent specific actions, prohibitions.

There are currently many regulatory instruments within the Build Up Skills area.

5.1.1 Planning and Building Act

The Planning and Building Act is a key piece of legislation for building in Norway. It regulates both land use and building applications. The Planning and Building Act shall promote sustainable development in the best interests of the individual, society and future generations. The act shall emphasise long-term solutions, and the consequences for the environment and society shall be described. It is therefore natural to interpret reduced energy consumption in buildings as part of its objective.

The most important regulation pursuant to the Planning and Building Act is the Building Permit Regulations (*Byggesaksforskriften*), which sets competence requirements in the building sector.

Building Permit Regulations

The Building Permit Regulations regulate who can do what, when and where. Section 11 of the regulations sets requirements for education and practice. The requirements are directed at companies, to ensure that the company's combined technical qualifications are at a level that creates a basis for central and local approval. The competence requirements are intended to ensure that companies that take on responsibility for building commissions have sufficient competence to perform the tasks in accordance with the Planning and Building Act. If specific competence requirements relating to energy efficiency are to be introduced, it would be natural to include these in the Building Permit Regulations.

EFTA's surveillance authority, ESA, has opened proceedings against Norway because it believes that the requirements of the Planning and Building Act regarding approval for local right of responsibility are not in accordance with Norway's obligations under the Directive on Services in the Internal Market. (<http://www.eftasurv.int/press--publications/press-releases/internal-market/nr/1666>). Against this background, there is reason to believe that certain changes related to the approval arrangements will be made.

The white paper on building policy has also signalled changes in that part of the regulation governing which measures are subject to mandatory application.

At present there is no general qualification requirement for establishing a company in the building industry in Norway. The former legislation on contractors and building trades and the licence to trade regulated the requirements for running a company in this industry. These regulations have been repealed, which means that there are now a number of parties in the building industry who do not have the qualifications that might be expected. At present there are only qualification requirements for measures for which application is mandatory under the Planning and Building Act. It is estimated that the market for measures that are not subject to mandatory application amounts to about NOK 50 billion.

Possible instruments:

- General qualification requirements for establishing companies in the building industry in Norway.
- Establishing a system for mandatory registration of measures that are currently outside the sphere of mandatory application under the Planning and Building Act. This could be formulated in such a way as to set qualification requirements for many measures that are

currently not subject to mandatory application under the Planning and Building Act.

5.1.2 Regulations regarding energy labelling of buildings and energy assessment of technical systems (Energy Label Regulations)

The Energy Label Regulations set requirements for the energy labelling of buildings and the energy assessment of technical systems in buildings. Section IV of the regulations sets specific competence requirements for who can perform energy labelling of buildings and energy assessment of technical systems. These regulations are important because they are the only ones that set specific requirements for energy competence in relation to the work to be carried out. For energy labelling of non-residential buildings, there is a requirement for engineering competence at bachelor level with focus on building techniques and energy, and a minimum two-year practice of energy calculations for the education and practice that correspond to the prevailing requirements for responsible planners within relevant construction work classes and approval areas.

5.1.3 The education system

The most important laws are the Education Act, which regulates primary, lower secondary and upper secondary education, and the Vocational College Act, which is intended to ensure the quality of vocational college education. In addition, the Master's Certificate Act and associated regulations regulate competence requirements for master's certificates.

The education system is important for ensuring that newly qualified workers have sufficient competence. The key points are the learning goals in the curricula and the competence of teachers. Surveys by FAFO (reference) show that the various schools are very different in terms of both content and structure of the teaching. The present curricula do not prevent pupils learning about energy efficiency, but neither are they any guarantee that they will actually get this essential competence.

The present curricula for building and construction have five programme areas in VG2 (2nd year upper secondary), including one for climate, energy and environmental technique. This area is mainly not about climate but is used as a collective description for plumber, roofer and tinsmith. According to the curricula, this line of education should help to "safeguard major social values by securing buildings against wind and weather and ensuring good interior climate with lower energy consumption".

Regarding the other building subjects, the curricula are less specific about energy consumption. At the same time, it is clear that with regulations amendment, education must also be changed. There is however nothing automatic about this, and much depends on teachers having the necessary competence if education is updated.

Possible instruments:

Specification of the different curricula for the building trades subjects so as to give competence goals

in energy efficiency in buildings.

5.2. Economic instruments

Typical economic instruments include the setting of taxes, duties, subsidies, loans and guarantees. Economic instruments affect various parties' assessments of what it is sensible to take on in such a way that they lead to desirable changes in society.

5.2.1 The Norwegian State Housing Bank and Enova

Norwegian State Housing Bank: -Competence supplements for sustainable homes and building quality

The Norwegian State Housing Bank's competence supplements for sustainable homes and building quality are intended to raise competence, give support to trial projects and convey information relating to the environment and energy, universal design and building practice.

The target groups for support are mainly local authorities and industry and research, development and teaching centres. The effect of the competence supplements only indirectly reaches those who will actually realise new buildings on the building sites. An effective enhancement of competence among building workers will not be an effect of this supplement unless the target group for the scheme is changed.

The Norwegian State Housing Bank has a number of different support schemes that potentially can affect energy use in buildings. The Norwegian State Housing Bank's instruments are both general and selective, in order to suit the needs of society and households. The start-up loan and support for home-makers helps first time buyers to become established in their own homes. Home support helps households in the most difficult financial position to reduce living expenses.

The Norwegian State Housing Bank can grant loans and support schemes aimed at local authorities, including kindergarten loans, investment support for elderly residential care homes and support for council-owned rented accommodation, which help local authorities to offer residents of their area good welfare conditions.

With the Norwegian State Housing Bank setting energy requirements that are higher than the regulatory ones, building projects offer an effective competence enhancement in the companies carrying out the projects. In addition to competence enhancement in companies, pilot projects can also be learning arenas for others in the building industry.

Enova:

Enova supports a number of different measures for improving energy efficiency in buildings.

- Support for investigation of passive building
- Support for building passive and low-energy buildings.
- Support for renovation of existing buildings and constructions over 100,000 kWh, where power consumption is cut by at least 10%.
- Programme for district heating.
- Support for introduction of new energy-efficient technology.

Similar to the Norwegian State Housing Bank's loan financing of pilot projects, Enova's support schemes contribute to pilot projects to be started. This has a learning effect among those who take part in the project and can also have a knock-on effect on others.

Enova has also used funding to develop instructions on passive building and other competence-raising projects. Enova is able to use funding on competence enhancement depending on whether this is perceived as a key obstacle in the market.

Possible changes in the instruments channelled through the Norwegian State Housing Bank and Enova:

In order to increase interest in raising competence in energy efficiency and energy conversion, competence requirements that go beyond those of the Building Permit Regulations can be linked to receiving support for building or renovation to low-energy/passive building level. It is crucial to set a criterion of objectively assessed competence. Currently, no such competence criteria exist, so they must be developed to be a suitable instrument for raising competence.

The intention of such competence criteria is to give people an incentive to increase their competence beyond what is needed according to the regulations. At the same time, this will also give Enova and the Norwegian State Housing Bank an added guarantee that the projects they support are properly executed.

There are various ways in which investment support and loan financing can be used to increase competence. For example:

- Competence requirements can be set for building companies who will perform the work on projects supported by Enova or the Norwegian State Housing Bank. Another alternative could be to increase financial support for those who implement projects using competent tradesmen, such as increased rates per m² or one-off support.

There is a great need for research and innovation in energy efficiency in buildings with ambitious goals. The need for developing building details, for example, is described in section 3.3.1. In the years to come, possible financing of research, evaluation of pilot projects and building details could occur through Enova and the Norwegian State Housing Bank. In 2012, Enova granted about NOK 5 million to SINTEF Building and Infrastructure for the preparation and updating of instructions relating to air seals, thermal bridges and documentation regarding the Norwegian standards for passive building.

It has been estimated that updating and developing 200 instructions relating to passive building will cost about NOK 85 million a year, or about NOK 12 million a year over seven years. The Byggforsk series is continuously updated and the aim is that it should be updated in relation to current regulatory requirements. But updating and developing 200 instructions related to passive building will require measures beyond normal production and could not be expected to be covered from normal subscription income. The same applies to the updates and preparation of the priority group of 15 instructions over 1 to 2 years [56]. This means that there will be a need for more financing, either from the public sector or from the building industry itself.

5.2.2 The Research Council

The energy, environment, building and construction programme was concluded at the end of 2004 and the subject areas were continued in a new programme called "RENERGI". The Research Council has just announced the next major program in energy research that will follow RENERGI. The provisional plan for the new program was adopted 15 June 2010 by the committee of the Research Council for energy, resources, and the environment.

ENERGIX is intended to support long-term and sustainable conversion of energy systems, to increase the supply of renewable energy, increase efficiency and flexibility and provide closer integration with Europe, along the safeguard of environmental considerations. ENERGIX shall help develop cutting edge new knowledge and solutions aimed at five main objectives:

- Securing reliable national energy supplies.
- Sustainable exploitation and use of national renewable energy resources.
- Reduction of Norwegian and global greenhouse gas emissions.
- Development of Norwegian trade and industry.
- Development of Norwegian research environments.

The projects that have received support from the Research Council contribute to the development of knowledge about energy efficiency and energy conversion. It is essential that the knowledge developed is made available to the building industry for further dissemination.

Possible instruments, Research Council:

Research projects will, to a varying extent, produce results that can be directly introduced as changes in the building industry. There is however potential for greater dissemination of research results than happens today. In order for research results to become knowledge that the building industry can use in companies or actual building projects, it is important that there are clear requirements for the dissemination of results when funding is granted, and also that such dissemination is done in a way that companies in the building industry can learn from.

5.2.3 Ministry of Education and Research

Post-qualifying education for teachers:

The Ministry of Education and Research currently provides support for post-qualifying education for teachers. One of the (2012) priority areas for the education of upper secondary teachers is post-qualifying training in vocational teaching. The experience from building industry organisations is that it is still financially difficult for schools to achieve post-qualifying training, in spite of the fact that post-qualifying training in vocational teaching is supposed to be a priority. The extent to which post-qualifying training is made a priority varies a great deal from school to school.

In-company training is an important arena for developing the school-work partnership and as an arena for post-qualifying training for vocational teachers. There has been a major project in the past year in which many schools and companies have collaborated in testing out whether in-company training for teachers can be part of their continuing education in climate and energy. It is also important for the industry that schools can use instructors from companies as resource persons in school teaching in the same field.

Relevant instruments for increasing energy competence among vocational teachers in the building trades could be increased availability of continuing education, government part-financing of the costs of substitute teachers while vocational teachers take courses (today the government only covers school owners' costs for substitute teachers where study places have been awarded) and in-company training for vocational teachers.

Possible instruments:

- Increased support for post-qualifying education of teachers in the areas of energy efficiency and energy conversion.
- Considering new organisation of the funding that goes to post-qualifying education of teachers, to ensure that financing is used for continuing education and that key areas such as energy efficiency and energy conversion are prioritised by teachers in the building and construction trades.
- Increased funding to establish in-company training schemes, so that vocational teachers can train on building sites with high-energy ambitions.

Pilot passive building projects:

In order to increase passive building and energy efficiency competence among teachers and pupils, a few schools have started projects in which schools build a passive building. This is described in section 4.1.1. The main difficulty in getting such projects started is financial resources. This is especially true for pilot projects that can test out various models for use in teaching. As the concept becomes more tried and tested, the objective must be to make it a normal form of teaching that is done within the school's ordinary budget.

Possible instruments:

It was found that NOK 6 million would have to be granted in order to get seven pilot projects off the ground in various parts of Norway.

Government financing of these projects can occur, for example, by means of:

- ☒ Collaboration across several government agencies
- ☒ Full financing from one ministry. The most relevant are the Ministry of Education and Research and/or the Ministry of Local Government and Regional Development.

Updating of teaching aids

It is currently up to publishers to update teaching aids, which is expensive for smaller subject areas such as building and construction. This means that books and other aids have considerable defects when it comes to energy efficiency and energy conversion.

The Directorate for Education and Training normally only supports the development of teaching aids and materials for narrow teaching subjects or translation into *nynorsk*, form of the language. If we wish to bring about a faster revision of materials for the building and electric subjects, so that these include information about passive building, energy-efficient renovation and the use of renewable energy for heating and ventilation, public subsidy beyond the traditional support criteria may be necessary.

Possible instruments:

In order to ensure that updated information about energy efficiency is included and updated in the building and construction subjects, an extension of the Directorate for Education and Training's subsidy scheme for teaching aids is proposed, so that for a brief period it also covers building and construction subjects, so that these can be updated in relation to the energy solutions of today and tomorrow.

5.2.4 Proposals for new economic instruments

A number of measures that are important for continuing training of tradesmen in the building industry are described in section 3. Two areas in particular are singled out - developing materials and teaching aids and increased course participation. This means that a financial lift is needed in competence about energy efficiency and energy conversion, in order to achieve the authorities' goals in this area. Among other things, this means a need for government financing to increase post-qualifying training among tradesmen in the building industry. In the white paper 28 (2011-2012) *Good buildings for a better society*, the government refers to useful experience in developing course material in the Low Energy Program. The costs of the various measures are described on pages 25-26 of the report "Socio-economic effects of competence measures for tradesmen" [64].

5.3. Informative – voluntary schemes

5.3.1 Current informative/voluntary schemes

The Low Energy Program

The Low Energy Program is a ten-year program working on raising competence in energy efficiency and energy conversion in the building industry. Those included in the programme are the Federation of Norwegian Construction Industries, the Norwegian Architects' Association, Statsbygg, Enova, the Norwegian Water Resources and Energy Directorate, the Norwegian Building Authority and the Norwegian State Housing Bank. The program works on both developing knowledge and disseminating it. This is a large area with a fragmented industry. The programme's funding is limited, which makes the work demanding. The white paper 28 (2011-2012) *Good buildings for a better society* points out that the Low Energy Program should be a key instrument for competence enhancement in energy efficiency. In order to get a bigger lift for competence in such a large industry, further funding is needed.

Government information campaigns

Enova and the Norwegian Building Authority have carried out information campaigns relating to energy efficiency that have also been aimed at tradesmen in the building industry. This does not happen regularly, but often in connection with changes in the regulations or specific campaigns run by Enova, such as in its "Enova recommends" campaigns.

Courses

Many parties offer tradesmen courses in energy-efficient building and renovation. The most important of these are industry organisations, the building products trade and large suppliers. Courses in energy efficiency and energy conversion are often linked with new regulations, although there are also some courses in addition to these. From experience, if the course is not linked with regulation changes, it can be difficult to attract many participants.

Many of those who are offering courses could offer more and more frequent courses covering energy efficiency and energy conversion. The problem is that most course organisers are unable to sponsor these courses, which means they rely on running them at a profit.

Certification/competence requirements

According to the Renewables Directive (2009/28/EC) article 14 (3), the EEA countries shall introduce

a certification or qualification scheme for installers of technical systems based on renewable energy with effect from 2012. This shall also be introduced in Norway.

Possible instruments:

One possibility is to develop a scheme to stimulate market advantages for companies that wish to raise their competence beyond the requirements of the regulations. Such a scheme could be developed in various ways. Certification schemes are often rather extensive systems with third party approval. Several organisations are involved with these, such as Det Norske Veritas, Norwegian Accreditation and the Technological Institute among others. The advantage of such a system is that it has great credibility because of the independent third party controls. The disadvantage is that such schemes can quickly be regarded as too big and bureaucratic to make much headway in the industry.

Voluntary qualification and certification schemes for vocational groups could also increase course participation among tradesmen where certification of personnel is possible. However this is dependent on the market demanding tradesmen who are certified in preference to those who are not. If certification schemes are made voluntary, funding will probably be necessary for information about the schemes, to get them known among buyers in the market.

Insurance conditions

The insurance companies offer insurance to both builders and home-owners. If a competent workforce is used, the risk of damage will be lower. One possibility is therefore that insurance companies can offer better conditions to companies that have completed further education or vocational training in this area. They might also be able to give home-owners better insurance conditions if the building contractor uses a workforce that has received further education in energy. A review must be made, so as to provide documentary evidence that increased competence leads to fewer faults and of possible benefits for the insurance companies. Consideration should also be given to requiring a competent workforce when rebuilding after damage. Settling insurance claims in cash leads in many cases to the use of unqualified workers or undeclared work.

6. Follow-up of measures and competence development

Proposals for follow-up of measures and of competence development:

- Assign responsibility and resources for an annual review of how measures proposed in the Build Up Skills project are followed up, as well as an annual review of competence in energy use in buildings among tradesmen in building and construction.

6.1 Proposal for follow-up of proposed measures

At present, every organisation, authority or programme makes its own ongoing assessment of the effect of its measures and instruments. The level and scope of such assessments varies greatly. They might involve the day-to-day experience of employees of the organisation, small-scale internal assessments or large-scale external assessments of measures and the use of instruments. For the measures in Build Up Skills, it is proposed that responsibility and resources are assigned for an annual review of how the project's proposals are followed up. The review should also cover an assessment of the effect the measures have had. It is estimated that such an assessment can be performed at a minimal cost of around NOK 100,000 a year. This task can be seen in context with the proposal to carry out competence reviews with regard to energy use in buildings among tradesmen in the building and construction industry every other year.

There will be a more specific description in part III of Build Up Skills.

6.1 Proposal for follow-up of competence development among tradesmen

There is currently no system for monitoring the level of knowledge in the building industry or measuring the effect of competence-raising measures. In 2010 and 2012, the Low Energy Program commissioned surveys of tradesmen's knowledge of energy use in buildings, passive building, internal climate, renovation, use of renewable energy etc. [17, 19]. If such surveys are carried out regularly, using the same methodology, the results can be used to build up a picture of trends in tradesmen's knowledge over time. Whether this should be part of the activities of the Low Energy Program must be decided by its steering. In any case, it would be sensible to assign responsibility and resources for continuing such surveys, so as to be able to follow trends in skills levels among tradesmen, reveal areas with a particular need for competence enhancement and identify any mismatches between today's level of competence and essential skills. We would recommend reviewing competence in energy skills among tradesmen about every other year. The costs of performing such surveys at a significant level are estimated as approximately NOK 400,000, if they are to cover the most relevant trades in the building industry.

At the same time, it is central to start work on developing a knowledge calculator that would make it possible to measure the energy competence of various trades in the building and construction industry. An attempt to identify a simple indicator in connection with an investigation into the socio-economic consequences of raising the energy competence of tradesmen has been made (see section 7). It should be further developed, so as to be able to measure the effects and benefits of competence measures initiated in the building and construction industry.

7. Economic and administrative consequences

Analyse og Strategi AS were commissioned by the Low Energy Program to prepare a report on the socio-economic consequences of initiating competence measures aimed at tradesmen in the building industry. The report considered consequences with regard to energy efficiency, building defects and longer employment of tradesmen. It must be stressed that the analysis is based on a number of very uncertain assumptions. The most important assumptions are given below. The whole report can be downloaded from the Low Energy Program's website. The measures considered in the report can be seen in box 7-1 with corresponding estimated costs, scope and period of the various measures. Socio-economic consequences have been considered for three different packages of measures and compared with a base scenario. The analysis does therefore not provide a basis for describing the socio-economic consequences of any single measure, but only as combined packages. It is worth mentioning that the measures that are included in the socio-economic analysis are not necessarily precisely the same as the measures described in section 3.

The report has investigated possible socio-economic benefits linked with raising competence in the building industry in three competence areas:

- Erecting buildings at passive building level.
- Implementing energy efficiency measures in existing buildings to regulatory level.
- Installation of renewable heat systems.

Surveys indicate that there are considerable shortfalls in the competence of tradesmen with regard to building methods for energy-efficient buildings. These shortfalls could lead to not deriving benefits in relation to:

- Reducing the additional cost of building energy-efficient buildings.
- Increased energy costs because buildings do not achieve the energy efficiency they should have.
- Reducing the number of cases of building defects.
- Increasing the retirement age for employees in the building industry

Three packages of measures

The report shows three possible packages of measures that would help raising competence in the building industry. More stringent regulatory requirements in the future have also been taken into consideration. The three packages have costs between NOK 181 million and NOK 366 million over the 14-year period considered in the analysis.

Table 7-1

	Cost estimate (NOK mill.) for the period 2012-2026
Package 1	181
Package 2	366

Package 3	366
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Possible benefits as a result of increased competence

On the other hand, the possible benefits identified in connection with better competence in the building industry range from just under NOK 400 million to almost NOK 1 billion over the same 14 year period as above.

Table 7-2

	Range of benefits (2011 NOK mill.) for the period 2012-2026
Reduced additional building costs	27-275
Reduced additional costs relating to energy consumption	126-178
Increased retirement age	Approximately 150 (does not distinguish between packages)
Reduced damage to buildings	76-377
Total	379-980

Uncertainty

It is however very difficult to isolate the effects of the proposed measures. It is therefore imperative to note that the benefit and cost effects are rough estimates of what the actual effects of the competence measures would be. They do however represent the best guess of what effects might amount to. The analysis is based on available information from previous reports on energy efficiency in buildings, and those who compiled the report are confident that the data taken as a basis for this analysis is reliable.

Box 7-1: Base scenario and packages of measures. Source: [64].

Base scenario:

1. Today's instruments are continued.
2. Signalled amendments to the building regulations are introduced:
 - a. Passive building introduced as a requirement for new buildings in 2015.
 - b. Low-energy level introduced as a requirement for existing buildings in 2015.
 - c. Near-zero energy level introduced as a requirement for new buildings in 2020.
 - d. Passive building level introduced as a requirement for existing buildings in 2020.
3. A (voluntary) qualification/ certification scheme is established for installers of heating systems based on renewable energy. Implementation is followed up with public information so that certified/qualified fitters are preferred in the market.

Package 1:

- Same as the base scenario, plus:
4. Establish seven geographically spread *pilot projects* in which upper secondary schools, vocational schools, universities and university colleges, local authorities, local building and construction companies etc. work together to get knowledge about passive building into education and training for the building trades.
 5. Develop existing course material to give detailed information for each trade, e-learning, establish databases of experience and cover practical use of the knowledge on the building site and in marketing of energy efficiency measures.
 6. Speed up the development and updating of building details, guidance material etc. on passive building (new building and existing buildings), with 50 new instructions by 2020.
 7. Dissemination of knowledge, courses and instructor's courses to a limited extent.

Package 2:

- Same as package 1, plus:
8. Courses/in-company training for vocational teachers in upper secondary schools to give them specific knowledge of energy.
 9. Establish a (voluntary) qualification/certification scheme for carpenters with regard to passive building or renovation with ambitious energy goals. Implementation is followed up with public information so that qualified carpenters are preferred in the market.
 - 58 10. Speed up the development and updating of building details, guidance material etc. on passive building (new building and existing buildings), with 150 new instructions by 2020 (in addition to the 50 already in package 1).
 11. Dissemination of knowledge, courses and instructor's courses to an increased extent.
 12. Introduce competence requirements regarding energy use in buildings in order to receive funding for building projects with ambitious energy goals, for example from Enova and the Norwegian State Housing Bank.

Table 7-3: Estimated costs, scope and period for competence measures

Measure	Package of measures	Estimated cost	Scope	Period
1	Base	<ul style="list-style-type: none"> • None 		
2	Base	<ul style="list-style-type: none"> • Estimated in Analyse og Strategi's report to Ministry of Local Government and Regional Development. 		
3	Base	<ul style="list-style-type: none"> • Estimated on the basis of costs for other schemes. • 3 million for information 	Approximately 1,000 tradesmen in plumbing/HVAC	2013->
4	1	<ul style="list-style-type: none"> • 6 million 	7 vocational colleges	2013-2015
5	1	<ul style="list-style-type: none"> • 15 million • (5 million over three years) 	Covers all trades in building and construction.	2013-2016
6	1	<ul style="list-style-type: none"> • NOK 20 million. • (5 million over four years) 	50 instructions for SINTEF Building and Infrastructure	2013-2017
7	1	<ul style="list-style-type: none"> • 40 million • (8 million over five years) 	Approximately 15,000 tradesmen	2013-2018
8	2	<ul style="list-style-type: none"> • 25 million • (5 million over five years) 	164 vocational colleges, five teachers per college	2015-2020
9	2	<ul style="list-style-type: none"> • Estimated on the basis of costs for other schemes. • 3 million for information. 	Approximately 2,500 carpenters	2016->
10	2	<ul style="list-style-type: none"> • NOK 70 million. • (10 million over seven years) 	200 instructions for SINTEF Building and Infrastructure	2013-2020
11	2	<ul style="list-style-type: none"> • 75 million • (15 million over five years) 	Approximately 35,000 tradesmen	2013-2018
12	2	<ul style="list-style-type: none"> • Estimated by Analyse og Strategi 	?	2014->

13	3	• Estimated by Analyse og Strategi	?	2016->
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The report concludes that increased competence could contribute to socio-economic benefits over a 14-year period (2012 – 2026) amounting to NOK 379 – 980 million. The most important social savings will be as a result of increased energy saving, a reduction in cases of building damage and an increase in the number of years tradesmen stay in work.

8. Authors and contributors

The report has been written by Gunnar Grini, Christine Molland Karlsen and Guro Hauge (Low Energy Program), with written contributions by Jørgen Leegaard (Federation of Norwegian Construction Industries).

Many people and organisations have assisted in obtaining literature and with input along the way. We would especially like to mention the partner group for the project, which has consisted of Mathieu Veulemans (Norwegian Building Authority), Håvard Solem (Enova), Jørgen Leegaard (Federation of Norwegian Construction Industries), Tor Backe and Ole Larmerud (Norwegian Association of Plumbing, Heating and Ventilating Contractors), Jon Sandnes and Thomas Norland (Norwegian Association of Building Contractors), Øivind Ørnevik and Frank Ivar Andersen (Norwegian Association of Building Constructors), Rolf Tollefsen (Norwegian Association of Master Bricklayers), in addition to the persons and organisations mentioned above who have provided written contributions.

The project's reference group and steering group have also provided input to the work. The reference group consisted of representatives of the Norwegian United Federation of Trade Unions, NELFO (the federation of electrical and IT companies), the Norwegian Refrigeration and HVAC Association, the Green Building Alliance, the Roofing Contractors' Association, the Ventilation and Tinsmiths' Association, the Norwegian Heat Pump Association, the Enterprise Federation of Norway, The Solar Energy Association, The Norwegian Heating technology Association, the HVAC Association, SINTEF Building and Infrastructure, The Consulting Engineer's Association, the Master Builder's Certificate Board and the City of Oslo Education Agency. Vox and the Directorate for Education and Training participated as observers in the reference group. The steering group for the project consisted of representatives of the Norwegian Building Authority, the Norwegian Water Resources and Energy Directorate, Enova, the Norwegian State Housing Bank, Statsbygg, the Federation of Norwegian Construction Industries and the Norwegian Architects' Association.

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Outline of the National Roadmap to be developed under the Build Up Skills Initiative

The roadmap has three main objectives:

- Identify measures to overcome barriers and skill gaps in the various professions to meet the 2020 targets in the building sector.
- Embed training on intelligent energy solutions through changes in the mainstream curricula and practice.
- Put in place the necessary measures to ensure that the added value of a more highly qualified workforce is recognised and the use of qualified workers is incentivised or made obligatory.

Each country should develop its roadmap according to its specific national situation and its status-quo analysis. However, each national roadmap should address at least the following issues:

- 2020 targets: energy savings and renewable energy contributions by the building sector to the 2020 national targets. This information should be taken from the status quo analysis.
- Qualification needs and gaps in the building sector. This part should be based on the results of the status-quo analysis concerning the identification of barriers and gaps between the current situation and the skills needs for 2020. Issues to be addressed by this section are:
 - skills needs;
 - qualification needs;
 - barriers to the achievement of the 2020 targets.
- General strategy for fulfilling the training needs in order to reach the targets.
- Identification – according to the needs of the different sectors – of priority measures (e.g. new qualification schemes and/or update of existing schemes) for each relevant profession to meet the defined targets. Regarding proposed measures for new or upgraded qualification schemes, the roadmap should address e.g. the following issues:
 - Scope, content, learning outcomes of the proposed schemes.
 - Costs and benefits.
 - Internships/apprentice of the trainees.
 - Multidisciplinary skills and knowledge.
 - Entry requirements, qualification levels, and certification of trainees.
 - Selection and accreditation of training providers and quality control.
 - Certification rules and requirements for building companies and installers.
 - Incentives and drivers, such as support schemes and certification requirements.
 - National registers.
 - Financing and administration.
 - Institutionalisation of the proposed schemes.
- Definition of an action plan for the implementation of the identified measures, covering at least the following issues:
 - Timeline (at least until 2020);
 - Resources required to drive the implementation (e.g. actors and budget);

- Intended certification and accreditation;
- Necessary accompanying measures (communication, incentive measures, etc.);
- Structural measures to monitor developments in skills requirements for the construction sector, potential early-warning systems on risks of tensions for certain occupations, etc.
- Monitoring of the progress of the proposed measures.

Remarks

While the analysis of the status quo must be comprehensive and cover all professions of on-site workers in the building sector, the roadmap with its proposed measures can be more selective if necessary, e.g. if some professions have already been well addressed.

In its entirety the roadmap must demonstrate that the proposed measures, implemented in the proposed scale and quantity, are appropriate to meet the national 2020 targets. Measures have to be in line with the requirements of national and European legislation in the energy sector (for instance Article 14 (3) of the RES directive as well as the requirements for nearly zero energy buildings as set by the recast of the Energy Performance of Buildings directive) and in the Vocational, Education and Training (VET) sector.

This outline might be subject to changes in line with the EACI roadmap template.